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Review

Forest Therapy Research in Europe: A Scoping Review of the Scientific Literature

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Abstract: This scoping review aims to outline key discoveries, gaps in knowledge, and potential future directions in the field of forest therapy research in Europe. Clinical studies investigating the effects of forest therapy sessions in Europe were systematically screened through PubMed, Embase, Cochrane Library, the Directory of Open Access Journals (DOAJ), and Google Scholar (search date: January 2024). This review encompasses 26 selected studies, collectively engaging 2775 participants across various European countries, including Italy, Poland, Spain, Germany, Finland, Hungary, Sweden, Iceland, and Switzerland. These studies predominantly measured psychological outcomes such as mood states, affect, attention levels, subjective wellbeing, and quality of life. Additionally, physiological assessments were conducted, covering vital signs, salivary cortisol, body composition, and blood count. Notably, most of the investigation sites were covered by evergreen forests. Forest therapy practices in Europe demonstrated significant benefits in psychological aspects, including relaxation, mood enhancement, and improved wellbeing, accompanied by physiological improvements, particularly in asthma patients. While a fair-to-good methodological quality was identified in randomized controlled trials, the acknowledged weaknesses point towards a need for more rigorous and standardized research approaches. In conclusion, this comprehensive scoping review provides valuable insights into the current landscape of forest therapy research in Europe, highlighting its potential to positively impact both physical and mental wellbeing. The findings underscore the need for further research addressing methodological limitations and exploring gaps in understanding, thereby contributing to the continued advancement of forest therapy as a holistic wellbeing intervention within the European context.

Keywords: forest therapy; shinrin-yoku; forest bathing; Europe; environmental medicine; mental health; wellbeing promotion; public health

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1. Introduction

Forest bathing, or "Shinrin-yoku" in Japanese, is a therapeutic practice that involves immersing oneself in a natural forest environment to promote physical, mental, and emotional wellbeing [1,2]. Originating in Japan, the concept emphasizes mindful engagement with nature to derive various health benefits [3]. Forest bathing commonly involves immersing oneself in a forest environment through activities like meditation and unguided walks; in contrast, forest therapy adopts a more structured approach, incorporating guidance from trained practitioners, stemming from diverse backgrounds, such as psychologists, meditation instructors, naturopaths, wilderness guides, and environmental educators, who play a role in facilitating therapeutic experiences in natural settings [4]. Nevertheless, the

certifications and backgrounds of forest therapy guides exhibit considerable heterogeneity, lacking a universally recognized training standard across all countries [5]; consequently, there is a necessity to establish specialized training programs for individuals aspiring to become professionals in this field to ensure a standardized and high-quality approach to forest therapy guidance. In this article, for the sake of simplicity and clarity, the term "forest therapy" will be used as a blanket term to encompass both concepts: this decision aims to streamline the discussion and avoid any potential confusion that may arise from introducing the nuanced difference between the two terms.

In the Far East, forest bathing is recognized and embraced as a form of preventive healthcare: the practice is supported by a combination of traditional beliefs, cultural practices, and scientific research [1]. For example, Japan has designated certain forests as therapeutic landscapes, and there are official forest therapy trails where individuals can engage in guided forest bathing experiences. Additionally, the Japanese government and healthcare system have formally acknowledged the health benefits of spending time in nature, leading to the integration of forest therapy into public health initiatives [6]. Likewise, the forestry department in China has promoted ecological services in forest reserves to enhance people's wellbeing, leading to the establishment of numerous national forest therapy bases and resulting in the integration of forest therapy into mainstream health promotion channels [6]. Similar initiatives have been enacted in South Korea, under the management of the Korea Forest Service, adopting a license system and focusing on expanding forest services within the country [7]. Recently, in Europe, there has been a growing interest in the therapeutic benefits of nature and outdoor green spaces, including forests [6,8,9]. Scientific research on the health benefits of spending time in nature, such as reduced stress levels, improved mental wellbeing, and enhanced immune function, has contributed to the acknowledgment of forest medicine in Europe [10]. Some European countries have integrated nature-based interventions, including forest therapy programs, into healthcare practices to complement conventional treatments, and the recognition of the healing properties of forests aligns with broader trends in ecotherapy and the promotion of a holistic approach to wellbeing [10]. Overall, while both Europe and the Far East acknowledge the positive impact of nature on health, the specific recognition and integration of forest medicine into mainstream healthcare practices can vary. In the Far East, forest medicine has been more systematically embraced and integrated into healthcare, whereas, in Europe, it is more diverse in its recognition and implementation across different countries. The field of forest medicine continues to evolve globally, and ongoing research and cultural shifts may influence how it is regarded and utilized in different regions. In summary, while countries like Japan with long-standing traditions in forest medicine offer valuable insights, studying forest medicine in Europe provides a unique opportunity to explore diverse cultural contexts, environmental conditions, and healthcare systems, contributing both to a broader and more inclusive understanding and to the further development of the field.

The objective of this scoping review is to describe the principal findings, delineate inherent limitations, identify gaps in knowledge, and describe prospective directions in the landscape of forest therapy research within the European context. The primary focus of this review, as outlined in Section 2, centers on human studies that investigate the impact of forest therapy on the health and overall wellbeing of individuals.

2. Materials and Methods

2.1. Registration and Study Design

This scoping review adhered to the PRISMA guidelines [11] and was registered in "searchRxiv" under https://doi.org/10.1079/searchRxiv.2024.00435.

2.2. Eligibility Criteria

All studies conducted in a European country, irrespective of their design, involving either healthy participants or patients previously diagnosed with a medical condition

were included in this review. The intervention under scrutiny, labeled as forest therapy, denoted the act of staying in a forest, encompassing activities such as walking or merely contemplating nature, and inhaling its atmosphere for a predetermined duration. Studies conducted in city parks or urban green areas were excluded. The inclusion criteria did not discriminate based on the type of comparison/control group (control denoting no intervention and comparison incorporating any intervention apart from forest bathing). Studies measuring any psychological, physiological, and disease-related outcomes were incorporated. The language criteria included only articles written in English. Studies had to be published in peer-reviewed scholarly journals to be eligible for inclusion.

The following PICOS criteria were applied:

- Population (P): healthy participants or patients with a previously diagnosed disease.
- Intervention (I): forest therapy, which implies walking in a forest at a slow pace and contemplating the surrounding environment.
- Comparison (C): all types of comparison/control, including no intervention/control.
- Outcomes (O): all psychological and physiological outcomes, characteristics of the forest environment where the experiments were conducted, and a brief summary of the study conclusions.
- Study Design (S): all types of studies conducted in Europe and involving human subjects (both interventional and observational studies were deemed eligible for inclusion).

2.3. Information Sources and Search Strategy

The reviewers systematically searched PubMed, Embase, Cochrane Library, the Directory of Open Access Journals (DOAJ), and Google Scholar for relevant articles investigating the effects of forest therapy sessions conducted in Europe.

