

Review

# Effect of Nature Walks on Depression and Anxiety: A Systematic Review

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**Abstract:** The benefits of nature for our health have been an increasing research focus in recent years. In the context of a global increase in mental health diagnoses, the potential health benefits of nature have attracted attention. One practical nature treatment is to walk in nature. However, evidence for this practice on mental health has not been comprehensively appraised to date. This systematic review synthesized the effects of nature walks for depression and anxiety, and evaluated the methodological rigor of studies. Academic databases including ProQuest, PsycINFO, Science Direct, and Google Scholar were utilized to identify eligible articles, which were examined using the Newcastle–Ottawa Scale. Of 385 articles initially retrieved, 12 studies met all the eligibility criteria (nine pre-post within-subject studies, two quasi-experimental studies, and one experimental between-subjects study). These studies demonstrated that nature walks were effective for state anxiety but not generalized anxiety and the effects for depression were inconsistent. Findings indicate that nature walks may be effective for mental health, especially for reducing state anxiety. However, the quality of the included studies varied, and sample sizes were small, suggesting a need for more rigorous and large-scale research.

**Keywords:** nature walk; state anxiety; PRISMA; nature-based intervention; systematic review



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## 1. Introduction

In recent years, there has been increasing interest in the psychological and physiological benefits for individuals of spending time in nature [1]. Some of this interest is likely to have been motivated by acknowledging the damage from harmful human activities on our planet's fragile ecosystems and a keenness to attempt to reverse the harm [2] as well as from individual experiences of the simple benefits of enjoying time outside [3]. Spending time in nature and feeling connected to nature have positive impacts on people's mental health and wellbeing [1]. There is evidence that undertaking physical activity in nature can provide benefits above and beyond the benefits from the physical activity, through an increased connection to nature. The scope of physical activities examined embraces activities from the extremes of "free solo" climbing and kayaking [4] to less strenuous activities such as bird-watching or watching nature documentaries on TV [5] and the most popular "middle-ground" activities involving spending time in nature without strenuous activity including walking in nature. Nature-based interventions are potentially cost-effective treatments [6] that can provide multiple benefits [7] and are potentially accessible to a range of people providing there is adequate provision of public greenspace [8]. Forest bathing (shinrin-yoku) has received particular attention because it is often free and more accessible than established health interventions [9]. Other nature-based interventions, including walking in nature, have been demonstrated to have positive wellbeing impacts, including reducing stress levels [10]. Likewise, conducting a nature walk in a group reduced stress from stressful life events [11]. However, as for any therapy, there is still a need

to understand how health benefits manifest before nature-based activities could be utilized in practice [12]. A substantial increase in the research base is required before nature-based activities can be prescribed alongside established therapies [9].

There is an urgent need for effective and cost-effective treatments for mental health conditions [13]. Mental health is a global and growing health challenge. In 2017, an estimated 792 million people were affected by mental health issues worldwide [14]. Since then, the COVID-19 pandemic and associated widespread socio-economic changes are leading to a mental health crisis globally [15]. Of the conditions assessed in 2017, anxiety and depression were the most prolific disorders reported, affecting 284 million and 264 million people, respectively [14]. Both of these conditions have increased prevalence during the COVID-19 pandemic [16,17].

Anxiety encompasses a range of disorders including Generalized Anxiety Disorder, Panic Disorders, and Social Anxiety Disorders. These disorders can hinder a person's ability to function normally, impacting job and academic performance, and personal relationships [18]. During the COVID-19 pandemic, Hamilton and Coates [19] surveyed 6430 people in the UK and identified that almost half of the sample reported high anxiety, with anxiety scores showing a marked increase from pre-pandemic scores. As for many mental health conditions, anxiety is under-diagnosed, and there is a noted treatment gap for anxiety globally [20]. Even where treatment has been prescribed, it still may not be reliable or wholly effective. The main pharmacological treatments (most usually SSRIs (selective serotonin reuptake inhibitors) and SNRIs (serotonin-norepinephrine reuptake inhibitors)) have significant potential for adverse effects and drug-drug interactions [21]. Psychological therapies, such as CBT (Cognitive Behavioral Therapy), are recognized to have good efficacy but are still most effective when used in combination with pharmacological treatments [22]. Considering the long experience of testing and patient use of these medications, there is a need for different thinking about mental health therapy—perhaps toward a nature-based treatment approach.

