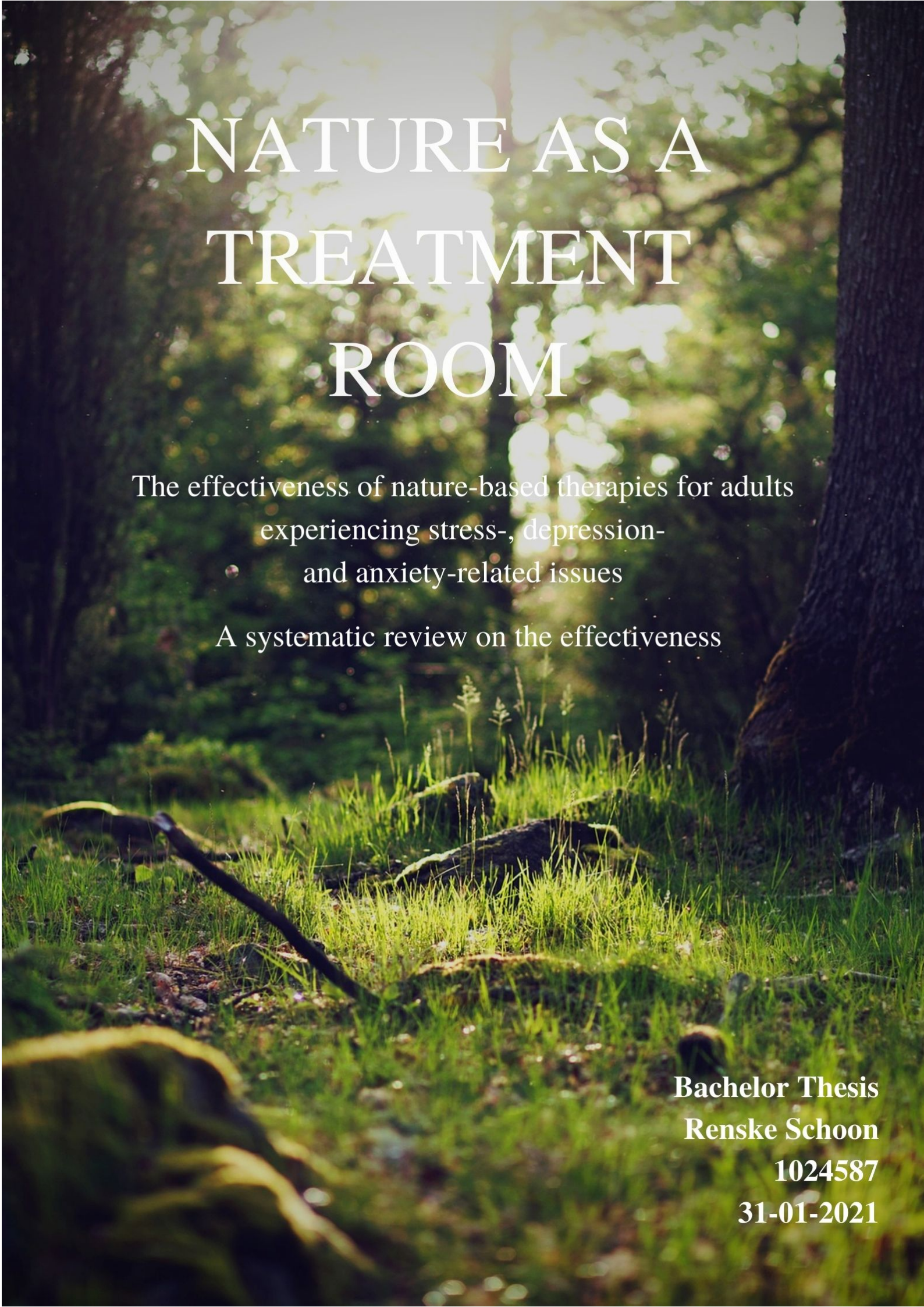

NATURE AS A TREATMENT ROOM

The effectiveness of nature-based therapies for adults experiencing stress-, depression- and anxiety-related issues

A systematic review on the effectiveness

Bachelor Thesis
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1024587
31-01-2021

Preface

Right now, you are reading the preface of my written report about Nature-Based Therapy, in which I tried to find answers to the following research question *'What is the effectiveness of Nature-Based Therapy on adults experiencing stress-, depression- and anxiety-related issues, according to the literature?*'.
I wrote this report as my graduation thesis, to graduate for my Bachelor study in Health and Society at the Wageningen University. This study is a systematic review, in which I tried to collect as many as possible studies to include in my thesis and so, to formulate a fulfilling answer to my research question. I was engaged in researching and writing this thesis from approximately May 2020 to March 2021. I extended writing my thesis over a longer time period than students usually do, due to a board year at my student association I was in the middle of since July 2020, and due to struggles in taking rest and concentrating on tasks before the summer holidays of 2020. I found it difficult to work on my thesis during the lockdown times before the summer break, and combining working at home on my thesis and less relaxation time made me quite exhausted and sad. I am happy to tell you, that I am feeling much better now almost a year later, and that right now you are reading my final graduation thesis, which I am very proud of and put a lot of effort into.

I want to thank my two great supervisors, Roald Pijpker and Lenneke Vaandrager, for helping me with formulating my research question and for giving me helpful feedback during the writing process. They also supported me in taking the rest I needed but also motivated me to go on with my thesis because of their enthusiasm for the research subject.
I also want to thank my great friends, that supported and helped me to work on my thesis before the summer break and during my board year. On my free days of the board on Thursday, I studied with them at the campus, that helped me to focus and have fun while I was writing my thesis. I also want to thank the beautiful nature around Wageningen for giving me rest, inspiration and concentration during the writing process (when you have read the results and discussion section of my thesis, you will understand why).

I hope you enjoy reading my thesis, and I hope that you will become as enthusiastic about the future of NBT as I am!

Kind regards,

Renske Schoon

Wageningen, March 2021

Abstract

Objectives The worldwide number of people experiencing stress-, depression- and anxiety-related issues worldwide is growing. To tackle the issues regarding the quality, availability and costs of mental health care, NBTs are seen as a possible solution. Yet, evidence on the effectiveness of NBT is lacking for people experiencing mental health issues. Because of the knowledge gap in the effectiveness of NBT on people experiencing depression-, anxiety- and stress-related issues, this study aimed at answering this question. ***Methods*** This study was a systematic review in which ten studies with various study designs were included to obtain an as broad as possible insight in the effectiveness of NBT. Four studies were RCT's, one study had an experimental design, three studies were longitudinal studies and two studies were case studies. The included articles were screened on quality and summarized by their study characteristics. The results are compared to existing theories about the effect of nature on mental health, and the six-step model of the NBT process. ***Results*** This study shows significant positive effects on mental health state and well-being, and that significantly decreases in the experience of negative emotions/feelings as stress and depression. Besides, the study shows that NBT helps in restoring mindful or behavioural functions as attention capacity, daily functioning and improvements in stress management. ***Conclusion*** On the basis of this research can be concluded that there are clues that NBT could be effective in the recovery of stress-, depression- and anxiety-related issues of adults. This study provides small evidence for the promising function/effect NBT could have in the recovery of adults experiencing depression-, anxiety- and stress-related issues. Further research is needed to the effectiveness and effective elements of NBT to find out what place NBT can take in in society's problems regarding the availability and quality of mental healthcare.

Key words: nature-based, stress, depression, anxiety, horticultural, forest therapy

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Introduction

At the moment, mental health issues is one of the main contributors to disability globally (World Health Organisation [WHO], 2019). The WHO predicts that in 2021, non-communicable diseases (NCDs) including poor mental health, will become the leading cause of death worldwide (WHO, 2019). Mental health issues entail among others depression-, anxiety, bipolar-, schizophrenia-, and stress-related problems, of which depression- and anxiety related problems have the highest prevalence worldwide (Our World in data, 2018). Of the 792 million people experiencing mental health issues globally, 264 million people experience depression-related problems and 284 million people experience anxiety-related problems (Our World in Data, 2018). In the past twelve months in the Netherlands, anxiety disorders and mood disorders have the highest prevalence of all mental disorders: ten percent of people experienced a type of anxiety disorder, and six percent a type of mood disorder, of which 5,2 percent experienced depression (Trimbos-Instituut, 2020). Depression and anxiety disorder are two types of mental health disorders that can be caused by psychological responses to chronic stress of an individual (Korte, Koolhaas, Wingfield & McEwen, 2005; Oh et al., 2020). Therefore, the prevention or treatment of chronic stress of individuals is important in the prevention of developing depression or an anxiety disorder.

Besides that mental health issues are devastating for mental health, they also repeatedly co-occur with other NCDs (WHO, 2019). According to the WHO (2019), mental health issues and other NCDs share a few risk factors regarding lifestyle. A few examples of these risk factors are high tobacco and alcohol use, poor diet and a lack of physical activity (Bonet et al., 2005; Scott & Happell, 2011). These risk factors can possibly lead to more serious physical health issues: tobacco use increases the risk of getting various kinds of lung diseases and cancer (Hylkema, Sterk, de Boer & Postma, 2007), poor diet can lead to cardiovascular problems and obesity (Fahrud, 2015) and a lack of physical activity can lead to various kinds of cancers and cardiovascular diseases (Lee et al., 2012). These studies show that the prevention and treatment of mental health issues, is a key strategy in the prevention of more severe mental and physical diseases. So, accessible mental health care for patients experiencing mental health issues is important.

Unfortunately, current forms of mental health care are not always sufficient or directly accessible for patients experiencing mental health issues in various countries. For example in the United Kingdom (UK) and the Netherlands, the waiting lists for gaining access to mental health care are long. In the UK, waiting times can lead up to more than a year, sometimes even to two years (Mental Health Foundation [MHF], 2006; Vasilakis et al., 2013). In the Netherlands, the waiting time between enlisting oneself for therapy and the first intake can be four to even thirteen weeks for certain mental disorders, while the maximum period of waiting for the first intake must be four weeks (according to the 'Treeknorm') (De Nederlandse Zorgautoriteit [NZa], 2018). Also, the total waiting time between signing up for therapy and the start of the treatment, must be within fourteen weeks according to the Treeknorm, but these waiting times exceed this norm to even 22 weeks for certain mental health disorders (NZa, 2018). Besides, standard forms of therapy like Cognitive Behavioural Therapy (CBT) are not suitable for every patient. These standard forms of therapy are given in indoor spaces, during which the health practitioner and the patient talk face to face, mostly in rooms with windowless walls (Cooley, Jones, Kurtz & Robertson, 2020; Berger & McLeod, 2006). This formal and clinical setting makes some patients feel uncomfortable, and is rather anxiety-evoking and intimidating than comforting for them (Cooley et al., 2020).

A problem regarding the affordability of mental health care, is that mental health care costs in various worldwide countries are high and still growing (Organisation for Economic Cooperation and Development [OECD], 2014). Mental health care costs in the OECD countries represented between 5% and 18% of total health expenditure in 2014 (OECD, 2014). These mental health care costs bring along even higher costs than these percentages for two reasons. Firstly, mental health patients are at greater risk for developing various chronic diseases as mentioned before: these chronic diseases will bring along more health care costs. Secondly, mental health issues contribute to direct and indirect economic losses. The direct costs are the costs of mental health care that patients receive, and the indirect costs are the

costs that mental health patients bring due to less productivity at work or absenteism (OECD, 2014). In the Netherlands, of all mental disorders, mood disorders and anxiety disorders primarily lead to high absenteism rates (Trimbos-Instituut, 2020). According to the WHO (2017), low levels of recognition and access to mental health care for people experiencing depression and anxiety, result in large global economic losses.

To tackle these issues regarding the access and affordability of mental health care, and to prevent more serious (mental) health problems, nature-based therapies (NBTs) are offered as a possible solution (Berger & McLeod, 2006; Oh, Shin, Khil & Kim, 2020). NBT is at the moment not accepted as a mainstream therapy form because the evidence for its effectiveness is lacking, which is something that should be changed when seeing the positive effects nature has on mental health and well-being (Oh et al., 2020). In this study, the definition of NBT by Annerstedt & Währborg (2011) is used: 'An intervention with the aim to treat, hasten recovery, and/or rehabilitate patients with a disease or a condition of ill health, with the fundamental principle that the therapy involves plants, natural materials and/or outdoor environment, without any therapeutic involvement of extra mammals or other living creatures' (p.372). The therapeutic involvement of extra mammals or other living creatures (also called animal-assisted therapy) (Annerstedt & Währborg, 2011), is left out of this study. Another aspect that defines nature-based therapy, is that a professional health practitioner is involved in the therapy. When no health practitioner is involved in the outside therapy, the activity is rather called 'therapeutic' than 'therapy' (Cooley et al., 2020).

NBT has several synonyms, among these are 'nature-assisted therapy (NAT)', and `nature-guided therapy' (Annerstedt & Währborg, 2011; Cooley et al., 2020). There are various forms of NBT that differ in content and the way they are given. NBTs can be given in groups (for example horticultural therapy, during which participants work in a therapy garden together with natural materials) or individually (for example forest therapy, during which participants solely walk and/or sit in silence in forests). Furthermore, NBTs can have a low to high extent to which nature is involved in the therapy (Cooley et al., 2020; Schwenk, 2019). NBTs are promising to be effective in tackling the above discussed issues for several reasons.