These search strategies were executed up until January 2024, with specific search terms tailored to each database. The results were screened and selected based on relevance to the research question.

- PubMed: "forest therapy"[Title/Abstract] OR "forest medicine"[Title/Abstract] OR "forest meditation"[Title/Abstract] OR "shinrin yoku"[Title/Abstract] OR "forest bathing"[Title/Abstract] OR "nature therapy"[Title/Abstract] OR "nature medicine" [Title/Abstract] OR "nature-based intervention*"[Title/Abstract].
- Embase: 'forest therapy':ab,ti OR 'forest medicine':ab,ti OR 'forest meditation':ab,ti OR 'shinrin yoku':ab,ti OR 'forest bathing':ab,ti OR 'nature therapy':ab,ti OR 'nature medicine':ab,ti OR 'nature-based intervention':ab,ti.
- Cochrane Library: "forest bathing" OR "forest therapy" OR "shinrin yoku" in titles, abstracts, and keywords.
- DOAJ: "forest bathing" OR "forest therapy" OR "shinrin yoku".
- Google Scholar (limited to the first 200 results): ("forest bathing" OR "forest therapy" OR "shinrin yoku") AND "randomized controlled trial".

The references of all studies eligible for inclusion were screened through "snowballing"/citation tracking to retrieve other potential articles matching the above-mentioned PICOS criteria.

2.4. Study Selection and Data Collection Process

Two authors (E.M. and M.A.) independently conducted the screening and selection process, with discrepancies resolved through discussion with the other authors. The scrutinized data derived from the studies meeting the inclusion criteria encompassed details such as the quantity and characteristics of the study participants, the nature of the intervention, the investigated outcomes, the specific study design employed, and the European location of the forests used for therapeutic sessions. Data were manually extracted, critically appraised, and synthesized qualitatively.

2.5. Risk of Bias Assessment

A specialized evaluation tool provided by the National Institutes of Health (NIH) was employed to appraise the quality of controlled intervention studies [12]. The comprehensive assessment included responses to 14 inquiries, examining aspects such as the existence and methodology of randomization, the concealment of treatment allocation, the blinding of both study participants and outcome assessors, the absence of significant group differences at the baseline, the rates of attrition and drop-out, adherence to the intervention protocol, the presence of confounding factors, the utilization of valid and reliable measurement methods, the recruitment of an adequate number of participants, and potential sources of bias. Each query permitted responses in three categories: "yes," "no," or "other" (indicating data non-reporting, indeterminate answers, or inapplicability). Individual studies underwent scrutiny, and their overall quality was categorized as poor if 6 or fewer items garnered positive responses (answered with "yes"), fair if positive responses ranged from 7 to 9, and good if at least 10 items yielded positive responses. In instances where determinations were unattainable, not applicable, or unreported, the overall quality was determined based on the available data. Item 4 of the study quality assessment tool ("Were study participants and providers blinded to treatment group assignment?") was deemed not applicable, as concealing forest therapy from those actively involved in it is not feasible. The study quality assessment was used to identify potential limitations and future proposals for forest therapy research in Europe.

3. Results

After screening the scientific literature, 1080 research items were retrieved, and 26 studies were eventually included in this review [4,13–37], encompassing a total of 2775 participants (min: 10; max: 1070; median: 46). The article selection process is described in a dedicated flowchart (Figure 1), while Table 1 provides an overview of the study characteristics, including population, intervention, comparison, outcomes, and methodological design.

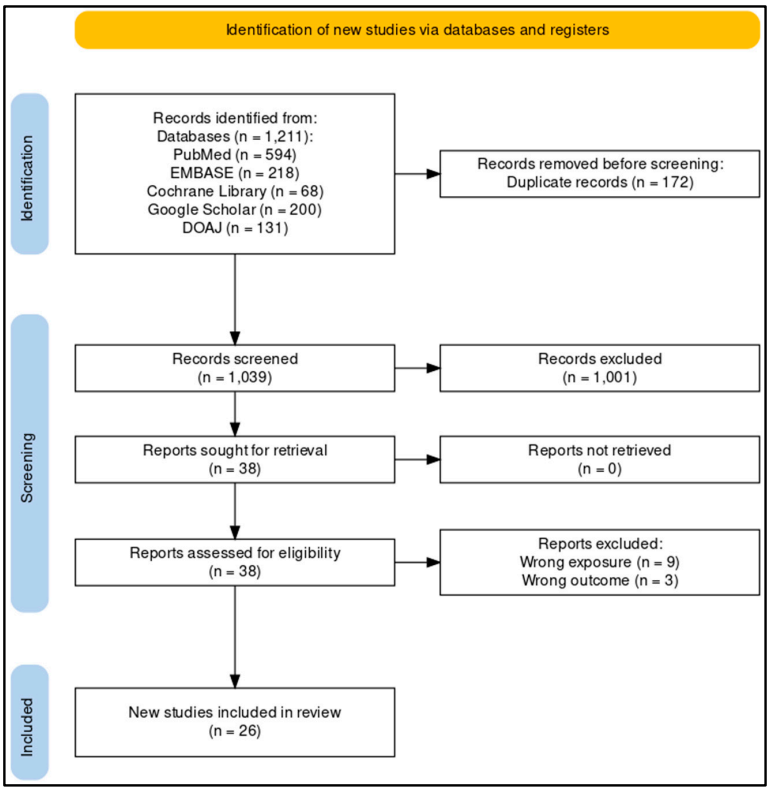

Figure 1. PRISMA flow diagram of the article selection process [37].

Table 1. Summary of study results (PICOS characteristics) [1].

Population	Intervention	Comparison	Outcomes			Study Design	Ref.
			Phys. [2]	Psyc. [3]	Env. [4]		
Healthy subjects (*n* = 100) Age (mean): 37.51–37.77 years old 56 F/44 M	Walking in a wild forest (30–40 min) once (*n* = 52)—each participant alone	Walking in a tended forest (30–40 min) once (*n* = 44)—each participant alone	None	Subjective wellbeing, arousal, and positive/negative affect (BFS)	None	RCT	[13]
Overweight couples with sedentary lifestyles (*n* = 88) Age: 50–60 yo 44 F/44 M	Forest therapy (3–4 h) every day for 1 week (*n* = 46)	Moderate hiking tours (3–4 h) every day for 1 week (*n* = 42)	60 days: – Blood count – Aerobic capacity – Body composition	60 days: – QoL (SF-12, EQ5D-5L) – Relationship quality	None	RCT	[14]
Healthy subjects (*n* = 77) Age: 30–61 yo 71 F/6 M	Forest therapy (45 min) once (*n* = 77)—groups of 1–4 people	Walking in an urban park or in the city center (45 min) once (*n* = 77)—groups of 1–4 people	– Vital signs (BP)	– Positive/negative affect (PANAS) – Subjective wellbeing (ROS, SVS, PRS) – Creativity	None	RCT (crossover design)	[15]
Healthy subjects (*n* = 75) Age range: 19–24 yo M/F?	Forest therapy (30 min) once (*n* = 30)—groups of 13–23 people	Walking in an urban environment (30 min) once (*n* = 45)—groups of 13–23 people	– Vital signs (HR, BP)	– Mood states (POMS) – Positive/negative affect (PANAS) – Subjective wellbeing (ROS, SVS)	None	RCT	[16]
Healthy subjects (*n* = 67) Age: 20–33 yo 46 F/21 M	Forest therapy (35–45 min) once (*n* = 20)—each participant alone	Gym physical activity (*n* = 24) or watching a nature video on TV (*n* = 23) for 40 min—each participant alone	– Salivary cortisol – Vital signs (HR, HRV)	– Positive/negative affect (PANAS)	None	RCT	[17]
Healthy subjects (*n* = 66) Age: 26–65 yo 39 F/27 M	Forest therapy (45 min) once in each of the four forests analyzed (urban, pristine, mature, and young forests) (*n* = 66)—groups of 1–6 people		None	– Positive/negative affect (PANAS) – Subjective wellbeing (ROS, SVS)	None	RCT (crossover design)	[18]