During the COVID-19 pandemic, it was estimated that almost one in five adults experienced some form of depression, doubling from around one in ten prior to the pandemic with more than half of adults who experienced some form of depression also reporting high levels of anxiety [23]. Recognized symptoms include feeling sad or being in a depressed mood, loss of interest or pleasure in activities once enjoyed, loss of energy, and feeling worthless or guilty [24]. Treatments usually include talking therapies and medications such as TCAs (tricyclic antidepressants), SSRIs (selective serotonin reuptake inhibitors), and SNRIs (serotonin-norepinephrine reuptake inhibitors). However, some of these do not yield the intended improvements. Many of the pharmacological treatments have unpleasant side effects [25]. Furthermore, even with the extensive testing and long history of use of these conventional treatments, patients with depression can both improve and remit unexpectedly [26]. As for anxiety, these challenges suggest a need to explore new ways of thinking about therapy for depression, such as those offered by nature-based treatments.

The COVID-19 pandemic placed a heavy burden on health services including mental health services [27]. The main psychological and pharmacological therapies are heavily reliant on limited and often costly resources, leading to delays in treatment. While some service providers have responded creatively to the shortfall during the pandemic, for example, by moving CBT online to sustain the care processes [28], it is clear that mental health systems need further innovation [29]. Greater need and reduced availability should drive attention toward free and publicly accessible therapies that are not reliant on the availability of professional care processes. This rationalizes a need to consider the efficacy of nature-based therapies in a specific way.

Here, we systematically reviewed the literature for evidence of the effect of nature walks on anxiety and depression outcomes. Nature walks are walks on a trail in a natural setting such as forests, woodlands, or parks [30] that can take any time from 15 min [31] to a few hours [32]. Nature walks can be undertaken by diverse populations (e.g., cancer

survivors [32], university students [33]) and conducted in any season of the year [31,34]. We focused on nature walks as an example of a nature-based therapy because they are simple and low-risk to undertake and potentially accessible to many people [35,36]. As these practical aspects are crucial in the delivery of treatment, the mental health effect of nature walks was chosen to be evaluated in this review.

## 2. Materials and Methods

This systematic review followed the preferred reporting items for systematic review and meta-analysis guidelines (PRISMA [36]) to review the literature in an organized manner and assess the quality of evidence for the psychological effects of nature walks. Klassen, Jadad, and Moher's framework [37] was used to help maintain the validity of our findings, considering question, criteria, missing articles, quality of the studies, assessment, and results. The extended version of the PICO (population, intervention, control, and outcomes) format [38] was created to establish a researchable question by focusing on four key components [39]. The primary research questions for this systematic review are (i) "How effective are nature walks for depression and anxiety?" and (ii) "What quantity and quality of evidence has been reported?"

### 2.1. Literature Search

Following a consultation with a subject librarian [40,41], four research databases—ProQuest, PsycINFO, Science Direct, and Google Scholar—were accessed via EBSCO to conduct a comprehensive literature search, focusing on where, when, who, how, what, and why [42,43]. Articles published before 31 October 2020 were considered in this systematic review. Three hundred and eighty-three articles were retrieved with search terms "nature" AND "walk" AND "psychology\*" ( $n = 333$ ) as well as "forest" AND "walk" AND "psychology\*" ( $n = 50$ ) in the title and abstract (other words such as "grassland", "coastal", "greenspace", and "woodland" were searched combined with "walk" AND "psychology\*"; however, only a small number of articles were retrieved, and none were eligible). Additionally, manual reference searches in published reviews [43,44] identified two articles [40]. Of a total of 385 articles, 44 were duplicates and therefore were removed. Three hundred and forty-one articles were screened for title and abstract, and 45 articles were reviewed in full text, which identified 12 articles that met all eligibility criteria (Figure 1). The co-author Y.K. completed the literature search, which was then reviewed by the co-author K.C.V.