Firstly, nature has a beneficial effect on health and well-being. Nature can among others restore cognitive functions, improve subjective health and can lead to stress reduction (Pálsdóttir, Stigsdotter, Persson, Thorpert & Grahn, 2018; Oh et al., 2020). Furthermore, contact with nature reduces depression and negative emotions, and increases positive emotions (Oh et al., 2020). Secondly, NBT could possibly have a positive health effect for both patients and health practitioners, because they are both physically active during the therapy in an outside environment (Cooley et al., 2020), but evidence for this is lacking. However, there is evidence for the positive effect of physical activity on mental and physical health, physical activity brings with stress relief and various health benefits as lower chance of cardiovascular diseases and other noncommunicable diseases (Hassink et al., 2017; WHO, 2019).

Thirdly, the different sitting in which NBT takes place, may tackle the problem of the too static and too formal setting of current given forms of therapy. In NBT, the setting in which the therapy takes place is in the ownership of both the patient and therapist and so contributes to a mutual relationship between the patient and health practitioner (Cooley et al., 2020). The natural environment as therapy setting, broadens the standard indoor setting of therapy forms.

Fourthly, NBT is a therapy with a holistic approach in which the mind and the body are seen as one and are both involved in the therapy, which has several positive effects for both mental and physical health (Cooley et al., 2020).

Fifthly, NBT gives rise to the idea that it can be a treatment option with minimal adverse side-effects (such as side-effects due to medication use) in comparison to standard therapy forms (Maund et al., 2019). Besides, Maund et al. (2019) discuss on the basis of their nature-based intervention, if NBT could also be a low-cost treatment form. From the cost-benefit analysis of their study intervention, no conclusions regarding the costs and benefits of NBTs can be drawn. Therefore, they call for more research to determine these costs and benefits of NBTs (Maund et al., 2019). If future research proves that NBT is a low-cost treatment option, NBT could help tackle the problem of the growing health care costs, but this is yet a point of discussion.

Research done to nature-based therapies is still in its infancy and several studies call for more studies to investigate the effectiveness of different forms of nature-based therapies (Maund et al., 2019; Corazon et al., 2018; Revell & McLeod, 2017; Sahlin, Matuszczyk, Ahlborg & Grahn, 2012). Especially

more evidence of the effectiveness of NBTs on adults experiencing depression and anxiety disorders is asked by Maund et al. (2019), and more evidence to the effectiveness of NBTs on adults experiencing stress-related issues by Pálsdóttir et al. (2014).

Besides that here is a knowledge gap, it is worth studying the effect of NBTs on these adults because of the high prevalence of depression and anxiety disorders worldwide and in the Netherlands, and the relationship of those mental health issues with the experience of chronic stress (Our World in Data, 2018; Trimbos-Instituut, 2020; Korte et al., 2005). Furthermore, the (in)direct economic losses due to people experiencing depression and anxiety disorders are high worldwide and in the Netherlands (Trimbos-Instituut, 2020; WHO, 2017).

Therefore, the aim of this study is to synthasize the effectiveness of different forms of NBT for adults (aged 18 to 65 years) experiencing stress-related, depression-related and anxiety-related issues. This leads to the following research question:

'What is the effectiveness of nature-based therapy for adults experiencing stress-, depression- and anxiety-related issues, according to the literature?'

This literature review can be used to discover why NBT can possibly be a promising form of therapy in mental health care. Besides, the information this systematic literature review brings, can be used to better adjust the forms of NBT to the individual patient's needs. In the long term, this knowledge on the effectiveness and usability of NBT can lead to a better quality of mental health care. Additionally, in the long term, the use of NBT forms in mental health care could possibly lead to shorter waiting lists for treatment, and to lower (mental) health care costs.

Theoretical framework

The six-step model of the nature-based therapy process

The lens through which the effectiveness of NBT is explored, is the six-step model of the nature-based therapy process by Oh et al. (2020) (see figure 1). This six-step model of the nature-based therapy process, will be used as a perspective to investigate the effectiveness of NBT forms on the recovery of mental health issues. The model provides insight in the different stages of rehabilitation of mental health issues people go through when they engage in NBT, and in what way nature influences the recovery from mental health issues. The model is based on a broad study to the effectiveness of NBT in treating mental health issues of the study participants (N=180) and covers various core elements of nature that could possibly help in treating mental health issues (Oh et al., 2020). One of these core elements, is the stimulating effect nature has on experiencing positive emotions like happiness (Oh et al., 2020). Because the model is recently published (this year), it is based on made assumptions based on the study results of Oh et al. (2020) and lacks substantiated evidence from other studies. Therefore, in the following paragraphs, the six-step model will be substantiated by earlier published validated theories.

The three pathways

According to the six-step model, nature would influence mental health in three ways: via an emotional, cognitive and behavioural pathway. In the following paragraphs, these pathways will be explained,

The emotional pathway

The emotional pathway is the way in which nature influences emotions positively: nature makes people experience less negative emotions as anger, and more positive emotions, as happiness (Oh et al., 2020). The emotional pathway is linked to the psychological mechanism 'communication with nature'. Another yet validated older theory that explains the positive influence nature has on emotional well-being, is the Stress Reduction Theory (SRT) by Ulrich et al. (1991). According to this theory, natural environments would have a stress-reducing or stress-restorative effect on individuals experiencing stress. This study carried out in 1991, found that individuals recover faster and more complete from stress both physically and emotionally, after exposure to natural environments than to urban environments (Ulrich et al., 1991). These results were in line with another theory about the beneficial effect of nature on emotional well-being: the Psycho-Evolutionary Theory (Ulrich, 1991). According to the PET, nature affects the emotional state positively: people feel more calm and stress-free after being in a nature than after being in an urban environment (Ulrich, 1991). Additionally, according to the PET, nature leads to positive changes in physiological activity, such as a faster lowering in heart rate after visiting a natural environment than an urban environment (Ulrich, 1991).

The cognitive pathway

The cognitive pathway is the way in which nature makes people think differently and makes people reflect on themselves (Oh et al., 2020). The cognitive pathway is linked to the psychological mechanism 'communication with oneself'. A yet validated older theory about the cognitive healing effect of nature, is the Attention Restoration Theory (ART) by Kaplan (1995). According to the ART, there are two types of human attention: the directed/voluntary attention, which is cognitively intense, and involuntary attention, which requires no cognitive effort (Kaplan, 1995). According to the ART, environments rich of natural stimuli are intrinsically fascinating, and so naturally evoke human's involuntary attention. This phenomenon is called 'soft fascination' (Stevenson, Schilhab & Bentsen, 2018; Kaplan, 1995). The decrease in attention capacity of humans is often caused by stress and mental fatigue, and leads to a decrease in the ability to solve problems and can lead to experience of several negative emotions like anger (Kaplan, 1995; Oh et al., 2020). Mental fatigue is a type of fatigue that is caused by a combination of a too big demand on cognitive processes, and a lack of cognitive rest by actions that are cognitively effortless (Kaplan, 1995).

By evoking human attention, the natural environment can rapidly recover and restore human's attention capacity (Kaplan, 1995). In this way, exposure to natural environments leads to a shift in focus on other life activities than cognitively demanding tasks, to mind wandering, and to increase in direct attention

functions like concentrating and avoiding distractions (Kaplan, 1995). This mind-wandering can help to think differently and helps to see things more clearly again, this is in line with the cognitive pathway of the six-step model (Oh et al., 2020; Kaplan, 1995).

The behavioural pathway

The behavioural pathway is the way in which nature, through the emotional and cognitive pathway, would make people's behaviour change (Oh et al., 2020). As the final steps of the six-step model, the behavioural pathway may lead to recovery of (mental) health issues and to life changes. This pathway is linked to the psychological mechanism 'communication with the world'. Another theory about the way nature influences human well-being and behaviour, is the Biophilia Hypothesis by Wilson (1993). The Biophilia Hypothesis claims that humans are attached to nature and that they have a nature-returning instinct (Wilson, 1993). Because of this instinct, humans would be able to instinctly feel calm and in connection with nature (Wilson, 1993). This may possibly lead to positive effects for emotional and physiological well-being of humans (Wilson, 1993), and so may lead to behaviour change, according to the behavioural pathway. Note: the three above explained pathways of the six-step model, are not yet validated and more research is needed to discover if the recovery of mental health issues by NBT actually takes place in this way.

The six stages

The recovery from mental health issues, according to the six-step model, would go through six different stages. The six stages are in the right order: Stimulation, Acceptance, Purification, Insight, Recharging and Change (see figure 1). The three pathways would correspond with different steps in the model: the emotional pathway covers the first three steps of the model, the cognitive pathway the third and fourth step, and the behavioural pathway the fifth and sixth step (Oh et al., 2020). The six steps will be explained in the following sections.

The first step is 'stimulation', which includes the experience of positive emotions, the change of mind and body, and recovery of emotions and senses in nature. People experience feelings as happiness and joy, and besides that, nature would make physical complaints like fatigue disappear and makes people feel refreshed and alive. This step is an important first step in the model, because people visit natural environments more frequently and actively due to these positive influences on their mood and health (Oh et al., 2020).

The second step is 'acceptance'. In this step, people experience receptive feelings in nature, like consolation and a feeling of comfort. People would feel accepted in nature for who they are, and can relax or come to peace in natural environments (Oh et al., 2020).

The third step is 'purification'. In this step people would overcome and let go their negative energy and emotions. Their mind and emotions will be cleansed and therefore can lead to for example stress relief. This step can possibly lead to insights in one's thoughts and emotions, and makes people more neutrally see themselves and reflect on themselves (Oh et al., 2020).

The fourth step, is 'insight'. This step is the most important step in the nature-based therapy process, because it would make people reflect on themselves which can lead to change of own thoughts, which is an important step to recovery of mental health issues (Oh et al., 2020).

The fifth step is 'recharging'. Nature would make people feel hopeful and more self-confident, and nature gives them power and makes them courageous. This positive energy leads to people developing a desire for life, and makes them go back into the world that they were afraid of before (Oh et al., 2020).

Following is the last and sixth step: 'change'. In this step, people recover from their mental health issues, and changes in their mental health occur. People begin to value their life differently and begin to see it as more satisfying than before. That people begin to evaluate their life differently, is due to changes that occur in for example relationships with others, new challenges and accomplishments. These life changes lead to self-realization, which makes people feel more in control over their life (Oh et al., 2020).

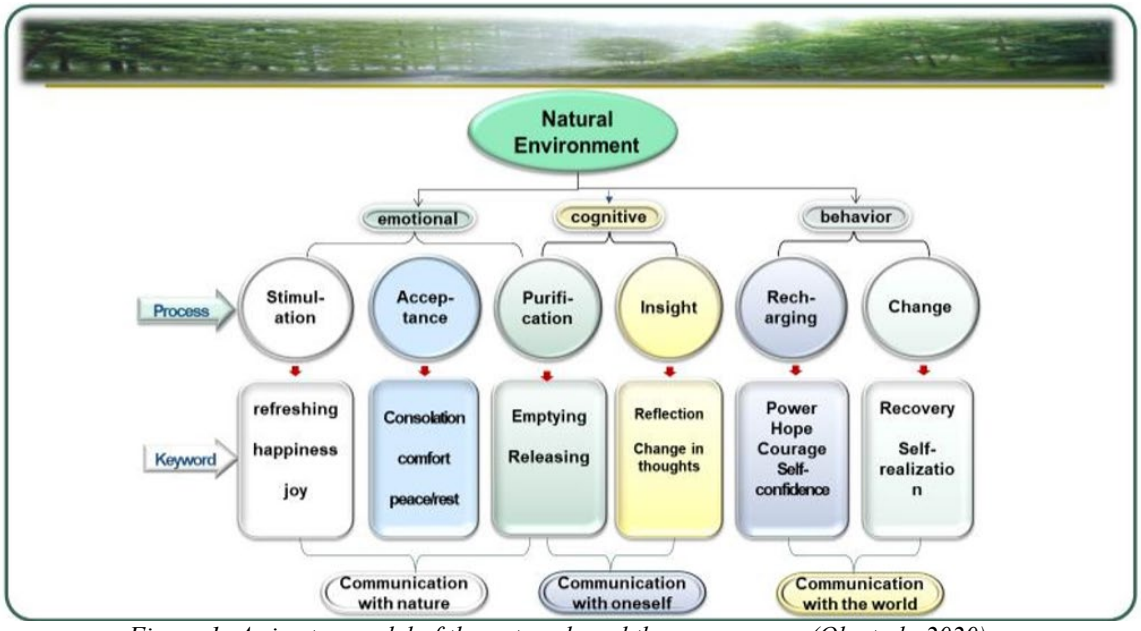

Figure 1: A six-step model of the nature-based therapy process (Oh et al., 2020).

Social pathway

The above mentioned model and the substantiated theories, seem to be applicable to the rehabilitation of individual patients. But also the social component of NBTs is valuable because of the positive effects the social interaction can have on the mental state of the study participants (Hassink, Vaandrager & Jansen (2017). According to Hassink et al. (2017), the social contacts participants experience, and working and learning together during the NBT, leads to a higher self-esteem and self-worthiness. Besides, it makes people more socially competent.