Table 1. *Cont.*

Population	Intervention	Comparison	Outcomes			Study Design	Ref.
			Phys. [2]	Psyc. [3]	Env. [4]		
Healthy subjects (n = 54) Age: 21.35 ± 1.39 yo 24 F/30 M	Contemplating a forest in silence (15 min) once in the winter and once in the spring (n = ?)	Viewing an urban environment in silence (15 min) once in the winter and once in the spring (n = ?)	None	– Mood states (POMS) – Positive/negative affect (PANAS) – Subjective wellbeing (ROS, SVS)	None	RCT	[19]
Healthy highly sensitive people (n = 39; 37 analyzed) Age: 18–70 yo 35 F/4 M	Forest therapy (1 h) once (n = 37)—groups of 5–14 people	Short walk in a field (1 h) once (n = 37)—groups of 5–14 people	– Salivary cortisol – Safety of treatment	– Mood states (POMS) – Subjective wellbeing (CSP-14)	None	RCT (crossover design)	[20]
Highly sensitive people (n = 17) Age: 18–70 yo 16 F/1 M			None	– Subjective wellbeing – Nature connectedness	None		[21]
Healthy subjects (n = 34) Age: 20–22 yo 34 F/0 M	Contemplating a forest in silence (15 min) once (n = 16)	Viewing an urban environment in silence (15 min) once (n = 16)	None	– Mood states (POMS) – Positive/negative affect (PANAS) – Subjective wellbeing (ROS, SVS)	None	RCT	[22]
Healthy subjects—university students (n = 22) Age: 18–30 yo 11 F/11 M	Contemplating a forest (15 min) once (n = 22)—groups of 11 people	Viewing an urban setting (15 min) once (n = 22)—groups of 11 people	None	– Mood states (POMS) – Positive/negative affect (PANAS) – Subjective wellbeing (ROS, SVS)	None	RCT (crossover design)	[23]
Patients with exhaustion disorder, mild depression, and anxiety (n = 20) Age: 24–55 yo 20 F/0 M	Forest therapy (50 min) once in a forest with and without a lake (n = 20)—group of 8–12 people	Visiting a city and a rock outcrop (50 min) once (n = 20)—group of 8–12 people	– Vital signs (HR, BP, HRR)	– Mood states (POMS, ZIPERS) – Attention capacity (NCPC) – Subjective wellbeing (PRS)	None	RCT (crossover design)	[24]

Table 1. *Cont.*

Population	Intervention	Comparison	Outcomes			Study Design	Ref.
			Phys. [2]	Psyc. [3]	Env. [4]		
Healthy subjects (n = 10) Age: 20–40 yo 6 F/4 M	Forest therapy (2 h) once (n = 10)	Walking in an urban area (2 h) once (n = 10)	– Vital signs (BP, HR, PEF) – MT absorption	None	– BVOCs and MT in the forest air	RCT	[25]
Healthy subjects (n = 134) Age > 18 yo (mostly 41–60 yo) 84 F/50 M	7 forest therapy sessions (3–4 h)—groups of 9–39 people	Walking in an urban park (n = 13)	None	– Mood states (POMS)	– BVOCs and AVOCs in the forest air	Non-RCT	[26]
Healthy subjects (n = 86) Age: 19–78 yo 60 F/26 M	Forest therapy (3 h) in Sant Llorenç (n = 34) or La Garrotxa (n = 23)	Guided hiking for 8 km (n = 18) or 3 km (n = 11)	None	– Anxiety (STAI) – Mood states (POMS) – Positive/negative affect (PANAS) – Mindfulness state of mind and body (M-E)	None	Non-RCT	[27]
Healthy subjects (n = 62) Age: 21.45 ± 0.18 yo 26 F/36 M	Forest therapy (15 min) once (n = 31)	Viewing an urban environment (15 min) once (n = 31)	None	– Mood states (POMS) – Positive/negative affect (PANAS) – Subjective wellbeing (ROS, SVS)	None	Non-RCT	[28]
Subjects with unspecified characteristics (n = 40) Age: ? F/M?	Contemplating a forest in silence (6:30 min) once (n = 40) divided into 4 groups	Resting indoor (6:30 min) once (n = 40) divided into 4 groups	None	– Subjective wellbeing	None	Non-RCT	[29]
Patients with affective (n = 27) or psychotic (n = 23) disorders (n = 50) Age: 25–60 yo 27 F/23 M	Forest therapy (1 h and 45 min) once (n = 50)—groups of 4–5 people	None	None	– Mood states (POMS) – Anxiety (STAI-S)	None	Pre–post study	[30]
Subjects with unspecified characteristics (n = 37) Age: 54.8 ± 12.7 yo 22 F/15 M	Forest therapy (8 h) once (n = 37)	None	– Vital signs (HR, HRV, BP, body temperature, PEF, FEV1)	– Emotional status (PSS)	None	Pre–post study	[31]

Table 1. *Cont.*

Population	Intervention	Comparison	Outcomes			Study Design	Ref.
			Phys. [2]	Psyc. [3]	Env. [4]		
Healthy subjects (n = 31) Age range: 20–40 yo 21 F/10 M	Forest therapy (8 h) once (n = 31)	None	– Salivary cortisol, alpha amylase activity, and IgA levels	None	None	Pre–post study	[32]
Healthy subjects (n = 21) Age: 21–29 yo 9 F/12 M	Forest therapy (5 h) once (n = 21)	None	– Vital signs (HR, BP)	– Mood states (POMS) – Positive/negative affect (PANAS) – Subjective wellbeing (ROS, SVS)	None	Pre–post study	[33]
Healthy subjects (n = 16) Age: 47.50 ± 8.32 yo 14 F/0 M	Forest therapy (3 h) once (n = 16)	None	None	– Mood states (POMS) – Anxiety (STAI) – Positive/negative affect (PANAS) – Mindfulness state of mind and body (M-E)	None	Pre–post study	[34]
Healthy subjects—workers (n = 12) Age: 25–63 yo 7 F/5 M	Forest therapy (2 h) in January and May (n = 12)	None	– Activity of cytotoxic lymphocytes and NK cells – Systolic BP	None	None	Pre–post study	[35]
Italian people, mostly healthy (n = 505) Age > 18 yo 329 F/176 M	Forest therapy (3 h) once—groups of 15–20 people	None	None	– Anxiety (STAI) – Mood states (POMS)	– BVOCs concentration in the forest air	Cohort study	[36]
Asthmatic adolescents with allergies (n = 42) Age: 13–17 yo 12 F/30 M	A 14-day stay in a forested area in the Italian Alps	None	– Spirometry and pulmonary functions	None	– BVOCs and AVOCs in the forest air	Cohort study	[37]