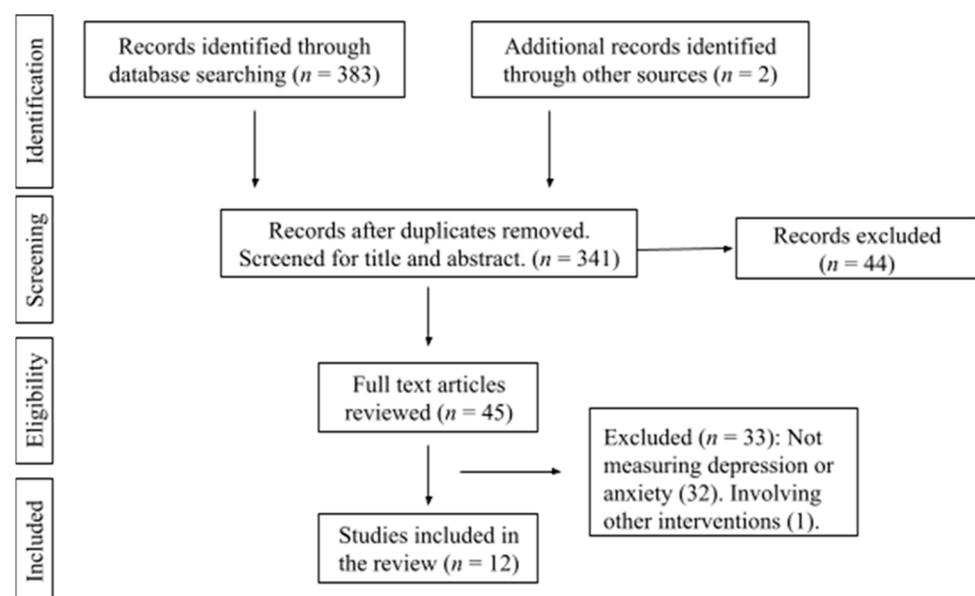


Figure 1. PRISMA flow diagram of the article selection process.

## 2.2. Selection of Studies and Outcomes

In order to be further analyzed, articles needed to (a) include a nature walk only, (b) measure depression and/or anxiety, (c) report an empirical intervention study (i.e., pre- and post-intervention scores of depression/anxiety), and (d) be published in a peer-reviewed academic journal written in the English language. Articles were excluded if they (a) included other nature-based interventions (e.g., shinrin-yoku), (b) did not measure either depression or anxiety, (c) used a single-participant design (i.e., case studies), and (d) did not examine an intervention (e.g., articles that only introduced and/or discussed concepts or research protocols) (see Table 1).

**Table 1.** Extended PICO for this review.

Review Questions	(i) How Effective Are Nature Walks for Depression and Anxiety? (ii) What Quantity and Quality of Evidence Has Been Reported?	
	Inclusion Criteria	Exclusion Criteria
Population	Any population	
Intervention	Nature walk only	Involving other nature-based interventions (e.g., shinrin-yoku)
Comparator	Any comparator including non-comparator	
Outcomes	Depression and anxiety	Other outcomes
Study Design	Empirical intervention studies	Single case studies, cross-sectional studies, qualitative studies, reviews, discussion articles, articles introducing theories/concepts/models/applications
Other	Published in a peer-reviewed academic journal in English	

## 2.3. Data Extraction and Synthesis

The co-author Y.K. conducted all the searches and reviewed all the search results. If the title and abstract of the article suggested a match with the eligibility criteria, the articles were shortlisted for further analysis ( $n = 45$ ). The co-author K.C.V. reviewed the selection process to minimize any potential bias. After K.C.V.'s review, full texts of the shortlisted articles were appraised by both co-authors independently, who then discussed and agreed which articles met the eligibility criteria. No additional eligible articles were identified in forward and backward reference searches.

Using a data extraction table, developed by Sturt et al. [45], key information of included studies was presented: publication details (authors, year, and country), study design and setting, participant characteristics, details of demographic data, intervention details, outcome measures, and study findings (see Table 2).

## 2.4. Quality Scoring: Assessing the Risk of Bias

The Newcastle–Ottawa Scale (NOS) was used to appraise the methodological quality and risk of bias [46]. Star marks (0–9) were used to indicate the quality scoring for each study (high risk: 0–3, medium risk: 4–6, low risk: 7–9) regarding: (a) representativeness of study group selection (four stars maximum), (b) comparability of groups (two stars maximum), and (c) ascertainment of either the exposure or outcome of interest (three stars maximum). Because the NOS was originally designed for medical research, some adjustments were made in this review focusing on nature walk: (a) the word “exposure” was changed to “intervention” (e.g., “Ascertainment of intervention”), (b) “Demonstration that outcome of interest was not present at start of study” to “Demonstration that the measured outcome was assessed before the intervention”; and (c) a star was given if the outcome was measured using a validated psychometric scale, instead of medical records, in the first item of “Outcome” (i.e., “Assessment of Outcome”).

**Table 2.** Study details of selected articles exploring the effects of nature walk on depression and anxiety (to be used in Results) (for details on “Nature/Urban exposure” and “Season”, see Appendix A).