Methods

Data sources and Search Terms

To obtain an answer on the above mentioned research question, a systematic literature research was conducted. For literature regarding this study topic, the databases Scopus, Web of Science and PubMed were searched. Because of the many terms that are used to indicate nature-based therapy, the used search queries of this study contain several terms to obtain articles about nature-based interventions. The search terms indicating nature-based therapy, and several other search terms indicating health and illness, are based on the search terms used in the systematic literature review by Annerstedt & Währborg (2011). The use of many search terms to identify studies about the effectiveness of nature-based therapies, improves the search sensitivity. The concept nature-based therapy is split up in two constructs: one construct defines the influence of nature like 'nature-assisted' and 'nature-based', and the other construct 'therapy' or 'restoration' or 'rehabilitation', to broaden the search results. Because the systematic literature review of Annerstedt & Währborg (2011) focused on studies to the effectiveness of NBTs between 1980 and 2009, the year of publication of the used studies in this systematic literature review was from 2009 and onwards. The search strings that were used in the databases, are showed in table 1.

Table 1: Search strings per database

Database	**Search string**
Scopus	Search string 1: TITLE-ABS-KEY(("nature-assisted" OR "nature-guided" OR "nature-based" OR "nature therapy" OR "forest bathing") AND ("mental *" OR "psycholog*") AND ("therapy" OR "rehabilitation" OR "restoration") AND ("adults" OR "patients") AND ("depression" OR "anxiety" OR "stress")) Search string 2: TITLE-ABS-KEY(("horticultural" OR "wilderness" OR "garden*") AND ("therapy" OR "rehabilitation" OR "restoration") AND ("mental *" OR "psycholog*") AND ("adults" OR "patients") AND ("depression" OR "anxiety" OR "stress"))
Pubmed	((((("nature-assisted"[All Fields] OR "garden*"[All Fields]) AND ("therapy"[All Fields] OR "intervention"[All Fields])) AND ("mental*"[All Fields] OR "psychiatric*"[All Fields])) AND ("adults"[All Fields] OR "patients"[All Fields])) AND (("depression"[All Fields] OR "stress"[All Fields]) OR "anxiety"[All Fields])
Web of Science	TOPIC:(("nature-based" OR "nature-assisted" OR "adventure" OR "wilderness") AND "therapy" AND ("adults" OR "patients"))

Inclusion and exclusion criteria

The in- and exclusion criteria as presented in table 2 were used to assess whether an article was suitable to use for this study. Various forms of qualitative studies and quantitative study designs that contain primary data were used in this study, as shown beneath. In the first place, this study aimed to use quantitative study designs like Randomized Controlled Trials (RCT's) and experiments above qualitative study designs. This was done because these study designs are most trustworthy to measure the effect of an intervention, because these study designs can diminish the risk of an influencing external factors on the study outcomes. But because the other study designs, like observational studies and case studies could also show an important treatment effect or could give a better understanding of why effects are found or not, therefore these study designs were also used. Besides, in the first place this study aimed to identify a sufficient amount of articles containing primary data, but when not enough primary-data

articles were identified, systematic literature reviews and meta-analyses were also used in this study. For this systematic literature review, the following study designs were used:
- Randomized controlled trials
- Non-randomized intervention studies
- Longitudinal studies
- Observational studies
- Case studies
(- Systematic reviews/meta analyses)

Table 2: Inclusion and exclusion criteria of the study

Inclusion criteria	**Exclusion criteria**
Scientific articles are peer reviewed	The definition of nature-based therapy does not match the used definition in this study
Scientific articles are written in English	The scientific articles do not provide primary obtained data regarding a form of nature-based therapy
The scientific article is about a kind of nature-based therapy and evaluates its effectiveness	The study participants do not excessively use alcohol or one or more kinds of drugs
The study participants meet the requirements of the defined study population (see 'definition of study population')	The study participants do not suffer from a form of dementia or personality disorder
A health practitioner is involved in the nature-based therapy	
The scientific article is published in the year 2009 or later	
The study design of the scientific article meets the study design requirements mentioned above	

Definition of study population

In this study, the study population entails patients experiencing depression-, anxiety- and stress-related issues. The study population of this study entails people who experience symptoms related to depression disorder, anxiety disorder, or stress disorder. Following will be a description of various symptoms of the disorders.

Symptoms associated with various forms of depression disorder like major depressive disorder, are feeling sad, trouble with sleeping in, changes in appetite, loss of interest or pleasure in activities earlier enjoyed, loss of energy/increased fatigue, feeling worthless, slowed movements and speech, difficulty in thinking/concentrating/making decisions, and thoughts of death or suicide (APA, 2017a).

There are various forms of anxiety disorder, which have various different symptoms that they bring with (APA, 2017b). A symptom that in quite every anxiety disorder occurs, is experiencing persistent and excessive worries that interfere with daily life activities (APA, 2017b). These worries may go together with physical symptoms of anxiety, such as restlessness, feeling easily fatigued, difficulty concentrating, muscle tension or problems with sleeping. One other core symptom of a few anxiety disorders, is panic attacks. Panic attacks are a combination of both physical and psychological distress, which is expressed in physical symptoms such as sweating, feeling of shortness of breath, and in psychological symptoms like fear of losing control and numbness (APA, 2017b).

There are three types of stress disorders, these are Post-Traumatic Stress Disorder (PTSS), Adjustment Disorder and Acute Stress Disorder (APA, 2017c). PTSS and Adjustment Disorder have similar symptoms, these are feeling tense/sad/hopeless, withdrawing from other people, showing impulsive behaviour or physical symptoms like tremors and headaches (APA, 2017c). Symptoms of Acute Stress Disorder are reliving the experienced trauma, having flashbacks or nightmares about the trauma and feeling numb (APA, 2017c).

The study population of the used studies, had to be screened on the extent of mental health issues before and after the nature-based intervention, in order to measure the effect of the NBT intervention on the mental health issues.

Search strategy and screening process

The search strings in table 1 were used to obtain all relevant data for this study. After the search with the search strings, the titles and abstracts of the identified articles were screened to assess if the articles were relevant and suitable for this study. The full article was read if after the title and abstract screening was still not clear if the article was suitable to use. Beneath in the PRISMA flow diagram is shown which articles were obtained from the results obtained by the search strings of table 1 (figure 2).

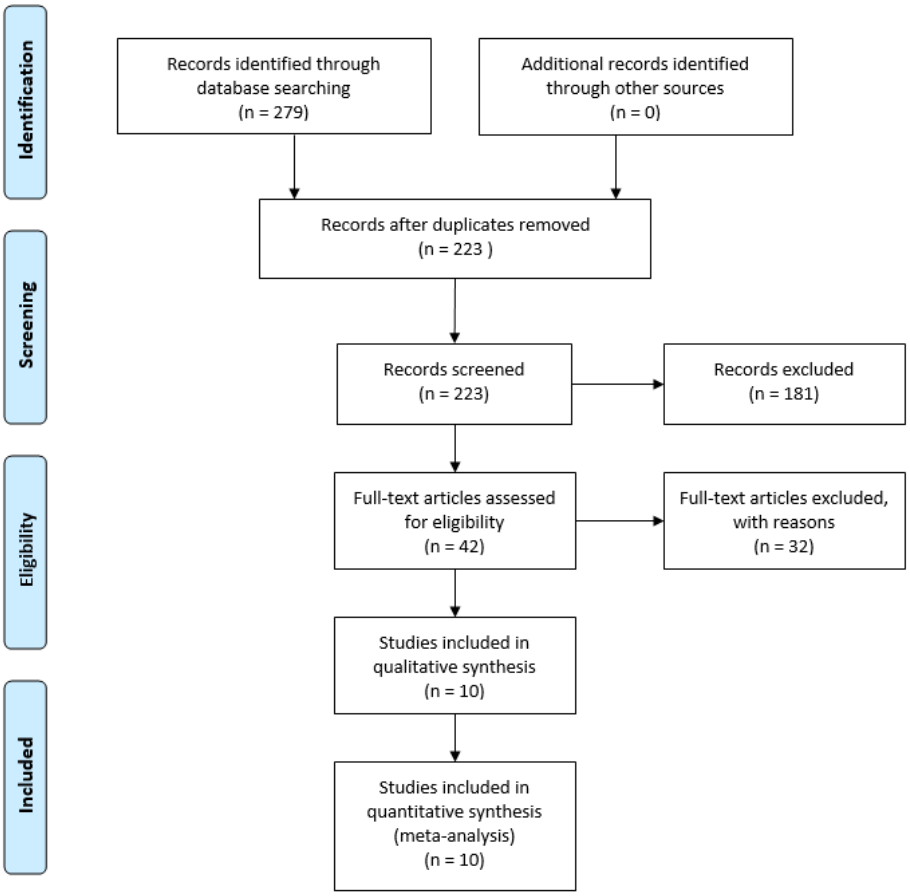

Figure 2: PRISMA flow diagram

Data Extraction

To help organise the selected articles, an Excel sheet was used. The following study characteristics of the article were included in the Excel sheet in the right order: the authors, publication date, the study setting (location and environment), characteristics of participants (age, gender, mental health issues), form of NBT, short description of content of the NBT, and the study outcomes (the experiences of patients and changes in measured outcomes).

Thereafter, a narrative data synthesis of the obtained study results was carried out. In this data synthesis, the results of the used study were categorized by the various forms of NBT and assessed on their homogeneity and heterogeneity. All kinds of study outcomes of the used studies were used to answer the research question, focusing on the effectiveness outcomes.

Article Quality Assessment

After the screening process, the articles were further assessed on their quality by using one of the three quality assessment checklists: one checklist especially for RCT's (appendix 1), one checklists for experiments that are not RCT's (appendix 2), and one for the other study designs of the articles used in

this study: those designs are longitudinal studies, observational studies, case studies and systematic reviews/meta analyses (appendix 3). The quality assessment criteria are inspired by the quality assessment checklists of the Critical Appraisal Skills Programme [CASP] part of the Oxford Centre for Triple Value Healthcare (CASP, 2020). The quality assessment checklists by CASP (2020) help researchers to critically analyse the trustworthiness, relevance and results of published papers. The used quality assessment criteria are divided in sections A (the internal validity), section B (the study results) and section C (the external validity). After answering the questions of every particular section, an indication of the quality of each section was given by giving the section a quality score in numbers. To assess the overall quality of the study, the scores of the particular sections were added up. Upon this final quality score, an overall conclusion is drawn of the article quality (which is either low, moderate or strong). In this systematic review, several scientific articles were included to find an answer to the research question. These articles were likely to vary in article quality, The strong quality articles are more trustworthy: these articles contain more reliable results and conclusions than the articles of low(er) quality. Therefore, the article quality was discussed in the results section and the discussion section to show how reliable the found results are. The article quality was also discussed to show in what extent the conclusions drawn upon the used articles in this systematic review were reliable and trustworthy.

Results

Study characteristics

In this systematic review, ten studies are included in the data-analysis with different study designs. Four of these studies are Randomized Controlled Trials (RCT's), one study has an experimental study design, three studies have a longitudinal study design, and two studies have a case study design. Two articles, the studies of Sonntag-Öström et al. (2015a) and Sonntag-Öström et al. (2015b) that are included, are about the same study and so both are RCT's, but the articles used different outcome measures. Both articles were included in this review to give a more complete picture of the study effects. In table 3 beneath, the used articles and their study designs are presented.

The other study characteristics of the studies included in this systematic review differ on several aspects. Various study characteristics of all the used studies are presented in table 6, these are the characteristics study design, study content, context, participants and study outcomes. Only the significant study outcomes are reported in the 'outcomes' column of the table.

Table 3: Study designs of the included studies

Authors + year	**Study design**
Corazon et al. (2018)	RCT
Gonzalez et al. (2011)	Case study
Grahn et al. (2017)	Experiment
Sahlin et al. (2015)	Longitudinal study
Sonntag-Öström et al. (2011)	Case study
Sonntag-Öström et al. (2015a)	RCT
Sonntag-Öström et al. (2015b)	RCT
Vujcic et al. (2017)	RCT
Währborg, Petersson & Grahn (2014)	Longitudinal study
Willert, Wieclaw & Thustrup (2014)	Longitudinal study

Study content

Studies to various types of NBT are included in this study, these are 'wide-defined' forms of NBT and forest therapy (also known as 'forest-bathing'). Most studies with these more wide-defined forms of NBT, included activities in their study content as horticultural activities (for example sowing and potting plants), walking and relaxing in a rehabilitation garden and breathing exercises or mindfulness exercises outside. Besides the activities in which nature plays a more active role, for example during horticultural activities, also activities in which nature plays a more passive role were included. Nature plays a more passive role during activities when the study participants do not 'work' directly with nature/natural materials. Instead, nature is the study context in which other activities take place, for example carrying out breathing exercises outside. Most studies combined the before mentioned activities with frequently personal therapeutic conversations with a health practitioner.

In seven of ten studies, the NBT participant group was compared with a control group. In six of these studies, the control group followed conventional therapy, by which Cognitive Behavioural Therapy (CBT) was meant. During CBT, patients regularly have therapeutic conversations with a health practitioner and when needed they take in medicines to fasten/improve their recovery. In only one of these studies, the control group followed the same activities as the NBT group (as breathing exercises and therapeutic conversations), but then carried out inside in contrast to the outside environment of the NBT group.

Participants' mental health state

The participants of the included studies, all differed in their mental health state, but all fulfilled the inclusion criteria in the methods section about mental health complaints. In nine of ten studies, some of the participants or all participants suffered from stress-related complaints and/or stress-related illness, among which Exhaustion Disorder (ED) is a common illness. In eight of ten studies, some of the participants suffered from depressive complaints, or had mild to moderate depression or depressive

episodes. In two of ten studies, some of the participants suffered from anxiety-related complaints or anxiety.