Table 1. *Cont.*

Population	Intervention	Comparison	Outcomes			Study Design	Ref.
			Phys. [2]	Psyc. [3]	Env. [4]		
Italian participants in forest therapy sessions (n = 1070) Age: 45–54 yo 643 F/352 M	Forest therapy sessions (2.5–3 h)—groups of 15–20 people	None	– Lifestyle characteristics (BMI, smoking habit, medicinal drugs, diet)	– Anxiety (STAI) – Nature connectedness	None	Cross-sectional survey	[4]

[1] Table description: The studies are grouped according to their methodological design (RCTs, non-RCTs, pre–post, and observational studies). In each group, research experiments are ordered on the basis of their sample size (from the largest to the smallest). Table legends: AVOCS = anthropogenic volatile organic compounds; BFS = self-rating scales of mental state, adapted from the Abele-Brehm's scale [38]; BMI = body mass index; BP = blood pressure; BVOCs = biogenic volatile organic compounds; CSP-14 = Change in Subjective Self-Perception; EQ5D-5L = Euro Quality of Life Questionnaire; F = females; FEV1 = forced expiratory volume; HR = heart rate; HRR = heart rate recovery; HRV = heart rate variability; M = males; M-E = state mindfulness scale; MT = monoterpenes; NCPC = Necker Cube Pattern Control; NK = natural killer cells; PEF = peak expiratory flow; POMS = profile of mood states; PRS = perceived restorativeness scale; PSS = Perceived Stress Scale; QoL = quality of life; RCT = randomized controlled trial; Ref. = reference; ROS = restorative outcome scale; SD = standard deviation; SF-12 = Short Form Health Survey; STAI = State-Trait Anxiety Inventory (S = State Anxiety; T = Trait Anxiety); PANAS = positive and negative affect schedule; SVS = subjective vitality scale; ZIPERS = Zuckerman Inventory of Personal Reactions [39,40]; [2] physiological; [3] psychological; and [4] environmental.

Additionally, in Figures 2 and 3, the main reasons why certain studies were excluded from this literature review are summarized. These doughnut charts provide a description of the criteria that guided the exclusionary process, offering transparency into the robustness of the review methodology. The reasons for the exclusion of research items from this review were mainly due to the study location (regions outside Europe), irrelevant research topics, non-original publications (such as other literature reviews or editorials), and intervention types different from forest therapy (Figure 2). Specifically, among the studies excluded for the reasons mentioned in the last point, about one-third focused on indoor meditative activities (36.36%), with a smaller proportion related to therapeutic gardening and horticulture activities (17.17%), or walks in urban parks different from the traditional forest setting (12.12%) (Figure 3).

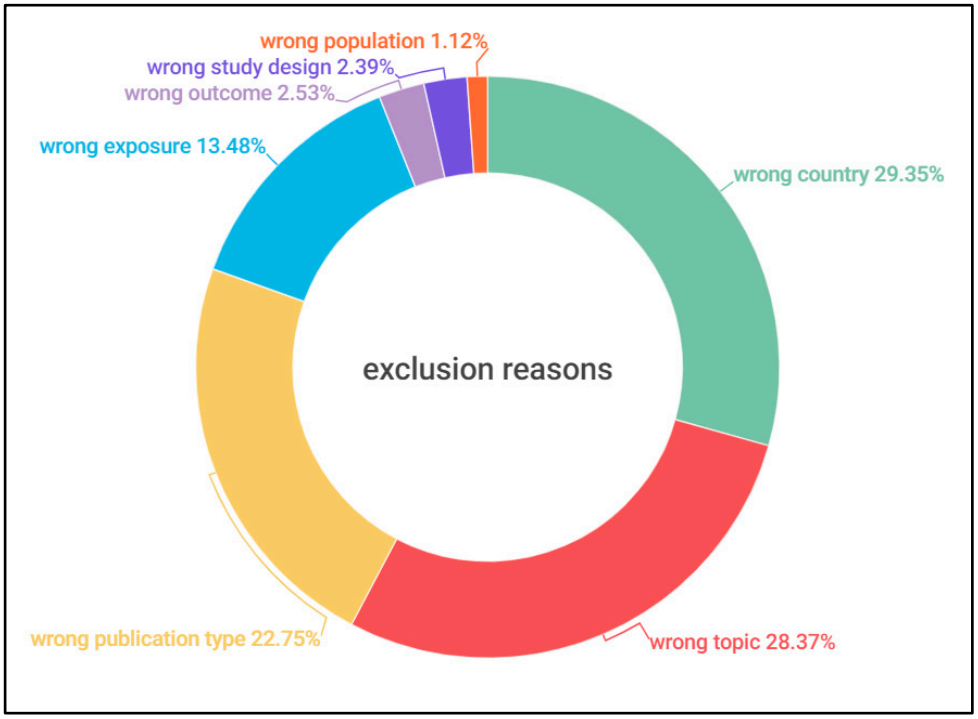

Figure 2. Main reasons for the exclusion of studies from this literature review.

Among the included studies, 13 were randomized controlled trials (RCTs) [13–25], involving a total of 322 participants (min: 10; max: 100; median: 54). In these RCTs, the intervention consisted of a single session of forest therapy (or a few daily sessions repeated within a week), lasting from a minimum of 15 min to a maximum of 2 h. In most cases, the forest therapy sessions involved both the physical aspect of walking and the meditative component of contemplating the surrounding environment; however, in some instances, the intervention included only one of these components (see Table 1 for further clarification). The control group engaged in analogous activities but in an urban or rural setting or in a forest with distinct characteristics compared to the experimental group (refer to Table 1 for further details). With the exception of one RCT [25], psychological outcomes, primarily related to mood states, positive/negative affect (emotional distress), attention levels, subjective wellbeing, and quality of life, were measured. Physiological outcomes were assessed in seven RCTs [14–17,20,24,32], encompassing vital signs such as blood pressure, heart rate, respiratory parameters, salivary cortisol levels, body composition, and blood count (additional details in Table 1). One study measured environmental characteristics, specifically biogenic volatile organic compounds in the forest air [25].