No.	Year	Author(s)	Country	Sample and Setting	Intervention Details	Nature/Urban Exposure	Season	Measures	Findings
1	2020	Lesser et al. [32]	Canada	9 adult cancer survivors (8 females and 1 male).	2 trail walks per week (2.5 h a week) for 8 weeks with a hiking guide.	Forest—sloped area.	Not recorded.	Generalized Anxiety Disorder-7 and Visual Analog Scale	Significant reduction in state anxiety but not in generalized anxiety.
2	2020	Janeczko et al. [47]	Poland	75 university students (nonclinical) divided into either taking a walk in apartment suburbs; green suburbs; coniferous forest; or deciduous forest.	2-km walk (30 min) keeping distance to each other, not allowed to talk.	Urban: A1: single-family dwellings with more greenery. A2: multi-family buildings with less greenery. Forest: B1: coniferous forest; B2: deciduous forest.	One day. Late autumn (November).	Profile of Mood States (POMS)	Depression was reduced in all groups from pre- to post-walk. No difference was found among groups.
3	2019	Koselka et al. [48]	USA	38 participants (age range 18–35; 22.9 + 4.6 years; 20 females and 18 males; nonclinical) divided into (i) 50-min nature walk, (ii) 50-min walk on busy road, and (iii) activity of daily living. Crossover design.	50-min walk at moderate-intense pace with 9 days of washout period.	Busy road; forest.	Not recorded.	State-Trait Anxiety Inventory (STAI)	Nature walk reduced state anxiety.
4	2019	Song et al. [31]	Japan	12 female university students (age of the approaches sample ( $n = 60$ ) was $21.0 \pm 1.3$ years) walked for 15 min either in a forest or urban environment.	15-min nature walk and urban walk crossover next day.	Six locations, with a paired city and secondary forest site (mixed oak woodlands).	Summer.	POMS and STAI	Nature walk reduced depression and anxiety, and state anxiety significantly more than urban walk.
5	2018	Hassan et al. [33]	China	60 nonclinical university students (30 females and 30 males; mean age, $19.6 \pm 1.42$ years) randomly allocated to a 15-min nature or urban walk.	15-min nature walk and urban walk crossover next day.	Urban area; bamboo forest.	One day. Season not specified.	STAI	Nature walk reduced state anxiety.

Table 2. Cont.

No.	Year	Author(s)	Country	Sample and Setting	Intervention Details	Nature/Urban Exposure	Season	Measures	Findings
6	2018	Song et al. [49]	Japan	585 Japanese male students (Age $21.7 \pm 1.6$ years) walked for 15 min either in a forest or urban environment. Crossover next day.	15-min nature walk and urban walk crossover next day.	City areas were either downtown or near a train station; "Safe, well-maintained" forest areas.	Summer.	POMS and STAI	Nature walk reduced depression and anxiety, and trait anxiety significantly more than urban walk.
7	2016	Korpela et al. [50]	Finland	13 depression patients (9 females and 4 males; age range 29–59 years, M = 48, Md = 52 years).	2-h walk a week for 8 weeks	Park with a lake and ornamental plantings; urban woodland.	Recruitment in spring.	Beck Depression Inventory	Depression reduced from pre- to post-walk, and post-walk to 3-month follow-up.
8	2015	Bratman et al. [51]	USA	60 nonclinical adults (33 females and 27 males, total mean age = 22.9 years) randomly assigned to nature or urban individual walk for 50 min.	Participants were told to take good pictures to blind the intervention. Nature group comprised 30 participants (18 females and 12 males, total mean age = 22.8), and urban group also comprised 30 participants (15 females and 15 males, total mean age = 22.9).	Urban walk: adjacent to a major road. Nature walk: grassland, scattered shrub, and oak trees.	Equal spread across autumn, winter, spring, and summer.	STAI	Nature walk reduced anxiety, relative to urban walk (separate data on state and trait anxiety were not reported).
9	2015	Song et al. [52]	Japan	20 middle-aged hypertensive individuals ( $58.0 \pm 10.6$ years) walked for 17 min either in a forest or urban environment. Crossover next day.	17-min nature walk and urban walk crossover next day.	City; coniferous forest.	Not recorded (however, the average temperature of the forest was $24^{\circ}\text{C}$ and urban was $28^{\circ}\text{C}$ ).	POMS	Nature walk reduced depression and anxiety significantly more than urban walk.

Table 2. Cont.

No.	Year	Author(s)	Country	Sample and Setting	Intervention Details	Nature/Urban Exposure	Season	Measures	Findings
10	2015	Song et al. [53]	Japan	23 male university students (age $22.3 \pm 1.2$ years) walked for 15 min either in a forest or urban environment. Crossover next day.	15-min nature walk and urban walk crossover next day.	Park that contained many hardwood trees and a large pond; urban residential area.	Autumn (October)	POMS and STAI	Nature walk reduced depression and anxiety significantly more than urban walk.
11	2014	Marselle et al. [54]	England	1516 participants (66% were female, and 88% were aged 55 years or older) who had attended at least one session in the Walk for Health (WfH) program responded to online survey.	WfH attendee who continued to walk during the 13-month of the research period was defined as Nature Group Walker, and those who did not as Non-Group Walker. 1081 Nature Group Walkers and 435 Non-Group Walkers were identified.	Nature: "natural and semi-natural places, green corridor, farmland, urban green space, coastal, or a mixture of any of the above".	Not recorded.	10-item Major Depressive Inventory	Group nature walk reduced depression from T1 to T2.
12	2013	Song et al. [55]	Japan	13 male university students (nonclinical) aged $22.5 \pm 3.1$ years divided into park walk and city walk. Crossover design.	15-min walk in urban parks and city	Urban park—treed; city area.	One day. Late autumn (November).	POMS and STAI	Nature walk reduced anxiety (both POMS and STAI) but not depression.