Quality appraisal

All studies included in this systematic review were assessed on among others their quality, regarding the methods, influence of bias and results of the study in question. Six of ten studies were identified as being of strong quality (of which two articles were about the same study), and four were identified as being of moderate quality (see table 4). The filled in quality assessment forms are attached in appendixes 4 until 14. In these quality assessment forms, the possibility of influence of researcher bias in the study was assessed too. From the article of one study was clear that the researcher thought about their own role in the study, and this was clearly written in the methods section of the study of Sahlin et al. (2015). In the other nine articles, it was not clear if the researcher considered his/her own influence on the study (results), and if so, to what extent was thought about it.

Table 4: Quality appraisal outcomes

Authors + year	**Article quality**	**Score**
Corazon et al. (2018)	Strong	13.5 of 18 points
Gonzalez et al. (2011)	Moderate	7 of 12 points
Grahn et al. (2017)	Strong	14.5 of 16 points
Sahlin et al. (2015)	Strong	10 of 12 points
Sonntag-Öström et al. (2011)	Moderate	8 of 12 points
Sonntag-Öström et al. (2015a)	Strong	13 of 18 points
Sonntag-Öström et al. (2015b)	Strong	13.5 of 18 points
Vujcic et al. (2017)	Strong	13 of 18 points
Währborg, Petersson & Grahn (2014)	Moderate	7 of 12 points
Willert et al. (2014)	Moderate	6 of 12 points

Outcome measures

The studies included in this systematic review, used various outcome measures to obtain answers for their research questions. The outcome measures shown in table 5 were used in the studies and are categorised in four different categories: *mental health, behaviour, work-ability and experiences* (table 5).

Table 5: Four categories of outcome measures

Category	**Outcome measures**
Mental health	Stress level, depression level, anxiety level, burn-out-level, well-being, experience of existential issues, Sense of Coherence (SOC), long-term mental health state, mental health state, healthcare consumption
Behaviour	Personal control, Stress Management Skills (SMS), daily functioning, attention capacity, healthcare consumption
Work-ability	Sick leave status, Return To Work (RTW), occupational competence, work-ability
Experiences	Experiences of treatment, preferred environment for treatment, preferences of practical arrangements for treatment

Although all studies differed in what outcome measures were used, a similarity between all studies is that every study in its own way measured the direct effect of the NBT on the mental health of the

participants. Therefore, almost all studies used one or more outcome measures of the category 'mental health' (table 5), except for the study of Grahn et al. (2017) that only measured RTW. The outcome measure 'health care consumption' and outcome measures for measuring change in stress-related symptoms were used repeatedly, while the other outcome measures were used less frequently.
Only three of the used studies measured qualitative data of the participants' experiences of the NBT programmes, as thoughts and feelings, these were the studies of Sonntag-Öström et al. (2011), Sonntag-Öström et al. (2015a) and Sonntag-Öström et al. (2015b). The other seven studies obtained quantitative data regarding the various outcome measures of the categories mental health, behaviour and work-ability.

Study effects
The results of the included studies are described beneath and categorised by the three pathways from the six-step model of the NBT process (see figure 1), which are the emotional, cognitive and behavioural pathway. A more complete description of the characteristics of the studies is presented in appendix 14, and a shorter summary of the findings of the studies is presented in table 6.

The emotional pathway

Step 1: Stimulation
Outcomes of this study that belong to the first step of the six-step model of the NBT process, are the study outcomes of the case study of Sonntag-Öström et al. (2011) and the RCT of Sonntag-Öström et al. (2015b). Both of these studies reported increases in mental health state. The study of Sonntag-Öström et al. (2011) reported significant improvements in feeling more relaxed, happy and harmonious, and for feeling more at peace from before to after the NBT programme (for all mentioned measures $p<0.05$). The study of Sonntag-Öström et al. (2015b) reported significant improvements in mental health state for single exposure to one of the natural environments (all p-values were $p<0.001$). During the treatment period, significant improvements were found in all mental state variables compared to baseline (all p-values are $p<0.03$) except for the irritated/harmonious scale ($p=0.109$). Besides, Sonntag-Öström et al. (2011) reported the participants enjoyed and appreciated the *freedom* they experienced in the forest environment around them and in their own head by walking solely in the forest environment. The content of the studies of Sonntag-Öström et al. (2011) and Sonntag-Öström et al. (2015b) were quite similar, as both studies were forest therapy during which the participants walk solely in a forest environment for a period of time. After those individual walks, the participants came together to have lunch and do relaxing exercises.

Step 2: Acceptance
Outcomes of the studies that belong to the second step of the six-step model of the NBT process, are the study outcomes of the longitudinal study of Sahlin et al. (2015), the case study Sonntag-Öström et al. (2011) and the RCT of Sonntag-Öström et al. (2015b). The study of Sahlin et al. (2015) reported significant increases in well-being from 41.9 at baseline (SD: 8.1, $p<0.0001$) to 46.7 before treatment's start (SD: 8.8, $p<0.0001$), to 47.8 at treatment's end (SD: 9.4, $p<0.0001$), to 49.1 a year after treatment's start (SD: 10.7, $p<0.0001$). The study of Sonntag-Öström et al. (2011) reported that participants that had walked in a forest environment during the therapy, experienced *rest* in nature. The participants appreciated the rest in nature, but also appreciated the combination of talking together with other study participants and having time alone in the forest. Also, the participants of the study of Sonntag-Öström et al. (2015b) reported that the participants experienced *peace of mind* in the forest environment. So, the forest therapy programmes of Sonntag-Öström et al. (2011) and Sonntag-Öström et al. (2015b) had a quite similar effect on the emotional state of the participants. The study of Sahlin et al. (2015) included various activities and was a more wide-defined form of NBT. Activities as working in the garden, walking in nature and therapeutic painting and conversations were included in the study programme.

Emotional & cognitive pathway

Step 3: Purification

Outcomes of this study that belong to the third step of the six-step model of the NBT process, are the study outcomes of the case study of Gonzalez et al. (2011), the longitudinal study of Sahlin et al. (2015), the RCT of Vujcic et al. (2017) and the longitudinal study of Willert et al. (2014).

Reductions in the experience of various negative emotions was found, among others reductions in depression levels in the studies of Gonzalez et al. (2011) and Sahlin et al. (2015). In the study of Sahlin et al. (2015), for two participant groups the depression levels were measured. The depression levels in group one significantly declined from 27.3 points at the study start to 17.6 points at the end of the NBT (F: 36.247) ($p<0.10$). Three months after the treatment's end, the level was increased to 20.8 points. Despite this increase, the overall depression level between the treatment's start to three months after treatment significantly decreased (F: 3.435) ($p<0.05$). In group two, the depression level declined significantly from 24.1 points at treatment's start to 19.6 points at treatment's end (F: 8.436) ($p<0.007$). Three months after the treatment's end, the level was increased to 20.8 points, with a $p>0.05$, which means there is no significant declining trend in depression severity from treatment's start to three months after treatment (F: 4.187) ($p=0.052$). In the study of Sahlin et al. (2015), the depression levels decreased significantly from 23.2 at baseline (SD: 10.0) to 15.7 at treatment's start (SD: 8.7, $p<0.0001$), to 14.2 at treatment's end (SD: 8.0, $p<0.0001$) to 13.0 a year after treatment's start (SD: 8.7, $p<0.0001$). Also, the number of participants experiencing moderate or severe depression decreased from 52% at baseline to 26% at treatment's end, and decreased further to 21% a year after the start of the treatment.

Also reductions in stress level were found in the studies of Vujcic et al. (2017) and Willert et al. (2014). The study results of Vujcic et al. (2017) reported significant changes in stress level from before treatment to after treatment in the experimental group, furthermore, this change was larger than the change in stress level within the control group (F: 5.442, $p<0.05$). Also, the study results of Willert et al. (2014) showed a significant reduction in stress-related symptoms, a reduction from 25.15 at baseline (SD: 7.20) to 20.54 three months after treatment's start (CI: 0.38; 0.94) ($p<0.01$). A significant reduction was also found in the control group, a reduction from 23.91 at baseline (SD: 7.48) to 19.75 three months after treatment's start (CI: 0.23; 0.93) ($p<0.01$). Furthermore, reductions in burn-out and anxiety levels were found in the study of Sahlin et al. (2015). The burn-out levels decreased significantly from 5.1 at baseline (SD: 0.88) to 4.4 at treatment's start (SD: 1.16, CI: 8.6; 36.9) to 4.26 after treatment's end (SD: 1.28, CI: 7.9; 38.2) to 4.12 a year after treatment's start (SD: 1.26, CI: 19.6; 55.8). The anxiety levels decreased significantly from 17.2 at baseline (SD: 11.8), to 12.8 at treatment's start (10.1, $p=0.001$), to 12.1 at treatment's end (SD: 8.4, $p=0.005$) to 10.2 a year after treatment (SD: 7.8, $p<0.0001$). Additionally, the number of participants scoring moderate to severe anxiety decreased significantly from 47% at baseline to 34% at treatment's end, to 19% a year after treatment. The above-mentioned studies were quite similar in their study content, all studies included among others horticultural activities, walking and relaxing in nature and breathing exercises outside.

Cognitive pathway

Step 4: Insight

Outcomes of this study that belong to the fourth step of the six-step model of the NBT process, are the study outcomes of the case study of Sonntag-Öström et al. (2011) and the RCT of Sonntag-Öström et al. (2015a). Sonntag-Öström et al. (2011) reported that the study participants experienced feeling *'no demand'* in the natural environment. Sonntag-Öström et al. (2015a) reported an increased attention capacity level for the study participants for single exposures in the forest. After two hours solely walking in the forest, participants experienced fewer spontaneous reversals ($p=0.04$) and focused reversals ($p=0.009$).

Behavioural pathway

Step 5: Recharging

Outcomes of this study that belong to the fifth step of the six-step model of the NBT process, are the study outcomes of the RCT by Sonntag-Öström et al. (2015b). The results indicate that when the participants were able to find peace of mind during the forest visits, they could start to reflect upon their life and started to *think more positively*, this in turn led to *desire for change in their life situation*.

Step 6: Change

Outcomes of this study that belong to the sixth step of the six-step model of the NBT process, are the study outcomes of the studies of Corazon et al. (2018), Grahn et al. (2017), Sonntag-Öström et al. (2015a), Sahlin et al. (2015), Willert et al. (2014) and Währborg et al. (2014).

The study of Willert et al. (2014) reported significant increases in daily functioning from 13.22 at baseline to 14.86 three months after treatment's start (CI: 1.39; 3.88, $p<0.01$). There was a significant small effect for the control group: the level of daily functioning increased from 14.02 at baseline to 15.08 after treatment's start (CI: 1.54; 4.59, $p<0.01$).

Willert et al. (2014) also reported significant increases in work-ability from 2.24 at baseline (SD: 2.31) to 4.05 three months after treatment's start (CI: 1.09; 2.52, $p<0.01$). Work-ability increased in the control group from 2.41 at baseline (SD: 2.40) to 3.51 three months after treatment's start (CI: 0.22; 1.98, $p=0.01$).

Lastly, Willert et al. (2014) reported significant increases in self-efficacy from 13.22 at baseline (SD: 5.00) to 15.86 three months after treatment's start (CI: 1.39; 3.88, $p<0.01$). Self-efficacy increased in the control group from 14.01 at baseline (SD: 5.17) to 17.08 three months after treatment's start (CI: 1.54; 4.59, $p<0.01$).

Besides, Sonntag-Öström et al. (2015a) reported significant increases in long-term psychological health outcomes in both the experimental group (all outcomes were $p<0.001$) and in the control group (all outcomes were $p<0.003$) between measurement at baseline to treatment's end to one year after treatment's end. No significant differences were found between the psychological health outcomes between the experimental group and the control group.

Furthermore, Grahn et al. (2017) reported significant increases in RTW. Results regarding RTW were that 42 participants (44%) returned to full-time or part-time work after one year from treatment's end. Fourteen of them returned to full-time work. 53 participants (50%) did not return to paid work, but 23 of them (21,7%) took part in a job training or other forms of work-oriented activities. 30 participants (38,3%) did not do any work-related activity one year later. There was no information obtained from eleven participants. Another remarkable result, was the discovered trend that the longer the NBT endured, the more patients returned to full-time work. Patients participating in the 24-week programme reported a significantly higher ($p<0.05$) percentage of full-time work (44%) one year after beginning the rehabilitation period compared to those participating in the twelve-week (37%) and eight-week (20%) programmes. Also, the RTW rate was significantly higher for participants of the twelve-week programme than those of the eight-week programme ($p<0.05$).

Besides positive increases in the above mentioned variables, also reductions in healthcare consumption and sick leave levels were found in various studies. Significant reductions in healthcare consumption were found in the study of Sahlin et al. (2015), healthcare consumption (the number of visits to medical professionals) significantly decreased in the experimental group from 19.2 visits six months before treatment (SD: 11.4) to 10.8 visits six months after treatment (SD: 8.4, CI: -12.0; -4.7). For the last follow-up period, this number remained at the same level. Healthcare consumption significantly decreased in the control group from 17.6 (SD: 11.5) six months after treatment to 11.0 a year after treatment (SD: 6.6, CI: 3.7; 9.4). In the study of Corazon et al. (2018), healthcare consumption decreased from 18 twelve months before treatment to 13 twelve months after treatment with an effect size of $r = -0.396$ ($p<0.01$). Also, healthcare consumption decreased significantly in the control group from 21 to 14 number of contacts with an effect size of $r = -0.249$ ($p<0.05$). Währborg et al. (2014) reported significant reductions in healthcare consumption in the experimental group from 28.7 visits a year before treatment to 24.1 one year after treatment's end (CI: 0.43; 0.52). Healthcare consumption

reduced significantly in the control group from 18.3 visits one year before treatment to 16.8 visits one year after treatment (CI: 0.81; 0.87).