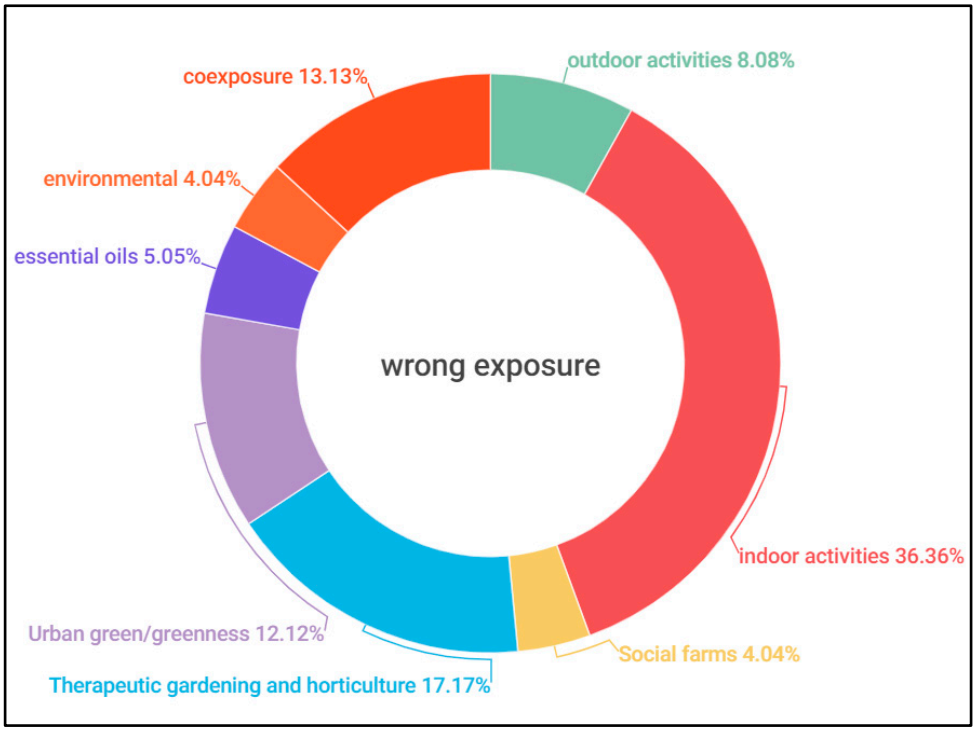

Figure 3. Details about the reasons for the exclusion of studies characterized by interventions other than forest therapy.

Considering non-randomized controlled trials (non-RCTs), four studies were included [26–29], with a combined population of 322 participants (minimum: 40; maximum: 134; median: 74). These studies featured a control group but lacked the randomization of study participants. In each of these studies, psychological outcomes were assessed, whereas physiological outcomes were not gathered (see Table 1 for further information). Additionally, environmental characteristics related to the composition of forest air were only collected in one study [26].

The pre–post studies, without any control group, eligible for inclusion were six [30–35], and they involved a total of 167 participants (min: 12; max: 50; median: 26), mostly healthy or sub-healthy subjects. In these studies, a range of outcomes were measured, encompassing both physiological and psychological aspects (occasionally focusing on only one type). Notably, none of these studies included the sampling of environmental characteristics related to the composition of forest air. In two of these studies, immune system functions, specifically lymphocyte activity, and stress hormone levels were measured [32,35].

Two cohort studies meeting the inclusion criteria involved 547 participants (minimum: 42; maximum: 505; median: 273.5) [36,37]. In both of these studies, the outcomes assessed comprised the composition of the forest air and either physiological or psychological measures. Notably, one study specifically measured respiratory function parameters in patients with asthma [37].

The only survey included in this review gathered information from 1070 individuals of both genders who participated in forest therapy sessions in Italy: the study aimed to explore their demographic, psychosocial, and lifestyle characteristics [4].

Table 2 describes the environmental characteristics pertaining to the forests under examination in the included studies. In addition to this, it includes a brief summation of the empirical findings, with a particular emphasis on the wellbeing advantages associated with forest therapy. The countries wherein forest therapy research has been undertaken encompass Italy, Poland, Spain, Germany, Finland, Hungary, Sweden, Iceland, and Switzerland. The forest sites selected for study exhibited a diversity ranging from evergreen to deciduous, with a notable prevalence of the former, as detailed in Table 2. Altitude

variations in the sampled forest sites were observed, predominantly falling below 1000 m above sea level. The collective body of forest therapy research conducted in Europe thus far has revealed substantive evidence supporting the notion that shinrin-yoku contributes to the enhancement of psychophysical relaxation, the reduction in anxiety levels, and improvements in the mood, subjective wellbeing, and overall quality of life for the participants in these studies. Moreover, the practice has demonstrated its capacity to ameliorate lung function parameters in adolescents with asthma [37]. Physiological outcomes also include an increase in natural killer (NK) cell activity and a concurrent reduction in stress hormone levels [17,32,35]. Predominantly, forest therapy sessions were conducted during the spring-to-autumn seasons, as detailed in Table 2, providing a seasonal context for the reported outcomes.

The methodological quality of the included RCTs, evaluated using the NIH tool, is outlined in Table 3. In particular, some weaknesses were identified, including inadequate information about the randomization procedure, a lack of details concerning allocation concealment, limited information on the blinding of outcome assessment, and the absence of a clear study protocol published in advance. However, despite these limitations, the quality of the RCTs was fair-to-good in all instances (see Table 3 for additional details).

Items of the NIH study quality assessment tool [12]:

1. Was the study described as randomized, a randomized trial, a randomized clinical trial, or an RCT?
2. Was the method of randomization adequate (i.e., use of randomly generated assignment)?
3. Was the treatment allocation concealed (so that assignments could not be predicted)?
4. Were the study participants and providers blinded to treatment group assignment?
5. Were the people assessing the outcomes blinded to the participants' group assignments?
6. Were the groups similar at the baseline on important characteristics that could affect the outcomes (e.g., demographics, risk factors, comorbid conditions)?
7. Was the overall drop-out rate from the study at the endpoint 20% or lower of the number allocated to treatment?
8. Was the differential drop-out rate (between treatment groups) at the endpoint 15 percentage points or lower?
9. Was there high adherence to the intervention protocols for each treatment group?
10. Were other interventions avoided or similar in the groups (e.g., similar background treatments)?
11. Were the outcomes assessed using valid and reliable measures, implemented consistently across all the study participants?
12. Did the authors report that the sample size was sufficiently large to be able to detect a difference in the main outcome between groups with at least 80% power?
13. Were the outcomes reported or subgroups analyzed prespecified (i.e., identified before analyses were conducted)?
14. Were all the randomized participants analyzed in the group to which they had been originally assigned, i.e., did they use an intention-to-treat analysis?

Table 2. Environmental characteristics of forest sites explored in forest medicine research across Europe along with the main results of the included studies.