### 3. Results

#### 3.1. Characteristics of the Studies

Of the 12 included studies, nine were pre-post within-subject studies [31–33,48–50,52,53,55], two were quasi-experimental studies [34,54], and one was an experimental between-subjects study [51]. Study location varied considerably (see Table 2), six studies were conducted in Asia (China and Japan), three were in North America (USA and Canada) and in Europe (England, Finland, and Poland). Nine of the studies compared a nature walk with an urban walk, one compared a nature walk with no walk, and one study included the assessment of the outcomes in a typical day that did not involve walking in any of the settings.

Regarding the psychological outcomes, eight of the included studies assessed anxiety through either the Generalized Anxiety Disorder-7 or the State-Trait Anxiety Inventory; two studies assessed depression using either the Beck Depression Inventory-II or the Major Depressive Inventory, and six assessed mood using the Profile of Mood States. Sample sizes were generally small (<100) for all but the Song et al. [49] and Marselle et al. studies [54].

Overall, the studies demonstrated that nature walks were successful in reducing state anxiety [31–33,48,51,55], but the effects on generalized, trait anxiety were mixed [32,49]. In six studies, a significant reduction in depression was also observed [31,34,49,50,52,53]. However, Janeczko et al. [47] reported a reduction in depression regardless of the type of walking (nature or urban). In fact, the impact of nature walking on depression appears to be less consistent and was not observed by Song et al. [55].

Regarding the environments where nature walks were undertaken, eight studies were in a forest or woodland [31–34,48,49,52,55], three studies included more than one type of nature [50,53,54], and one study was in a predominantly grassland environment [51]. There were water features present near the route in three studies [48,50,53]. Forest types varied considerably between studies, including a bamboo forest [33], deciduous trees [34,55], and coniferous forest [47], and four studies did not provide enough detail to determine the type [32,48–50]. Three studies were undertaken in autumn [34,53,55], three were in spring/summer [31,49,50], one study spanned four seasons but indicated little seasonal variation in the region [51], one likely varied but was not specified [54], and three did not specify, although images and descriptions implied trees were in leaf [32,33,48,52].

#### 3.2. Risk of Bias

The risk of bias of the 12 included studies was deemed to be medium to high (see Table 3). Five studies were deemed medium-risk [34,48,50,51,54], especially due to a lack of a control group and for assessing the follow-up immediately after the intervention. In only three of these studies was the representativeness of the sample adequately addressed [34,48,54]. Bratman et al.'s [51] scored particularly well in comparability. Marselle et al. [54] had the largest sample amongst all selected studies ( $n > 1000$ ), but the experimental group was twice as large as the control group, and the researchers did not measure the outcome before the intervention.

Finally, seven studies were deemed to have a high risk of bias [31–33,49,51,52,55]. Two studies conducted a within-subject design with small samples [33,55]. None of the studies assessed the outcome before the intervention and only tested the effect immediately after the intervention, not considering long-term effects.

Table 3. Assessment of risk of bias for intervention studies.

Author (Year)	Selection				Comparability	Outcome			Number of Stars (0–9)
	Representativeness of Exposed Cohort	Selection of Non-Exposed Cohort	Ascertainment of Intervention	Demonstrate Outcome Assessed before Intervention	Comparability of Cohorts on Basis of Design (*) or Analysis (*)	Assessment of Outcome	Follow-Up Long Enough	Adequacy of Follow-Up	
Lesser et al. (2020) [32]			*	*		*			3
Janeczko et al. (2020) [47]	*	*	*	*		*			5
Koselka et al. (2019) [48]	*		*	*		*			4
Song et al. (2019) [31]			*			*			2
Hassan et al. (2018) [33]			*			*			2
Song et al. (2018) [49]			*			*			2
Korpela et al. (2016) [50]			*	*		*	*	*	5
Bratman et al. (2015) [51]		*	*	*	**	*			6
Song et al. (2015) [52]			*			*			2
Song et al. (2015) [53]			*			*			2
Marselle et al. (2014) [54]	*	*	*		*	*			5
Song et al. (2013) [55]			*			*			2

\* (star mark) indicates that the study addressed the assessment item.