Corazon et al. (2018) reported significant reductions were found in the sick leave levels of the experimental group and control group one month before treatment to twelve months after treatment (NBT: $p<0.001$; CBT: $p<0.01$). Furthermore, 23 participants (77%) from the experimental group who were on sick leave before treatment's start were not on sick leave anymore twelve months after treatment's end. Besides, 15 participants (60%) from the control group who were on sick leave before treatment's start were not on sick leave anymore twelve months after treatment's end. No significant change was found in the number of months of sick leave for the participants from twelve months before the treatment to the twelve months after the treatment for either the experimental group or the control group ($p>0.05$). From twelve months before treatment to treatment's end, sick leave levels increased, and from treatment's end to twelve months after treatment these levels decreased in a similar extent as the increase. Sahlin et al. (2015) reported significant reductions in sick leave level too, the experimental group sick leave level decreased from 7204 days six months before treatment to 5335 days six months after treatment (SD: 30.8, CI: 24.5; 60.5) to 3982 days a year after treatment (SD: 30.8, CI: 6.0; 55.5). In the control group, the number of sick leave days first increased from 3897 days six months before treatment (SD: 68.9, CI: -93.0; -44.8) to 6997 days six months after treatment (SD: 67.7, CI: 44.8; 90.6), and then decreased to 3951 a year after treatment, although this decrease was not significant ($p=0.063$).

Experiences with the NBT

Although that in this systematic review the effective elements of NBT were not studied, Sonntag-Öström et al. (2015a) studied the experiences of participants with the NBT and found possible results that factors as amount of light in nature and the perception of different stimuli in the environment would influence the experience and appreciation of the NBT. The results of this study showed that forest settings with more light were more often chosen as forest environments to walk in and as favourite forest settings (Sonntag-Öström et al., 2011; Sonntag-Öström et al., 2015a). The participants also reported to appreciate various stimuli to see and hear in the forest environment (Sonntag-Öström et al., 2015a). Additionally, the results indicated that no significant effect was found for the influence of season on the study outcomes, while the amount of daylight and presence of various living stimuli did come out as influencing factors in this study (Sonntag-Öström et al., 2015a). Although that the effects on mental health state variables in the study were stronger in the spring period than in the autumn period, which could point to the hypothesis that length of daylight, increasing coldness and/or seasonal changes possibly influence the effectiveness of NBT (Sonntag-Öström et al., 2015a). The results of the study of Sonntag-Öström et al. (2011) are in line with this: the participants of this study also reported to prefer the forest settings that were bright and light.

Overall remarks

Regarding the outcomes of this study, it is remarkable that a lot of positive changes have taken place in the mental health and behaviour of participants of the experimental group. In every study, better mental health and/or positive changes in daily behaviour and/or in work-ability was reported for the participants of the experimental group. For example multiple significant reductions have been found in various mental health issues like stress level, depression level and anxiety level. Also increased mental health state was recorded repeatedly in for example the studies of Sonntag-Öström et al. (2015a) and Sonntag-Öström et al. (2015b) and the study of Sonntag-Öström et al. (2011). A second remarkable finding, is that this study found more positive changes in the outcome measures of the experimental groups than those of the control groups. For example positive significant effects were (mostly) found for the experimental groups in the studies of Vujcic et al. (2017), Sahlin et al. (2015) and Währborg et al. (2014). In the studies of Corazon et al. (2018), Willert et al. (2014) and Sonntag-Öström et al. (2015a), positive effects were found as well for the participants of the control groups.

Table 6: Study characteristics

Authors + year	Study design	Study content	Context	Participants	Outcomes
Corazon et al. (2018)	RCT	Gardening, relaxation time in the garden, mindfulness exercises, therapeutic conversations CBT	Nacadia Nature-Based Therapy Garden in Copenhagen, Denmark	Total of 72 participants NBT group: 37 CBT group: 35 20-60 years old Mean age: 46.5 years old M/W ratio NBT group: 18/82 % CBT group: 18/82 %	↓ **Sick leave** experimental group & control group ↓ **Healthcare consumption** experimental group & control group
Grahn et al. (2017)	Experiment	Gardening, walking and resting in the garden	The Alnarp Rehabilitation Garden in Southern Sweden	Total of 106 participants 22-63 years old Mean age: 45.7 years old M/W ratio 12 / 88 %	↑ **RTW**: 44% of participants returned to paid work
Vujcic et al. (2017)	RCT	Gardening, walking and resting in the garden, art therapy CBT and art therapy	A botanical garden in Belgrade, Servia	Total of 30 participants Experimental group: 16 Control group: 14 25-65 years old Mean age: 45.35 years old M/W ratio 30 / 70 %	↓ **Stress level** in experimental group
Sahlin et al. (2015)	Longitudinal study	Gardening, walking and relaxing in nature, therapeutic painting and conversations, body awareness and information about health-related topics CBT	Venue with garden and greenhouse Nearby nature reserve. Västra Götaland, Sweden	Total of 102 participants Experimental group: 57 Control group: 45 26–63 years old Mean age: 47 years old M/W ratio Experimental group: 7 / 93 % Control group: 0 / 100 %	↓ **Burn-out level** in experimental group ↓ **Depression level** in experimental group ↓ **Anxiety level** in experimental group

					⬆ **Well-being** in experimental group ⬇ **Sick leave** in experimental group ⬆ **Sick leave** in control group ⬇ **Healthcare consumption** in experimental and control group
Währborg, Peterson & Garhn (2014)	Longitudinal study	Gardening, relaxation exercises, psychotherapeutic activities, walking and resting in the garden CBT	Green rehabilitation garden in Alnarp, Southern Sweden	Total of 779 participants Experimental group: 103 Control group: 678 30–64 years old Mean age: 46.1 years old M/W ratio 11 / 89 % 11.5 / 82.5 %	⬇ **Healthcare consumption** in experimental group
Willert et al. (2014)	Longitudinal study	Educational and physical activities (as walking in nature), yoga and mindfulness exercises outside Same activities, but carried out inside	Mariendal Gardens (MG) in Aarhus, Denmark	Total of 93 participants Experimental group: 48 Control group: 45 25–59 years old Mean age: 45 years old M/W ratio Experimental group: 21 / 79 % Control group: 13 / 77 %	⬇ **Stress-related health symptoms** in experimental and control group ⬆ **SMS** in experimental and control group ⬆ **Daily functioning** in experimental and control group ⬆ **Work-ability** in experimental

					and control group
Gonzalez et al. (2011)	Longitudinal study	Horticultural activities, besides also walking and sitting on benches in nature	At four urban farms and outside in therapeutic gardens in Oslo, Norway	Two experimental groups Group 1: 18 participants Group 2: 28 participants 25–65 years old Mean age: 46.9 years old M/W ratio Group 1: 17 / 83 % Group 2: Statistically equivalent to group 1	⬇ **Depression severity** in group 1 and 2
Sonntag-Öström et al. (2015a)	RCT	Forest therapy: individual walks in forest of choice CBT At the end of NBT program: both groups followed CBT	In eight different forest environments at Bäcksjön, in the boreal zone in Northern Sweden	Total of 99 participants Experimental group: 51 Control group: 48 24–60 years old Mean age: 44.5 years old M/W ratio Experimental group: 20 / 80 % Control group: 9 / 91 %	⬆ **Long-term psychological health outcomes** in experimental and control group ⬆ **Mental health state** in experimental group ⬆ **Attention capacity** in experimental group
Sonntag-Öström et al. (2015b)	RCT	Forest therapy: individual walks in forest of choice CBT At the end of NBT program: both groups followed CBT	In eight different forest environments at Bäcksjön, in the boreal zone in Northern Sweden	Total of 99 participants Experimental group: 51 Control group: 48 24–60 years old Mean age: 44.5 years old M/W ratio Experimental group: 20 / 80 %	Several themes in experiences: **'striving for serenity', 'frustration in adaptation to nature', 'peace of mind', 'more positive thinking'**, and at the end of the programme **'desire for change'**

				Control group: 9 / 91 %	
Sonntag-Öström et al. (2011)	Case study	Forest therapy: individual walks in forest of choice	In six different forests in the boreal zone nearby Umea, Northern Sweden	Total of six participants 41–57 years old Mean age: 49.8 years old M/W ratio 50 / 50 %	↑ **Mental health state** in experimental group Interview themes: **rest, no demand** and **freedom** in forest environment, **social interaction** was appreciated

Discussion

Findings

The present study aimed to assess the effectiveness of NBT on adults experiencing stress-, depression- and anxiety-related issues. This systematic review tried to obtain an answer to the research question, using studies with various outcome measures. On the basis of this research, a few careful conclusions can be drawn. Firstly, based on this study, the results suggest positive changes in stress-related, depression-related and anxiety-related issues (Vujcic et al., 2017; Sahlin et al., 2015; Willert et al., 2014; Gonzalez et al., 2011). Secondly, the results also showed positive changes in mental health state and well-being (Sahlin et al., 2015; Sonntag-Öström et al., 2011; Sonntag-Öström et al., 2015b). Thirdly, the results also showed positive changes in restoring mindful or behavioural functions like attention capacity, stress management and daily functioning (Willert et al., 2014; Sonntag-Öström et al., 2015a). Fourthly, the results also showed positive changes in reducing healthcare consumption and sick leave levels (Sahlin et al., 2015; Corazon et al., 2018; Währborg et al., 2014). Lastly, the results also showed positive changes in experiencing peace of mind, rest and no demand from the outer world during the NBT sessions (Sonntag-Öström et al., 2011; Sonntag-Öström et al., 2015b).

Some long-term outcomes of this study as sick leave (Corazon et al., 2018; Sahlin et al., 2015), RTW (Grahn et al., 2017) and healthcare consumption (Corazon et al., 2018; Sahlin et al., 2015; Währborg et al., 2014), could possibly be improved by the positive effects of NBT on mental health. This could be so, because good individual mental health and several skills as a good SMS, work-ability and attention capacity are needed to be able to work and live as an individual in a healthy way. Improvements in mental health and the mentioned skills, could in this way lead to improvements in the long-term outcomes of this study. Thus, maybe there could be more similarities in the effect of NBT on participants' mental health and behaviour across the studies then seen at first sight.

Relevance of the findings

This systematic review provides carefully drawn conclusions on the effectiveness of NBT in restoring depression-, anxiety- and stress-related issues. This study is a step in the right direction in the search for more knowledge and evidence on the effectiveness of NBT. Despite the obtained knowledge this study contributes, the knowledge gap regarding the effectiveness of NBT is still big and further research to the effectiveness of NBT is needed to discover to what extent NBT might be effective in the recovery of certain mental health issues.

This study is subsequent to the review of Annerstedt and Währborg (2011). The results of this study are in line with the review of Annerstedt & Währborg (2011), in which significant reductions in depression and anxiety level are found as well. Annerstedt & Währborg (2011) recommended forthcoming studies to use more specified research questions, health conditions of the participants, population characteristics and intervention types when studying the effectiveness of NBT, as the study of Annerstedt & Währborg did not have any inclusion or exclusion criteria on these study characteristics. This systematic review was a more specified research with regard to the specified health conditions the study participants fulfilled: all included participants suffered from depression-, anxiety- and stress-related issues. Also, the age range of the participants was more specified in this study: all participants were between 18 and 65 years old. So, what this study contributes subsequent to the study of Annerstedt & Währborg is that this study provides information on the effectiveness of NBT on adults who specifically suffer from these mental health issues, and what NBT especially can mean for adults who suffer from these mental health issues. The results of the study of Oh et al. (2020) are also partly in line with the results of this study (see 'findings and theoretical framework'). Besides, the reductions in burn-out level, stress-related symptoms and sick leave, and the increase in work-ability of this study are in line with the study results of Sahlin et al. (2014), that reported similar study outcomes. This study of Sahlin et al. (2014) studied the effectiveness of NBT on people of all ages experiencing stress-related issues and is in study design comparable to some of the included studies in this systematic review.

Findings and theoretical framework

The theoretical framework used in this study, is the six-step model of the NBT process by Oh et al. (2020), substantiated by various existing theories as the ART, SRT, Biophilia Hypothesis and the PET.

The study results were expected to be more in line with the existing theories as the ART, SRT, Biophilia Hypothesis and the PET than the six-step model of the NBT process, because these theories are more validated. The study results were less likely to be in line with the six-steps model of NBT (see figure 1), as the six-step model is a recently published new model which lacks evidence for its reliability and so is not yet validated.
In addition to these earlier mentioned theories, also a theory regarding social interaction during the NBT was added to the theoretical framework. This theory is called the social pathway, and was added to the theoretical framework because the model lacks information or theory about the role of social interaction during the NBT. In the figure beneath, the similarities in the outcomes of this study and the used theories in the theoretical framework are shown (figure 3). The boxes beneath 'emotional', 'cognitive' and 'behaviour' are the six steps of the NBT process and explain the six steps. The existing theories that support the six-step model of the NBT process, are added too. Beneath these six boxes, the results of this study are linked to these six steps (see boxes with 'study results'). The social pathway and the results regarding that pathway are not included in the figure, because the social pathway as a theory was not part of the six-step model of the NBT process.