Country	Location	Forest Type	Altitude	Months/Season	Results (Significant Benefits in Favor of Forest Therapy)	Ref.
Italy	Lagundo	A low-lying Alpine forest in Italy, dominated by deciduous trees	350 m	October-June	Improved psychological wellbeing and health-related QoL.	[14]
	Various forest locations	Different Mediterranean and Alpine forests in Italy, including holm oak, domestic pine, Scots pine, beech, spruce, and silver fir and mixed deciduous/conifer stands	Various	June-October	Reduced anxiety, anger, and confusion.	[26]
	Misurina	A spruce, larch, and stone pine forest, with scattered silver fir trees	1800 m	July-September	Improved lung function parameters among asthmatic adolescents.	[37]
	Various forest locations	Different Mediterranean and Alpine forests in Italy, comprising practically all types of mid-latitude and lower-mid-latitude trees in Europe	Various	June-October	Forest therapy participants in Italy are mostly female subjects, aged between 45 and 54 years old, employed, unmarried, and with higher levels of trait anxiety.	[4]
			Various	Year-round	Decreased levels of anxiety.	[36]
	Castelfidardo	A unique biocenosis with a large presence of oak trees, along with dozens of other deciduous species	15–118 m	NR	Reduced stress levels and improved sympathovagal balance.	[31]
Poland	Warsaw	A pine forest (Sobieski) and an oak forest (Kabaty)	NR	November	Improved psychophysical relaxation in both forest settings.	[16]
	Olsztyn	A beech and oak forest	139 m	Springand winter	Broad-leaved trees have a more restorative effect in winter than in spring.	[19]
				March	Improved positive affect, restorativeness, and subjective vitality.	[22]
				March	Substantial emotional, restorative, and vitalizing effect (even during winter).	[28]
	Olsztyn	A forest dominated by Scots pine and spruce, with scattered oak and beech trees	139 m	August-November	Improved mood in patients with affective disorder; decreased anxiety in patients with psychotic disorder.	[30]
	Redykajny (Olsztyn)			May	Reduced stress levels, improved mood, and lower blood pressure and heart rate.	[33]

Table 2. *Cont.*

Country	Location	Forest Type	Altitude	Months/Season	Results (Significant Benefits in Favor of Forest Therapy)	Ref.
Spain	Montseny	A holm oak forest, with scattered pine trees	860–972 m	End of July	Increased blood levels of monoterpenes in people with a low blood concentration of these substances.	[25]
				July	Decrease in salivary cortisol concentrations, increase in alpha-amylase, and decrease in IgA from the fourth hour of exposure.	[32]
	Sant Llorenç and La Garrotxa	A pine and holm oak forest (Sant Llorenç) and a mixed holm oak, oak, and beech forest (La Garrotxa)	NR	October-May	Reduced anxiety and negative affect (the effects are more pronounced in Sant Llorenç).	[27]
	Sant Llorenç	A pine and holm oak forest	NR	October	Increase in positive affect, vigor, friendship, and mindfulness, and decrease in negative affect, anxiety, anger, fatigue, tension, and depressive mood.	[34]
Germany	Freiburg	Unknown	NR	August-October	Increased blood levels of monoterpenes in people with a low blood concentration of these substances.	[20]
					Improved psychological wellbeing, concentration, and body awareness.	[21]
	Germany or Austria (unclear location)	Unknown	NR	NR	Improved relaxation and lower levels of boredom. The participants' attitude played a pivotal role in enhancing the benefits.	[29]
Finland	Helsinki	A spruce forest	NR	Autumn andspring	Reduced perception of stress. No significant changes in cortisol levels.	[15]
			NR	April-June/September-October	Increased restorative effect, which was more pronounced in old-growth and mature forests.	[18]
	Evo	A spruce and birch forest	NR	January	Improved mood and sense of restorativeness.	[23]
Hungary	Pécs	An oak-dominated forest	535 m	May and January	Reduced blood pressure and increased activity of NK cells.	[35]
Sweden	Umea	A spruce and pine forest	NR	May-June and August-November	Enhanced psychological and physiological recovery, with benefits for patients suffering from exhaustion disorder.	[24]

Table 2. *Cont.*

Country	Location	Forest Type	Altitude	Months/Season	Results (Significant Benefits in Favor of Forest Therapy)	Ref.
Iceland	Reykjavik	A spruce forest	NR	February-March and April-May	Lower cortisol levels and improved mood.	[17]
Switzerland	Zurich	An Alpine forest in Switzerland (composition unknown)	NR	June-September	Improved changes in positive and negative affect. The benefits were influenced by the levels of physical activity.	[13]

Table 3. Methodological quality of the included RCTs.

Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Overall Quality [1]
Martens (2020) [12]	Y	?	?	/	?	Y	Y	Y	Y	Y	Y	N	?	Y	8
Huber (2023) [13]	Y	Y	?	/	?	Y	Y	Y	Y	Y	Y	Y	Y	Y	11
Tyrvainen (2013) [14]	Y	?	Y	/	?	Y	Y	Y	Y	Y	Y	N	?	Y	9
Janeczko (2020) [15]	Y	?	?	/	?	Y	Y	Y	Y	Y	Y	N	?	Y	8
Olafsdottir (2020) [16]	Y	?	?	/	?	Y	N	N	Y	Y	Y	Y	Y	Y	8
Simkin (2020) [17]	Y	?	Y	/	?	Y	Y	Y	Y	Y	Y	N	?	Y	9
Bielinis (2019) [18]	Y	?	Y	/	?	Y	Y	Y	Y	Y	Y	N	?	Y	9
Oomen-Welche (2022) [19]	Y	Y	?	/	N	Y	Y	Y	Y	Y	Y	N	Y	Y	11
Oomen-Welche (2023) [20]	Y	?	?	/	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	10
Bielinis (2019) [21]	Y	?	?	/	?	Y	Y	Y	Y	Y	Y	Y	?	Y	9
Bielinis (2021) [22]	Y	?	?	/	?	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Sonntag-Ostrom (2014) [23]	Y	Y	Y	/	?	Y	Y	Y	Y	Y	Y	Y	N	Y	11
Bach (2021) [24]	Y	?	?	/	?	Y	Y	Y	Y	Y	Y	N	Y	Y	9

[1] Overall quality of the included studies (number of items/domains answered with yes). Y = yes; N = no; ? = unclear; and / = not applicable.

4. Discussion

4.1. Critical Overview of the Available Evidence

This review included findings from 26 studies, collectively engaging 2775 participants across Europe, particularly in Italy, Poland, Spain, Germany, Finland, Hungary, Sweden, Iceland, and Switzerland (Figure 4). Psychological outcomes, spanning mood states, affect, attention levels, subjective wellbeing, and quality of life, were predominantly measured. The physiological assessments included vital signs, salivary cortisol, body composition, and blood count. Notably, most of the study sites were covered by evergreen forests. Forest therapy in Europe demonstrated notable benefits in psychological aspects such as relaxation, mood enhancement, and improved wellbeing, accompanied by significant physiological improvements, particularly in asthma patients. Despite the identified weaknesses, the methodological quality of the RCTs was generally fair to good.