#### 4. Discussion

This systematic review examined the quality and extent of evidence in studies investigating the effects of nature walks on depression and anxiety. Only 12 studies were identified focusing specifically on an empirical evaluation of this intervention and reported in English language peer-reviewed journals. Nature walks were found to reduce state anxiety consistently but not generalized anxiety. There were no clear effects of nature walks on depression in these studies. The small sample size and large variation in approach to the studies mean it is not possible to draw conclusions about the type of nature walk that would be most beneficial or who would benefit most from these.

The health benefits of spending time in nature [56–58] and of walking [59,60] are well established. This review has found there are very few studies focusing specifically on walking in nature for two specific mental health outcomes: anxiety and depression. Consistent with studies focused just on walking, the effects on anxiety and depression reported in studies included in this review were positive or neutral [61,62]. As reported in a meta-analysis on forest bathing [63], anxiety was the one mental health condition for which nature walks were consistently reported to be beneficial. More specifically, the current review identified that nature walks were effective for state anxiety but not for generalized anxiety. This may be explained by the soothing effects of phytoncides,

antimicrobial organic compounds released from plants [64], which are known to reduce stress and anxiety [64]. Indeed, phytoncides were also related to reduced depression on a self-report measure [65]; however, more robust biological evidence supports a link between phytoncides and anxiety [66]. Further research is needed to examine these specific pathways through which nature walks provide mental health benefits.

A number of reviews looking at the physical and mental health benefits of walking have identified a lack of consistency in study design and could therefore not draw strong conclusions about the benefits and most effective interventions [67–69]. This challenge is reflected in our review, where studies varied substantially in the participant group composition and the intervention details. Participant groups included people with pre-existing physical health conditions (cancer [32]), pre-existing mental health conditions (depression [50]), any participant (but health controlled for [54]), or primarily healthy subjects. Variation in participant groups made drawing any conclusions particularly difficult in relation to depression outcomes, which were examined in only three studies. Marselle et al. [54] found group walks in nature to be a strong predictor of lower depression symptoms, while two studies focused on individuals found opposite effects of nature walks on depression symptoms [34,55]. It is possible that walking in a group was the important aspect of Marselle et al.'s study [54], although Janeczko et al. [47] also found lowered depression symptoms on individual walks, and previous work has similarly found inconclusive results of the benefits of group over individual activity [61]. A previous systematic review has found walking to reduce depression symptoms [61] and that exercise more generally is important in reducing depression symptoms [70,71], and it may be that the act of walking rather than the environment the walk is in is what is important for depression. There is insufficient evidence from the studies included in this review to draw a robust conclusion.

The details of the intervention varied between studies. Lesser et al. [32] involved walks up notable slopes, while two studies noted the route was flat [33,51]. Walk duration varied from 2.5 h a week over multiple weeks [32] through to a single, 15-min route [33,55]. Janeczko et al. [47] found walking duration to have an important effect on all outcomes, indicating these interventions are not comparable. The appropriate time “dose” of walking is not well understood [62], and our review suggests the methodological approach needs to be strengthened in future studies. This information is available for exercise more generally [70], and methodological approaches could be extrapolated to the nature walk context. None of the studies in this review compared walking to other treatment approaches (pharmacological treatments or psychological therapies) although previous work has suggested that treatment of depression with exercise may be most effective when combined with a pharmacological approach [68]. Another aspect of the studies related to time is the duration of effect. None of these studies assessed long-term effects of any of the interventions, although one did indicate the study was a pilot, and the intention was to follow up with a longitudinal study [48], which would be a welcome addition.

A key benefit identified for nature-based therapies is that they are free and publicly accessible, in principle. Nature is not equally accessible to everyone, however [72], and even where some form of nature is available it is not always of the same “quality” [73]. In working toward recommendations for nature-based health interventions, it is important to understand what nature is most beneficial to address both equity of provision and to consider health outcomes in the context of other functions and benefits provided by both greenspace [74] and blue space [75]. It was not possible in this study to look for effects of particular types of natural environment as the environment varied considerably between studies, from the broad vegetation type (e.g., forest vs. grassland), the inclusion of additional features (e.g., water), and the season of study (autumn vs. spring/summer) (Appendix A). There is a growing body of literature suggesting that people's response to nature varies depending on very specific measures of the environment, including vegetation structure [76,77], leaf color and shape [78], season [79], perceived biodiversity [80,81], and infrastructure on and management of the site [82]. Within the included studies, only