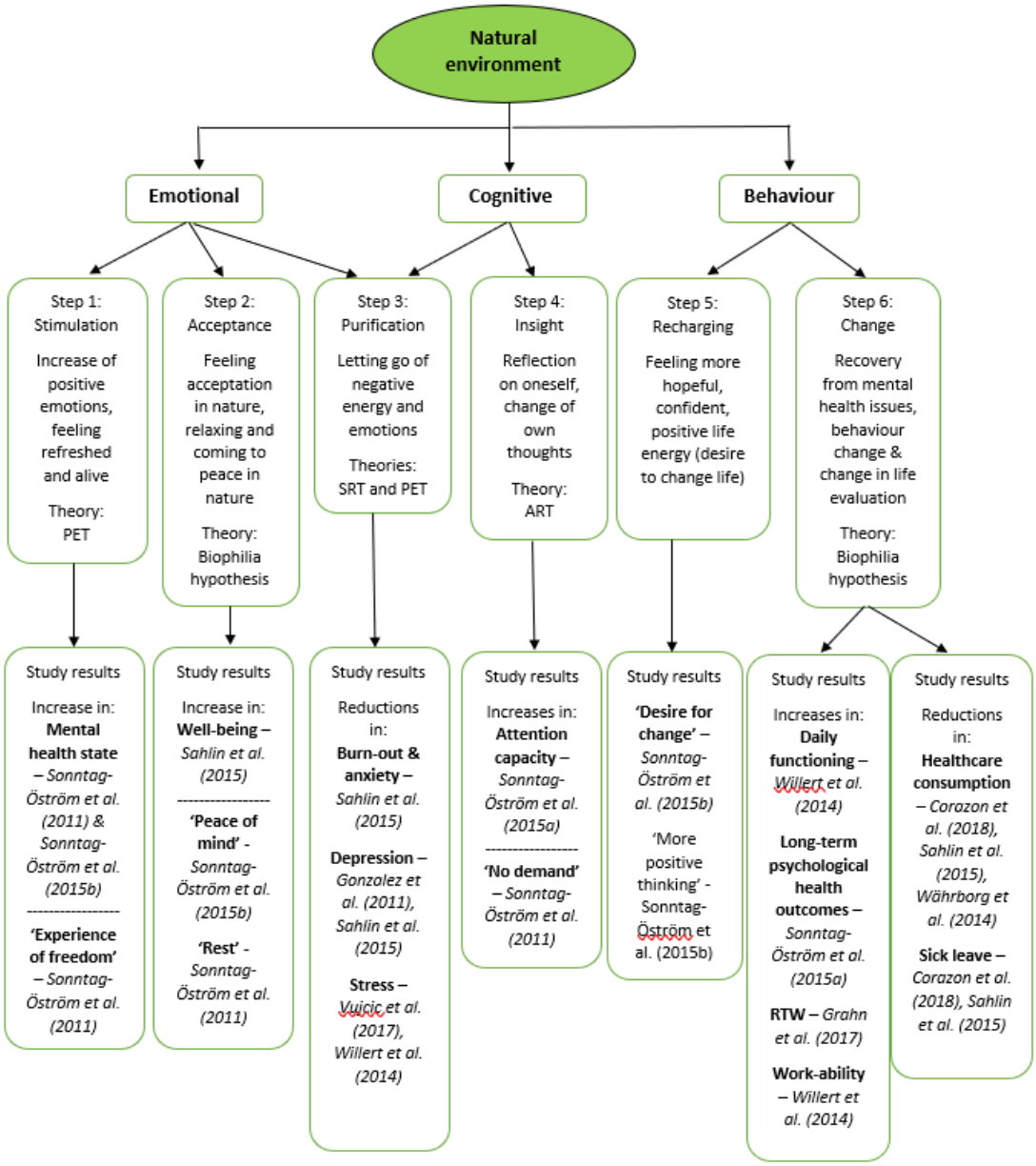

Figure 3: Study findings in relation to the theoretical framework

The core elements of the six-step model of the NBT process are shown in figure 3, those are the three pathways and the corresponding six steps towards recovery of the mental health issues. In the boxes under the six steps, the results of this systematic review are shown, categorised per step of the model. Observing figure 3, various study outcomes can be pointed out that are in line with the six-step model of the NBT process and the other theories included.

Firstly, studies applying quantitative methods showed that the NBT led to 'increase in mental health state' and 'increase in well-being'. These findings are quite in line with the PET, that claims that nature affects the emotional state positively (Ulrich, 1991). Studies applying qualitative methods showed that NBT led to 'Experience of freedom' and 'more positive thinking'. These findings are in line with the PET because of the increase in positive emotions the participants had faced. These findings are also in line with the step 'stimulation' of the six-step model, in which people's positive emotions are increased.

Secondly, studies applying qualitative methods showed that participants experienced 'peace of mind' and 'rest' in the natural environment. These findings are quite in line with the Biophilia Hypothesis that claims that humans would feel instinctly more calm in a natural environment (Wilson, 1993). Also, these results are in line with the step 'Acceptance', of which coming to peace in nature is an element.

Thirdly, studies applying quantitative methods showed reductions in burn-out and anxiety level and reduction in stress level. These findings are in line with the SRT and the PET, because the SRT and PET both claim that nature has a stress-relieving effect (Ulrich et al., 1991). Also reductions in depression level were found among various studies, and as depression can be developed due to chronic stress (Korte et al., 2005; Oh et al., 2020), the depression levels could possibly also have reduced due to the stress-relieving effect of nature. The results are in line with the step 'Purification', as the negative emotions of participants have reduced after or during the NBT treatment of the studies.

Fourthly, studies applying quantitative and qualitative methods showed increase in attention capacity, and participants experienced 'no demand' in the natural environment. These findings are in line with the ART by Kaplan (1995) that nature would have a restorative effect on the mind regarding mind clearing and mind wandering. According to the ART, nature would be a source of soft fascination that naturally evokes human attention (Kaplan 1995). Humans would experience a clear mind and a restored attention capacity by to the soft fascination effect of nature. The study results are kind of in line with the step 'Reflection', in this step humans would reflect on their own thoughts and change their way of thinking. The restored attention capacity and the experience of no demand, could bring with a clear mind and headspace to think about their own life and reflect on it.

Fifthly, a study applying qualitative methods showed that participants experienced 'desire for change', this is in line with the positive life energy and desire for life change as elements of the step 'Recharging' in the six-step model of the NBT process.

Sixthly, studies applying quantitative and qualitative methods showed a positive change in daily functioning, work-ability and RTW, and recorded a reduction in long-term psychological health issues. This may indicate a (partly) recovery of mental health issues. This could align with the Biophilia Hypothesis, that claims that the natural feeling of calmth and connection with nature could lead to positive mental health effects and in the end possibly to behaviour change (Ulrich et al., 1991). This behaviour change, could have happened in the studies of Grahn et al. (2017), Sonntag-Öström et al. (2015a) and Willert et al. (2014), seeing the increased study outcomes in the model at step six. Additionally, also reductions in sick leave levels and healthcare consumptions were found in multiple studies, also indicating a change in mental health and/or behaviour of the participants. These findings are in line with the step 'Change', during which participants experience recovery from their mental health issues and change their behaviour.

From this study results is not clear if all or a few of the steps of the six-step model are experienced by the participants in their recovery, and if so, in what order the steps are gone through by the participants. This is not clear from the included studies due to lacking evidence and data on the experiences, thoughts and feelings of the participants regarding the NBT treatment. To study if the six-step model of the NBT process is an accurate representation of the recovery process of NBT participants, more research is needed.

Lastly, the effect of social interaction on the experience and effectiveness of the NBT was not clear from the included studies, as only one of the included studies (Sonntag-Öström et al., 2011)

obtained data regarding the experience of social interaction during the NBT. Sonntag-Öström et al. (2011) found that participants appreciated the social interaction during group activities, but also found that the participants really appreciated time alone in the forest settings. What the exact influence of the social interactions was on the study outcomes, remains unclear from this study.

Study strengths and limitations

This study has several strengths and limitations regarding among others the design, methods and participants groups of the study.

A strength regarding the study participant groups, is the age range and mean age of the study participants in all included studies. The age range of the study participants was quite similar, and mostly between 24 and 60 years old, while the mean age was around 46 years old. The only exceptions to this is the study of Sonntag-Öström et al. (2011) with a smaller age range between 40 and 60 years old. A limitation regarding the participant groups is that in some included studies the participant groups were quite small, these were the studies of Sonntag-Öström et al. (2011), Vujcic et al. (2017) and Gonzalez et al. (2011). The participant group of the study of Sonntag-Öström et al. (2011) had a participant group of only six participants, the participant groups of the other two studies had around 20 participants. The small amount of participants in the participant groups may have influenced the internal validity of the results of this study. A limitation regarding the study participant groups, was the unequal men/women ratio in the participant groups of most included studies. In eight of ten included studies, this ratio was strongly unbalanced (20/80%). This unequal balance in gender in the participant groups could have influenced the study results, because the effect of the NBT and the experiences of it could be different for men and women. Due to the unequal men/women ratios in this study, the study results may be less generalizable to the general population.

A strength regarding the study locations of the included studies, is that the study locations of the included studies all were in Scandinavian countries as Denmark and Sweden, except for the study of Vujcic et al. (2017), that took place in Servia. Besides, almost all included studies took place in a kind of garden, among others in green rehabilitation gardens or botanical gardens. Only the studies on forest therapy took place in forest environments. This means that the influence of the various natural environments could be more similar than when the natural environments varied more across the included studies.

A limitation regarding the six-step model of the NBT process, is that the model was based on individual rehabilitation of mental health issues, while the content of many studies included in this study was partly group-based and thus included activities in small groups of people. The six-step model of the NBT process was not based on group therapy, and there was no knowledge included about the influence of social interaction during the therapy. Besides, the model did not take into account the social interactions of the individual participants outside the therapy programme, as earlier mentioned in the discussion section. This makes the outcomes of this study more difficult to compare with the six-step model of the NBT process, as part of the theoretical framework.

A limitation regarding the design of the study, is that several studies included in this systematic review are case studies or longitudinal studies, that give space and time to participants to live their own life outside the therapy sessions. The way of living of the individual participants could have influenced the study effects, as behaviour outside of the therapy sessions influences mental health and behaviour too (Scheepers, Tobi & Boeije, 2016). In case studies and longitudinal studies, the effect of the studies is therefore more difficult to attribute to the exposure of the treatments. Although that more controlled study designs as RCT's or experiments are better able to control for this, also these kind of studies cannot completely control the behaviour and mental health and well-being of participants outside the study programme (Scheepers et al., 2016).

A strength regarding the content of the included studies, is that there are many similarities in the therapy content across the included studies. For example, seven studies included a few or mostly horticultural activities in their therapy programme. Three studies about forest therapy by Sonntag-Öström et al. (2011), Sonntag-Öström et al. (2015a) and Sonntag-Öström et al. (2015b) did not include horticultural activities in their study content, but walking and resting in nature was on the other hand the core of the content of forest therapy. This makes, that all ten studies included 'walking and resting in nature' in their study programme. About the therapy content of the control conditions can be said that the study content of almost all control conditions were quite similar to each other: all contents consisted

mostly of CBT sessions. Only the studies of Vujcic et al. (2017) and Willert et al. (2014) had a different study programme for the control conditions. Vujcic et al. (2017) also included art therapy in the programme of the control group besides the CBT sessions. The control group of the study of Willert et al. (2014) carried out the same activities as the experimental group, but then mainly inside.

A strength regarding the outcomes of this study, is that the outcomes of studies with comparable study contents often reported similar study effects. For example the studies of Gonzalez et al. (2011) and Sahlin et al. (2015) that both reported reductions in depression levels, and had a similar study content that included horticultural activities and walking and resting in nature.

Regarding bias, there could be spoken of an influence of researcher bias in this study. As pointed out in the methods section, it is not exactly clear for most included studies what the exact role of the researcher was in the data collection and in the data-analysis. Biased researchers regarding the effectiveness of the treatment could have influenced the study results to being results that are more in line with the hypothesis or desired results of the study. This could have lead to a biased data analysis and so to less reliable study results.

Beyond the scope of this research

Several questions and unknown issues arose during the writing process of this study. One of these unknown issues, is the influence of the geographical difference of the study locations of the included studies. Although that the study locations of the included studies nearly all took place in Scandinavian countries, the natural environments where the studies took place still varied between the studies. It is yet not clear what the influence of the various natural environments was in the recovery process of the study participants. Besides, it is also unclear what exact elements of nature/the NBT are effective in the recovery process of mental health issues. Furthermore, it is also unclear what influence various natural factors had in the effectiveness of the NBT as weather, temperature, season and amount of daylight. Besides, the influence of the senses on the experience and effectiveness of the NBT was also still unclear, as smell, hearing, seeing and touch. The study of Sonntag-Öström et al. (2011) obtained some information on the experiences of participants with the natural environment that the NBT took place in, but the experiences of only this study are not sufficient to draw conclusions upon what natural elements hasten recovery of mental health issues. Unfortunately, it was beyond the scope of this research to study these questions.