The findings from the studies included in this review reveal distinctive patterns in carrying out forest therapy sessions. In Europe, these sessions predominantly occur during the spring-to-autumn seasons, a choice motivated by favorable meteorological conditions and heightened terpene emissions during this period. Additionally, European sessions are typically singular, with a minimum duration of 15 min; however, they often extend significantly, ranging from 2 to 3 h or even more (see Table 1 for further details). The nature of exercises undertaken during European forest therapy sessions tends to emphasize non-strenuous physical activities, in a balance between gentle walking and contemplation of the surrounding forest environment. Conversely, in Asian studies, forest therapy often lasts more than one hour, sometimes unfolding over multiple consecutive days [41–44], and the focus leans more heavily towards the contemplation of the natural environment, occasionally integrating other complementary practices and therapies [45,46].

In essence, while European sessions prioritize the integration of brief-yet-impactful exposures, their Asian counterparts tend to embrace more prolonged and immersive experiences, intertwining forest therapy with diverse therapeutic approaches. Compared to research in the Far East, experimental studies on physiological indicators in Europe are quite limited, as well as trials on the health-promoting effects of forest therapy on different groups. Future studies should explore the mechanisms involved in the health-promoting action of the forest, investigating factors such as forest type, setting, atmosphere, activities, duration, and frequency [47]. The diverse European forest ecosystems offer an advantage but require standardized investigation protocols. Research efforts should also focus on analyzing the physiological health effects through clinical research methods, addressing the current need for a more rigorous experimental design to substantiate the medical effects of forest therapy [48]. The challenges of conducting outdoor experiments, especially in collecting physiological data, necessitate the careful consideration of experimental protocols,

settings, and locations, and the detailed analysis of environmental characteristics becomes essential for reproducibility and predicting the expected effects of forest therapy.

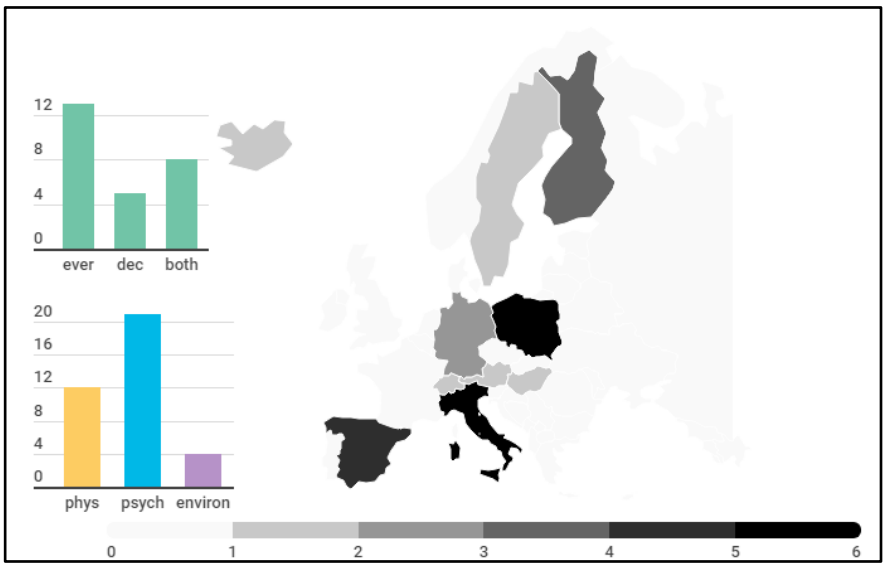

Figure 4. Forest therapy research in Europe: "mapping" the available evidence. The geographical distribution of studies on forest therapy research in Europe is illustrated, where the intensity of gray shading corresponds to the number of trials analyzed for each country. Complementing the map, a bar chart with the number of studies analyzing physiological (yellow), psychological (blue), or environmental (purple) outcomes is reported. Another informative bar chart categorizes the forest sites scrutinized in the studies, ranging from evergreen ("ever") to deciduous ("dec") or mixed ("both"), providing a comprehensive overview of the diverse ecological contexts under investigation.

The focus on Europe for the review of forest medicine studies holds considerable significance, even when compared to nations with well-established traditions in this field, such as Japan or Korea. First of all, researchers can delve into how various cultural backgrounds within the continent perceive and integrate nature-based interventions into wellbeing practices [49,50]. Additionally, Europe encompasses a spectrum of ecosystems, from Nordic forests to Mediterranean landscapes [51,52], and a study of forest medicine in Europe can provide a unique opportunity to comprehend how diverse environmental conditions influence the therapeutic outcomes of forest-based interventions. This knowledge, in turn, can inform the development of tailored approaches for different regions, considering the ecological diversity within the continent.

Furthermore, Europe boasts well-established healthcare systems [53,54], prompting a critical examination of how forest medicine can be properly integrated into public health practices. Understanding the compatibility of forest therapy with existing healthcare frameworks in Europe can be important for facilitating its adoption as an evidence-based complementary intervention [55,56]. This investigation aligns with the broader goal of enhancing holistic patient care within established healthcare structures, including the goal of relieving the growing burden of healthcare expenditures.

From an environmental perspective, European countries are grappling with challenges stemming from urbanization and aging, and their impact on mental health and wellbeing [57,58]. An in-depth exploration of the role of forest medicine in addressing these challenges provides valuable insights into mitigating the adverse effects of urbanization and aging through nature-based interventions. This is crucial, among other things, for developing targeted strategies to enhance mental wellbeing in the face of growing stressors [59–61].

Finally, focusing on Europe fosters international collaboration and the exchange of knowledge among countries with diverse experiences in forest medicine. This collaborative effort has the potential to lead to the development of best practices, shared research

methodologies, and a more comprehensive understanding of the global impact of forest therapy initiatives.

4.2. Relevant Areas of Forest Therapy Research in Europe

Research on forest therapy in Europe spans across three major domains: health, sustainability, and society (Figure 5).

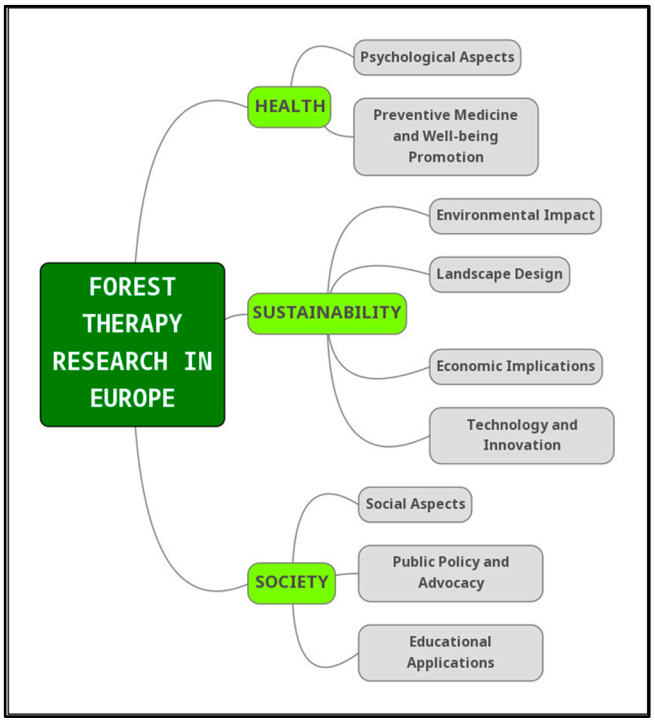

Figure 5. Relevant areas of forest therapy research in Europe.