one directly controlled for different aspects of the environment in their site selection [47], and only a subset measured additional features of the environment [33,34,55]. In most of the reviewed studies, it is not possible to separate out the influence of the different aspects of the environmental conditions in the walking environments that may have been providing any benefit. For example, two studies compared a nature walk with a walk by a busy road [51,55]. These two environments differ on a wide range of metrics including temperature, humidity (measured in Song et al. [55], Hassan et al. [33], and Janeczko et al. [47]), light levels (measured in Song et al. [55]), noise pollution (measured in Janeczko et al. [47]), air pollution, physical disturbances (e.g., passing cars), colors, and shapes of the visual landscape. To parse out the relative importance of these features, studies testing the different elements of the environment would be beneficial. Future studies addressing the types of vegetation, vegetation context (including associated infrastructure), the season, and the levels of biodiversity most beneficial for achieving health benefits from nature walks would be important contributions to the literature [74,80,83].

As outlined above, the studies included in this review were not sufficiently comparable in study design, participant selection, or intervention approach to draw robust conclusions about the benefits of nature walks as an intervention for anxiety or depression. The consistently positive effect of nature walks on state anxiety measures combined with the medium to high risk of bias in the majority of studies included in this review suggest a need for more targeted research in order to develop recommendations for health practice. Despite the small number of studies, three continents were included (Asia, North America, and Europe). Variation in effect between continents, country, and climatic region is an area where future research would be beneficial. Consistent patterns across regions could be sought by focusing on the environmental conditions and specific measures of the natural environment (as above). None of the studies were randomized controlled trials. One study did blind the participants to the purpose of the study. The mental health benefit of walking in nature is a growing area of research and is reflected in the publication dates of the studies included in this review, six of which were published in the last four years and all published within the last nine years. There is a great deal of scope for undertaking more controlled studies on this intervention for this area to continue to develop.

This review had four primary limitations. The first is that only studies published in English-language academic journals were included. The number of studies missed because of this is not known. The second is focusing on articles that are studying walks exclusively. This strengthens the conclusions as the results can be confirmed to focus on walks, but studies that report outcomes of nature walks in conjunction or addition to other interventions may have been missed (e.g., studies that combined walking and viewing [84]). The third limitation is in the specific aims of the included studies. While the broad goal of all studies was to look at the effects of a nature or forest walk, the variation in how these were measured reflects differences in the specific aims. Nine of the studies focused on comparing the relative effects of a nature walk in contrast to an urban walk [31,34,45,47–49,52,53,55], two studies compared measures before and after a walk [32,50] and one study compared walking to not walking [54]. As the literature on this topic grows, teasing apart these different comparisons would be worthwhile. Lastly, this study did not focus on “park walks”, as the richness of nature can be significantly limited in some parks: indeed, some of the included nature walk studies in this review were conducted in the park; however, the richness of nature was reported. Close examination of park walk literature can offer additional insights.

## 5. Conclusions

The 12 studies identified through this review focused specifically on the effects of nature walks on anxiety and depression and suggest that state anxiety can be reduced through nature walks. The effect of nature walks on generalized anxiety was mixed. The evidence for effects of nature walks on depression symptoms was inconclusive. The low number of studies with high variability in the subjects and the type of nature subjects were

exposed to in these studies suggest more work is required. Given the global challenges to healthcare systems of anxiety and depression and the relatively cost-effective treatment intervention of a walk in nature, the establishment of a more robust research base on this topic is warranted.

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## Appendix A

**Table A1.** Selected articles exploring the effects of nature walk on depression and anxiety with study details. Full study details are in Table 2 of the main text. Here, “Location” is added, and “Nature/Urban exposure” and “Season” are expanded to include more detail from the papers.

No.	Year	Author(s)	Country	Location	Nature/Urban Exposure	Season
1	2020	Lesser et al. [32]	Canada	Participants from Fraser Valley, British Columbia, Canada	“Lush green old growth forest”. Sloped.  Urban: A1 “among single-family buildings with lots of greenery”, “noticeably higher level of noise, the presence of a wide two-lane street, dominating apartment blocks and a smaller share of green space”, green ratio = 12.62%; A2 “multi-family buildings dominated and the share of greenery was smaller”, “a quiet community with detached houses and green areas”, green ratio = 10.5%.	Not recorded. Description suggests trees are in leaf.
2	2020	Janeczko et al. [47]	Poland	Warsaw	Forest: B1: Kabaty Forest coniferous forest, “species composition is dominated by pines accompanied by oaks and a share of younger birches and a multitude of limes”, green ratio = 0.58%; B2: Sobieski Forest, deciduous forest, “dominated by broadleaved species, with an old forest, 120–160 years old, and numerous types of trees, such as oaks, pines, and beeches”, green ratio = 0.0%. Sample photos and aerial images included.	One day. Late autumn (November). Outdoor temperature 10 a.m. 9.2 °C at 10 a.m. in urban areas, 8 °C in the forest. Also recorded: pressure, wind speed, humidity, sound, and light.