Recommendations and implications for future research

On the basis of this systematic review, more research is needed to the effectiveness and effective elements of NBT. Researchers should consider with carrying out future research to NBT, what elements in nature or in the content of the NBT could influence its effectiveness. Natural elements that that should be taken into account in carrying out research to the effectiveness or effective elements of NBT, are the influence of daylight, sound, smell, weather, seasons and social interaction on the study outcomes. This further research could be carried out in more controlled conditions by using controlled study designs as RCT's and experiments, because by these more controlled study designs, causality is better measurable. It would also be effective when investigating the effect of particular natural elements, to control as much as possible for the influence of other natural environments. To obtain results of higher reliability it is important to do these interventions on a large scale with many study participants, but a strong internal validity of the study is least important to obtain reliable study results.

Conclusion

The aim of this systematic review was to study the effectiveness of NBT on adults experiencing stress-, depression- and anxiety-related issues. Based on the quantitative and qualitative analysis of the included studies, the careful conclusion can be drawn that there are clues that NBT could be effective in the recovery of stress-, depression- and anxiety-related issues of adults. Positive effects of NBT were found in multiple included studies, regarding mental state, behaviour and work-ability of the study participants. Thus, this study provides small evidence that supports the promising effectiveness of NBT to tackle various societal issues at stated in this study. Multiple study findings aligned with the theoretical framework, in which validated theories regarding the positive effect of nature, and the six-step model of the NBT were part of. This study design, a systematic review, provided a broad and yet structured approach to answering the research question. Yet, answers to various questions regarding the effective elements and influencing factors on NBT still remain unanswered. Therefore, to better understand the implications of this research, further studies could address the question of what elements of NBT are effective in the recovery of mental health issues, and what factors of nature influence the effectiveness of the study.

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Appendixes

Appendix 1: Blank quality appraisal form: RCT's

Quality Assessment Tool Worksheet:
Randomized Controlled Trials

Article name: …
Authors & year of publication: …

How to use this worksheet:
Answer each question if possible with: yes, no, or can't tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-6 points: Low quality
When 7-12 points: Moderate quality
When 13-18 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated?

- Was the used methodology of the study appropriate for the research aim?

- Did the study author(s) discuss why and how this methodology was chosen?

- Was the participant recruitment strategy of the study appropriate to the research aims?

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes)

- Was the assignment of participants to treatments randomized?

- Were the groups similar at the start of the study?

- Were the participants health workers and study personnel 'blind' to treatment?

- Were the groups (aside of the experiment) treated equally?

Score section A: … of 9 points

Section B: The study results
- Have ethical issues been taken into consideration?

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process)

- Is there a clear statement of findings?

- How large was the treatment effect?

- Were all clinically important outcomes considered?

- What is the effect of the study results? (e.g. do the study results give new information, are they valid)

Score section B: … of 6 points

Section C: The external validity
- Can the study results be applied to the target population?

- Are the benefits of the study worth the harms and costs?

- How valuable is the research?

Score section C: … of 3 points

Final score of article quality: … of 18 points, which means a low/moderate/strong (underline the correct answer) article quality.

Appendix 2: Blank quality appraisal form: Experiments

Quality Assessment Tool Worksheet: Experiments

Article name: …
Authors & year of publication: …

How to use:
Answer each question if possible with: yes, no, or can't tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 16 points:
When 0-5 points: Low quality
When 6-10 points: Moderate quality
When 11-16 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated?

- Was the used methodology of the study appropriate for the research aim?

- Did the study author(s) discuss why and how this methodology was chosen?

- Was the participant recruitment strategy of the study appropriate to the research aims?

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes)

- Were the participants health workers and study personnel 'blind' to treatment?

- Were the groups (aside of the experiment) treated equally?

Score section A: … of 7 points

Section B: The study results
- Have ethical issues been taken into consideration?

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process)

- Is there a clear statement of findings?

- How large was the treatment effect?

- Were all clinically important outcomes considered?

- What is the effect of the study results? (e.g. do the study results give new information, are they valid)

Score section B: … of 6 points

Section C: The external validity
- Can the study results be applied to the target population?

- Are the benefits of the study worth the harms and costs?

- How valuable is the research?

Score section C: … of 3 points

Final score of article quality: … of 16 points, which means a low/moderate/strong (underline the correct answer) article quality.

Appendix 3: Blank quality appraisal form: Several study designs

Quality Assessment Tool Worksheet: Case studies, longitudinal studies, observational studies, systematic reviews/meta-analyses

Article name: …
Authors & year of publication: …

How to use:
Answer each question if possible with: yes, no, or cant tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-4 points: Low quality
When 5-8 points: Moderate quality
When 9-12 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated?

- Was the used methodology of the study appropriate for the research aim?

- Did the study author(s) discuss why and how this methodology was chosen?

- Was the participant recruitment strategy of the study appropriate to the research aims?

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes)

Score section A: … of 5 points

Section B: The study results
- Have ethical issues been taken into consideration?

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process)

- Is there a clear statement of findings?

- What is the effect of the study results? (e.g. do the study results give new information, are they valid)

Score section B: … of 4 points

Section C: The external validity
- Can the study results be applied to the target population?

- Are the benefits of the study worth the harms and costs?

- How valuable is the research?

Score section C: … of 3 points

Final score of article quality: … of 12 points, which means a low/moderate/strong (underline the correct answer) article quality.

Appendix 4: Corazon et al. (2018)

Quality Assessment Tool Worksheet:
Randomized Controlled Trials

Article name: A long-term follow-up of the efficacy of Nature-Based Therapy for adults suffering from stress-related illneses on levels of healthcare consumption and sick-leave absence: A Randomized Controlled Trial

Authors & year of publication: Corazon, S.S., Nyed, P.K., Sidenius, U., Poulsen, D.V., Stigsdotter, U.K. (2018)

How to use this worksheet:
Answer each question if possible with: yes, no, or can't tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-6 points: Low quality
When 7-12 points: Moderate quality
When 13-18 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated? 1
Yes they are

- Was the used methodology of the study appropriate for the research aim? 1
Yes very appropriate, the research aims to measure the effect of the NBT, carrying out a study in the form of a RCT is the most reliable and most controlled study design to measure the effect.

- Did the study author(s) discuss why and how this methodology was chosen? 1
Yes, because evidence regarding the effectiveness of NBTs is lacking, and the RCT to this study topic are limited to.

- Was the participant recruitment strategy of the study appropriate to the research aims? 1
Yes, various recruitment strategies were used to obtain suitable and various participants which is very good. Also, the assessment if the participants were suitable for the study was very carefully described.

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes) 0.5
A lot of actions in the interventions were done by health practitioners like psychologists and a psychiatrist, the researcher itself did not really help himself which prevents the researcher bias of the study and influence on the study outcomes. It is not described directly, but I sensed in the article that they thought about it.

- Was the assignment of participants to treatments randomized? 1
Yes

- Were the groups similar at the start of the study? 0
That is not clear, I don't think so. The 84 participants were randomly assigned to the experimental and control group.

- Were the participants health workers and study personnel 'blind' to treatment? 0
No

- Were the groups (aside of the experiment) treated equally? 1
Yes

Score section A: 6.5 of 9 points

Section B: The study results
- Have ethical issues been taken into consideration? 1
Yes, approval by ethics committee

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process) 1
Yes

- Is there a clear statement of findings? 1
Yes, clearly written and compactly stated.

- How large was the treatment effect? 0.5
Not very large, there are some significant treatment effects but they are quite small.

- Were all clinically important outcomes considered? 0
Not really. Sick-leave and health care consumption were used as outcome measures, but a lot of other factors play a role in the results of these outcome variables! Like social contacts, everyday life, experience of the treatment, etc. Those factors were all not measured.

- What is the effect of the study results? (e.g. do the study results give new information, are they valid) 0.5
They do give new information, although it is not much.

Score section B: 4.5 of 6 points

Section C: The external validity
- Can the study results be applied to the target population? 1
Yes, various patients, various recruitment strategies, various symptoms.

- Are the benefits of the study worth the harms and costs? 1
Yes, not much harm, quite costs, but the results are worth the costs.

- How valuable is the research? 0.5
Quite valuable, it gives new significant results and insight in the study topic. Despite that, not much new information.

Score section C: 2.5 of 3 points

Final score of article quality: 13.5 of 18 points, which means a low/moderate/**strong** (underline the correct answer) article quality.

Appendix 5: Gonzalez et al. (2011)

Quality Assessment Tool Worksheet: Case studies, longitudinal studies, observational studies, systematic reviews/meta-analyses

Article name: A prospective study of existential issues in therapeutic horticulture for clinical depression
Authors & year of publication: Marianne Thorsen Gonzalez, Terry Hartig, Grete Grindal Patil, Egil Wilhelm Martinsen & Marit Kirkevold (2011)

How to use:
Answer each question if possible with: yes, no, or can't tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-4 points: Low quality
When 5-8 points: Moderate quality
When 9-12 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated? 1
Yes

- Was the used methodology of the study appropriate for the research aim? 0.5
A bit, a RCT would have been more suitable, but this follow-up design was also valuable.

- Did the study author(s) discuss why and how this methodology was chosen? 0.5
Yes, it is explained why, but not how.

- Was the participant recruitment strategy of the study appropriate to the research aims? 0
Not really actually. they wanted very specific participants (a lot of inclusion and exclusion criteria before a participant could join the study), and they used advertisements in news papers to obtain them. One of the exclusion criteria was also that the participant did not work in the garden as leisure activity, in the first place; a lot of people do that, and secondly; these people are also the people who are interested in that advertisement and will read and react to it. So that choice did not seem very logical to me.

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes) 0
No

Score section A: 2 of 5 points

Section B: The study results
- Have ethical issues been taken into consideration? 1
Yes, approval of ethics committee

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process) 1
Yes

- Is there a clear statement of findings? 1
Yes

- What is the effect of the study results? (e.g. do the study results give new information, are they valid) 1
They give new information and are valid too

Score section B: 4 of 4 points

Section C: The external validity
- Can the study results be applied to the target population? 0
I dont think so, participant recruitment through advertisements is not the best way I think. Also, the participant groups were quite small.

- Are the benefits of the study worth the harms and costs? 0.5
Yes they are, not much harms, many costs: but they are worth it.

- How valuable is the research? 0.5
It gives new information, although it could have been more reliable and valuable if it had another study design.

Score section C: 1 of 3 points

Final score of article quality: 7 of 12 points, which means a low/**moderate**/strong (underline the correct answer) article quality.

Appendix 6: Grahn et al. (2017)

Quality Assessment Tool Worksheet: Experiments

Article name: Longer nature-based rehabilitation may contribute to a faster return to work in patients with reactions to severe stress and/or depression
Authors & year of publication: Grahn, P., Pálsdóttir, A.M., Ottosson, J., Jonsdottir, I.H. (2017)

How to use:
Answer each question if possible with: yes, no, or can't tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 16 points:
When 0-5 points: Low quality
When 6-10 points: Moderate quality
When 11-16 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated? 1
Yes

- Was the used methodology of the study appropriate for the research aim? 1
Yes, definitely. Maybe the best possible study design to measure NB-rehabilitation effects because of the quasi-experimental design.

- Did the study author(s) discuss why and how this methodology was chosen? 1
Yes

- Was the participant recruitment strategy of the study appropriate to the research aims? 0.5
Yes, the only thing is that it is not clear how homogenous/heterogenous the participant groups are.

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes) 0.5
Yes a bit taken into account.

- Were the participants health workers and study personnel 'blind' to treatment? 1
No

- Were the groups (aside of the experiment) treated equally? 1
Yes

Score section A: 6 of 7 points

Section B: The study results
- Have ethical issues been taken into consideration? 1
Yes

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process) 1
Yes

- Is there a clear statement of findings? 1
Yes

- How large was the treatment effect? 1
Quite large, RTW rates were quite high!

- Were all clinically important outcomes considered? 1
Yes, many outcome measures were taken into account.

- What is the effect of the study results? (e.g. do the study results give new information, are they valid) 1
They give new information, for example that the longer the nature-based rehabilitation period endures, the more likely participants are to recover from their symptoms.

Score section B: 6 of 6 points

Section C: The external validity
- Can the study results be applied to the target population? 0.5
In a certain way, yes. Via social insurance officers they were recruited.

- Are the benefits of the study worth the harms and costs? 1
Yes, costs were worth the results

- How valuable is the research? 1
Quite valuable

Score section C: 2.5 of 3 points

Final score of article quality: 14.5 of 16 points, which means a low/moderate/**strong** (underline the correct answer) article quality.

Appendix 7: Sahlin et al. (2015)

Quality Assessment Tool Worksheet: Case studies, longitudinal studies, observational studies, systematic reviews/meta-analyses

Article name: Using Nature-Based Rehabilitation to Restart a Stalled Process of Rehabilitation in Individuals with Stress-Related Mental Illness
Authors & year of publication: Sahlin, E., Ahlborg, G., Tenenbaum, A. & Grahn, P (2015)

How to use:
Answer each question if possible with: yes, no, or cant tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-4 points: Low quality
When 5-8 points: Moderate quality
When 9-12 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated? 1
Yes definitely!

- Was the used methodology of the study appropriate for the research aim? 0.5
Not really, that is also a topic discussed in the discussion section. The aim was to explore the effect of the intervention, therefore a follow-up study was well chosen, but the effect of the interventions were more difficult to measure or control for other factors because of the less 'controlled' design. An experimental design could therefore have been more suitable.

- Did the study author(s) discuss why and how this methodology was chosen? 1
Yes, they did.

- Was the participant recruitment strategy of the study appropriate to the research aims? 0.5
Yes, not really randomized though. But participants were free to join, tested if they could join the study (inclusion criteria), and were therefore assessed by professional health practitioners.