4.2.1. Health and Wellbeing

Delving into the wellbeing benefits, studies have explored the intricate connection between therapeutic forests and psychophysical health: investigations cover stress reduction by examining cortisol levels, the impact on physical health, including respiratory outcomes, and mental benefits such as attention restoration, anxiety reduction, and mood improvement [4,13–37]. Despite the challenging nature of conducting outdoor experiments and collecting physiological data in forest settings, recent efforts have emphasized the importance of rigorous research methods to obtain valid conclusions and substantiate the medical effects of forest therapy.

4.2.2. Sustainability and Environmental Aspects

In the realm of environmental impact, researchers have scrutinized biodiversity and ecosystem services provided by therapeutic forests. This entails assessing the air quality, analyzing the composition of vegetation and the volatile organic compounds released by plants, and investigating sustainable management strategies for forests used for therapeutic purposes [26,62–67]. Furthermore, other research has focused on designing suitable trails for therapeutic activities within forest environments [68].

4.2.3. Society and Community Life

The social aspects of forest therapy extend to its influence on social cohesion, community wellbeing, and addressing social inequalities: cultural and societal perceptions of nature and forests have been explored, alongside economic implications such as their role in eco-tourism, impact on local economies, and cost–benefit dynamics [69–73]. Additionally, studies have investigated educational applications, technological advancements

(benefits of virtual forest contemplation), and the role of forest therapy in European public policy [74–80].

4.3. Forest Characteristics

Various forest types across Europe have been utilized in studies on forest therapy research, reflecting the diverse ecological landscapes of the continent (see Table 2 for additional details). These include different Mediterranean, Alpine, and continental forests, such as spruce and pine forests, holm oak- and oak-dominated forests, and practically any combination of mixed forests, in different European regions.

Each type of forest, including those blanketed in snow, provides a unique setting that could enhance our understanding of the therapeutic effects associated with nature experiences. Despite the current challenges in establishing clear connections between specific forest environments and psychophysiological health benefits, preliminary findings suggest that forests composed of holm oak or a mix of holm oak and pine—common in Mediterranean regions—show promising health outcomes [26,27,34,36]. Furthermore, there is some evidence to suggest that mature and ancient forests may offer greater therapeutic benefits than their younger counterparts, though this assertion is based on a single study [18]. This could inform the development of more effective forest therapy interventions. Additionally, the growing body of evidence highlighting the unique and significant role that exposure to forest-derived monoterpenes plays in enhancing psychological [36] and physiological health [37], opening up new avenues for selecting the most beneficial forest types for therapy, based especially on the emission of monoterpenes from predominant tree species.

4.4. Study Limitations

Potential limitations of this study should be considered: unlike original research studies, scoping reviews do not generate new empirical data but rather provide a comprehensive overview of the available evidence in a given field. Consequently, our conclusions are based on the synthesis of information gathered from existing studies rather than on the conduct of new experiments. Furthermore, the generalizability of the findings may be limited due to the heterogeneity observed among the included studies. Variability in participant demographics, intervention protocols, and outcome measures may hinder the extrapolation of results to broader populations or contexts. Lastly, the scoping nature of this review, while valuable for mapping the existing literature, may not provide in-depth insights into the causal relationships between forest therapy and health outcomes. A more comprehensive systematic review or meta-analysis could be warranted to delve deeper into specific aspects of forest therapy research.

4.5. Practical Implications

Despite different environmental contexts and experimental strategies, the significant outcomes of forest therapy studies in Europe cover a broad spectrum of psychological and physiological conditions. Thus, this examination of forest therapy research within the European context yields valuable insights with practical implications.

The synthesis of findings highlights the potential for tailoring therapeutic interventions by optimizing session duration and incorporating diverse natural environments to maximize the observed benefits. Policymakers in public health can consider integrating forest therapy programs into community wellness strategies, guided by an understanding of their positive impacts on mental and physical wellbeing. Healthcare professionals may find value in incorporating forest therapy into their practice, particularly for individuals experiencing stress or anxiety, as well as asthmatic patients.

The findings also suggest potential benefits for educational settings, where integrating nature-based activities into the curricula or offering forest therapy as a supplementary approach may support student wellbeing and cognitive development. This review also underscores the importance of addressing the methodological limitations in forest therapy research: improving the rigor and standardization of research methodologies is critical to

ensuring robust investigations and comparability across studies. Moreover, considering the environment, landscape planners should aim to enhance the therapeutic potential of green spaces and forests by designing natural areas that prioritize accessibility and safety.

Recognizing the benefits for various populations, there is potential for increased community engagement in forest therapy initiatives: inclusivity in program design, considering the diverse needs and preferences of different demographic groups, can enhance the effectiveness of interventions. Furthermore, professional training programs for forest therapy practitioners can incorporate insights from this review to optimize the impact of the interventions. Finally, the absence of forest therapy studies in certain European countries emphasizes the need for extending research efforts to these regions. Conducting studies in currently unexplored areas will contribute to a more comprehensive understanding of the potential benefits and challenges of forest therapy across diverse European populations, enriching the broader scientific knowledge base in this field.

5. Conclusions

In conclusion, this scoping review provides a comprehensive overview of the current landscape of forest therapy research in Europe. The synthesis of the findings reveals a growing body of literature emphasizing the positive impact of forest therapy sessions on both physical and mental wellbeing. However, inherent limitations in the methodological quality of some studies, as highlighted in this review, underscore the need for more rigorous and standardized research approaches. The identified knowledge gaps, particularly in areas such as long-term effects, optimal session duration, and specific population responses, suggest avenues for future research. Additionally, the scarcity of studies exploring diverse environmental characteristics and their influence on therapeutic outcomes points towards a need for deeper investigations.

In particular, future studies should delve into analyzing the effects of diverse forest types on psychophysical wellbeing. Then, a more precise understanding of the relationship between exposure to forest therapy and the duration of the associated benefits is important too. Additionally, researchers should explore whether there are other benefits, such as cardiovascular prevention, improvements in metabolic health, and impacts on various psychological domains, that have not been comprehensively assessed to date.

Despite these challenges, the overall trend suggests a promising potential for forest therapy in promoting health and wellbeing in the European context. As this field evolves, researchers, practitioners, and policymakers should collaboratively address the identified limitations and embrace opportunities for further inquiry to enhance the understanding and application of forest therapy interventions across diverse populations and settings in Europe.

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