Table A1. Cont.

No.	Year	Author(s)	Country	Location	Nature/Urban Exposure	Season
3	2019	Koselka et al. [48]	USA	Evanston, IL	Both started “parking lot of Harms Woods (George F. Nixon Woods)” Busy road “crossed Harms Road . . . and walked east, on the sidewalk of Old Orchard Road. This road is a busy 4 lane road that passes over Interstate 94 as it approaches a large shopping mall approximately 1 km away”. Forest preserve. “Participants assigned to walk in the forest walked north from the parking lot on a well-groomed gravel trail into the woods along the North Branch Trail . . . , which follows the Chicago River . . . . After walking north for approximately 500 m, they crossed a footbridge over the river then walked south on the graveled trail for approximately 750 m . . . . Distances walked along both routes varied depending on each participants’ pace.” Sample photos included. Each location had one city site, one forest site.	Photos indicate trees are in leaf.
4	2019	Song et al. [31]	Japan	Six locations: Iwate, Gifu, Hyogo, Ibaraki, and Kanagawa (2 locations)	Forests: Iwate (secondary forest (red pine and oak) and artificial forest (larch)); Motosu (secondary forest (oak and cherry)); Hyogo (secondary forest (oak and maple)); Ibaraki (secondary forest (red pine and oak)); Kanagawa 1 (secondary forest (red pine and oak)); Kanagawa 2 (secondary forest (oak) and artificial planting (ginkgo))	Summer (5 August to 6 September). Variable conditions. Also recorded: weather, temperature, humidity, and illuminance.
5	2018	Hassan et al. [33]	China	Chengdu	Urban area “that included many traditional buildings”. “Well-managed” bamboo forest Sample photos included. Flat.	One day. Season not specified. Temperature: 22 °C in the bamboo forest; 27 °C in the urban site. Humidity also recorded.
6	2018	Song et al. [49]	Japan	52 locations all over Japan (map provided)	City areas were either downtown or near a train station; “safe, well-maintained” forest areas, representative of the region. Park area: “a lakeside arboretum with flowerbeds, bushes and old trees surrounding a nineteenth-century former manor house”.	Summer.
7	2016	Korpela et al. [50]	Finland	Tampere	Urban woodland: “area with old trees and views over the lake is on a ridge with a 1920’s sight-seeing tower”. Both within three km of the city center.	Recruitment in spring.
8	2015	Bratman et al. [51]	USA	San Francisco Bay Area	Urban walk: “a main thoroughfare through Palo Alto, a busy street with three-to four lanes in each direction and a steady stream of traffic (El Camino Real)”. Nature walk: “a park near Stanford University (known as “The Dish”) along a paved path through grassland with scattered shrubs and oak trees”. Both on “fairly level ground”. Sample photos included.	Equal spread across autumn, winter, spring, and summer. Little climatic variation between seasons due to location. Season not analyzed. Not raining.

Table A1. Cont.

No.	Year	Author(s)	Country	Location	Nature/Urban Exposure	Season
9	2015	Song et al. [52]	Japan	Nagano	City; coniferous forest with Japanese cypress trees (Akasawa Shizen Kyuyourin; Akasawa natural recreation forest). Image provided.	Not recorded. Average temperature: forest was 21.4 ± 1.2 °C, urban was 28.1 ± 1.1 °C. Humidity also recorded. Autumn (7, 15, 16 October). Variable weather.
10	2015	Song et al. [53]	Japan	Chiba	Park (Kashiwa-no-ha Park) that contained many hardwood trees (e.g., maple, tulip trees, cherry trees, and chestnut) and a large pond; urban residential area.	Temperature: park 18.0 ± 1.7; city 19.2 ± 1.9. Humidity and illumination also recorded.
11	2014	Marselle et al. [54]	England	Whole country.	Nature: “natural and semi-natural places, green corridor, farmland, urban green space, coastal, or a mixture of any of the above”.	Not recorded.
12	2013	Song et al. [55]	Japan	Chiba	Urban park. Kashiwanoha Park. Treed. City area. Images provided.	One day. Late autumn (November). “Trees in the park had either lost their leaves or the leaves had turned red or yellow”. Sunny. Temperature: 14.0 °C in the city, 13.8 °C in the park. Humidity and intensity of illumination also reported.

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