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes) 1
Yes, choices were made concerning the role of the researcher in the methods of the study and the outcomes.

Score section A: 4 of 5 points

Section B: The study results
- Have ethical issues been taken into consideration? 1
Yes, approval by ethics committee

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process) 1
Yes, quite precisely.

- Is there a clear statement of findings? 1
Yes there is.

- What is the effect of the study results? (e.g. do the study results give new information, are they valid) 0.5
Results are promising for the future role of NBT forms. Although, the participant groups are small and OHS group was not the best control group to compare with the experimental group. So if the results are that reliable, is a point of discussion.

Score section B: 3.5 of 4 points

Section C: The external validity
- Can the study results be applied to the target population? 0.5
I think they can to a certain extent. The study outcomes are very complete (a lot of outcome measures were taken into account/were used to measure the treatment effect) which makes the results of this study quite complete and valuable. Despite that, the participant groups were small and from one hospital.

- Are the benefits of the study worth the harms and costs? 1
Yes, harms are low, costs are high, but the results of the study are worth the costs I think.

- How valuable is the research? 1
For an explorative study design, the research is very valuable and gives a good insight in the possible promosing effect of NBT.

Score section C: 2.5 of 3 points

Final score of article quality: 10 of 12 points, which means a low/moderate/**strong** (underline the correct answer) article quality.

Appendix 8: Sonntag-Öström et al. (2011)

Quality Assessment Tool Worksheet: Case studies, longitudinal studies, observational studies, systematic reviews/meta-analyses

Article name: Can the boreal forest be used for rehabilitation and recovery from stress-related exhaustion? A pilot study
Authors & year of publication: Sontag-Öström, E., Nordin, M., Järvholm, L.S., Lundell, Y., Brännström, R., Dolling, A. (2011)

How to use:
Answer each question if possible with: yes, no, or can't tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-4 points: Low quality
When 5-8 points: Moderate quality
When 9-12 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated? (1)
Yes

- Was the used methodology of the study appropriate for the research aim? (1)
Yes I think so, both quantitative and qualitative methods were used to obtain the required study results. These two kinds of methods combined, are suitable to obtain answers on the varying research aims which varied from aims that require statistical results to answers on the experience of the forest sides.

- Did the study author(s) discuss why and how this methodology was chosen? (0)
No, they did not.

- Was the participant recruitment strategy of the study appropriate to the research aims? (1)
Yes I think so, the participants were obtained through a Swedish Health Care Centre that investigated and measured the mental health complaints of the participants.

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes) (0)
No, nothing is told about the role of the researcher in the study.

Score section A: 3 of 5 points

Section B: The study results
- Have ethical issues been taken into consideration? (0.5)
Yes, the researchers thought about it, but ethical approval was not required for the study because the study is a pilot study and can therefore be seen as a part of the development and the evaluation of a clinical treatment.

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process) (1)
Yes, the data analysis is quite detailed.

- Is there a clear statement of findings? (0.5)
The findings are written out very detailed in long complex sentences, which makes that there is not a short clearly statement of what is exactly found.

- What is the effect of the study results? (e.g. do the study results give new information, are they valid) (1)
The effect of the study results is quite big, it is one of the first studies to the effect of forest therapy and it shows hopeful results for the further research to the effect of it.

Score section B: 3 of 4 points

Section C: The external validity
- Can the study results be applied to the target population? (0)
I do not think so, because the study population is very small and only Swedish participants took part in the study.

- Are the benefits of the study worth the harms and costs? (1)
Yes I definitely think so, because the participants were positive about the practical

arrangement of the study, and because of the found study results which are promising for further research.

- How valuable is the research? (1)
I think the research is valuable, for new knowledge about the effectiveness of forest therapy is found.

Score section C: 2 of 3 points

Final score of article quality: 8 of 12 points, which means a low/**moderate**/strong (underline the correct answer) article quality.

Appendix 9: Sonntag-Öström et al. (2015a)

Quality Assessment Tool Worksheet:
Randomized Controlled Trials

Article name: Can rehabilitation in boreal forests help recovery from exhaustion disorder? The randomised clinical trial ForRest

Authors & year of publication: Sonntag-Öström, E., Nordin, M., Dolling, A., Lundell, Y., Nilsson, L., Järvholm, L.S. (2015)

How to use this worksheet:
Answer each question if possible with: yes, no, or can't tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-6 points: Low quality
When 7-12 points: Moderate quality
When 13-18 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated? (1)
Yes, they are very clearly stated.

- Was the used methodology of the study appropriate for the research aim? (1)
Yes, the RCT is a very trustworthy method to study the effect of an intervention and to equalize other possible influencing factors on the study outcomes.

- Did the study author(s) discuss why and how this methodology was chosen? (0)
No

- Was the participant recruitment strategy of the study appropriate to the research aims? (1)
Yes, the participants were all found through screening or by asking the Swedish Social Insurance Agency if this Agency knew any participants that could participate in the study.

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes) (0)
No

- Was the assignment of participants to treatments randomized? (1)
Yes, and the randomization was carried out carefully. Besides, prevention of possible bias for randomization was thought of and discussed.

- Were the groups similar at the start of the study? (1)
Yes

- Were the participants health workers and study personnel 'blind' to treatment? (0)
No, they all knew what the content of the interventions was about. To inform the participants before the start of the treatment is needed for the participants to know in what kind of study they participate.

- Were the groups (aside of the experiment) treated equally? (0.5)
Can't tell, I think they are but it is not clear from the article.

Score section A: 5.5 of 9 points

Section B: The study results
- Have ethical issues been taken into consideration? (1)
Yes

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process) (1)
Yes, the results were represented and explained in detail.

- Is there a clear statement of findings? (1)
Yes there is a clear and short overview of the findings.

- How large was the treatment effect? (0.5)
The treatment effect was not really large, because most of the results that were found were not statistically significant. Despite that, the study gave some new information regarding the

effect of forest visits as (part of) a therapy and the effect of the forest visits was measured compared to contemporary kinds of therapy.

- Were all clinically important outcomes considered? (1)
Yes I think so, various outcome measures were used that presented a complete view of the effects of the treatments.

- What is the effect of the study results? (e.g. do the study results give new information, are they valid) (0.5)
They give some new information about the effect of forest visits which are valid too.

Score section B: 5 of 6 points

Section C: The external validity
- Can the study results be applied to the target population? (0.5)
Partly they are. The participant groups consisted of men and women with various ages and characteristics. Unfortunately, the participant groups consisted out of merely women and men were outnumbered.

- Are the benefits of the study worth the harms and costs? (1)
I think they are, because new information was discovered and the study contributes to research to the effect of NBT.

- How valuable is the research? (1)
I think it is quite valuable for the research to forms of Nature-Based Therapy to know this information.

Score section C: 2.5 of 3 points

Final score of article quality: 13 of 18 points, which means a low/moderate/**strong** (underline the correct answer) article quality.

Appendix 10: Sonntag-Öström et al. (2015b)

Quality Assessment Tool Worksheet:
Randomized Controlled Trials

Article name: ''Nature's effect on my mind'' – Patients' qualitative experiences of a forest-based rehabilitation programme
Authors & year of publication: Sonntag-Öström, E., Nordin, M., Dolling, A., Lundell, Y., Nilsson, L., Järvholm, L.S. (2015b)

How to use this worksheet:
Answer each question if possible with: yes, no, or can't tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-6 points: Low quality
When 7-12 points: Moderate quality
When 13-18 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated? (1)
Yes, there are clearly written.

- Was the used methodology of the study appropriate for the research aim? (1)
Yes, the RCT is a very trustworthy method to study the effect of an intervention and to equalize other possible influencing factors on the study outcomes.

- Did the study author(s) discuss why and how this methodology was chosen? (0.5)
It is partly discussed why this methodology was chosen, it could have been written out more clearly and more complete.

- Was the participant recruitment strategy of the study appropriate to the research aims? (1)
Yes, the participants were all found through screening or by asking the Swedish Social Insurance Agency if this Agency knew any participants that could participate in the study.

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes) (0)
No

- Was the assignment of participants to treatments randomized? (1)
Yes

- Were the groups similar at the start of the study? (1)
In this study, only the experimental group (the group that followed NBT) was interviewed, so no comparison was made between the two study group from the other article of Sonntag-Öström et al. (2015). From Sonntag-Öström et al. (2015a) I know that the groups were similar.

- Were the participants, health workers and study personnel 'blind' to treatment? (0)
No, they all knew what the content of the interventions was about. To inform the participants before the start of the treatment is needed for the participants to know in what kind of study they participate.

- Were the groups (aside of the experiment) treated equally? (0.5)
Same as other article of Sonntag-Öström et al. (2015): I can't tell, I think they are but it is not clear from the article.

Score section A: 6 of 9 points

Section B: The study results
- Have ethical issues been taken into consideration? (1)
From the other article of Sonntag-Öström et al. (2015), I know the answer is yes. But from this article I cannot tell.

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process) (1)
Yes, the data analysis was quite clear and complete.

- Is there a clear statement of findings? (1)
Yes

- How large was the treatment effect? (0.5)

The effect was quite there, the effect was seen in a change in mental state in the short-term, effects on long-term mental state were not really there.

- Were all clinically important outcomes considered? (1)
Yes for this qualitative study design, I think so.

- What is the effect of the study results? (e.g. do the study results give new information, are they valid) (1)
The results do give new information, the results are also valid because these are valid in qualitative study designs. Some interview answers were given by more participants and so, maybe an effect can be drawn upon these results.

Score section B: 5.5 of 6 points

Section C: The external validity
- Can the study results be applied to the target population? (0)
No, because the study participants were mainly women and were all Swedish.

- Are the benefits of the study worth the harms and costs? (1)
Yes I think so

- How valuable is the research? (1)
I think it is valuable to get to know the experiences of the participants of this NBT, additionally to studying the effect of the treatment on mental state.

Score section C: 2 of 3 points

Final score of article quality: 13.5 of 18 points, which means a low/moderate/**strong** (underline the correct answer) article quality.

Appendix 11: Vujcic et al. (2017)

Quality Assessment Tool Worksheet:
Randomized Controlled Trials

Article name: Nature Based solution for improving mental health and well-being in urban areas
Authors & year of publication: Vujcic, M., Tomicevic-Dubljevic, J., Grbic, M., Lecic-Tosevski, D., Vukovic, O., Toskovic, O. (2017)

How to use this worksheet:
Answer each question if possible with: yes, no, or can't tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-6 points: Low quality
When 7-12 points: Moderate quality
When 13-18 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated? 1
It is clear to me

- Was the used methodology of the study appropriate for the research aim? 1
Yes, a RCT is a reliable and prevents or minimizes the effect of other external factors (as confounders) on the study outcomes, more than other (experimental) study methods. Because the participants for the study groups (control and experimental) are randomized, the risk for influence of the participants on the study outcomes are also diminished.

- Did the study author(s) discuss why and how this methodology was chosen? 0
No

- Was the participant recruitment strategy of the study appropriate to the research aims? 1
Yes, randomly selected from the hospital.

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes) 0
No

- Was the assignment of participants to treatments randomized? 1
Yes

- Were the groups similar at the start of the study? 1
Yes

- Were the participants health workers and study personnel 'blind' to treatment? 0
No

- Were the groups (aside of the experiment) treated equally? 1
Yes

Score section A: 6 of 9 points

Section B: The study results
- Have ethical issues been taken into consideration? 1
Yes, approval from ethics committee.

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process) 1
Yes

- Is there a clear statement of findings? 1
Yes

- How large was the treatment effect? 1
Clearly stated that the effect was there

- Were all clinically important outcomes considered? 0.5
Yes most of them, I missed the reporting of the experiences of participants with the different treatments. That is also an important outcome to know if these treatments are suitable and comfortable.

- What is the effect of the study results? (e.g. do the study results give new information, are they valid) 1
Quite big, shows effect of HT quite clearly and how promising the effect of HT can be.

Score section B: 5.5 of 6 points

Section C: The external validity

- Can the study results be applied to the target population? 0

No, participants groups are way too small. Also, all participants were from one hospital in Sweden.

- Are the benefits of the study worth the harms and costs? 1

Yes, there were not really harms. High costs, but the results are promosing and helpful in the research to the effect of nature-based therapies, so in my eyes it was worth the costs as well.

- How valuable is the research? 0.5

It was a study of good quality, but there were a few things missing and the conclusions are not that strong because of the little participant samples.

Score section C: 1.5 of 3 points

Final score of article quality: 13 of 18 points, which means a low/moderate/**strong** (underline the correct answer) article quality.

Appendix 12: Währborg et al. (2014)

Quality Assessment Tool Worksheet: Case studies, longitudinal studies, observational studies, systematic reviews/meta-analyses

Article name: Nature-assisted rehabilitation for reactions to severe stress and/or depression in a rehabilitation garden: Long-term follow-up including comparisons with a matched population-based reference cohort
Authors & year of publication: Währborg, P., Petersson, I.F., Grahn, P. (2014)

How to use:
Answer each question if possible with: yes, no, or cant tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-4 points: Low quality
When 5-8 points: Moderate quality
When 9-12 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated? 1
Yes

- Was the used methodology of the study appropriate for the research aim? 0.5
Kind of, maybe an experimental design would have been more suitable.

- Did the study author(s) discuss why and how this methodology was chosen? 0
No

- Was the participant recruitment strategy of the study appropriate to the research aims? 1
Yes

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes) 0
No

Score section A: 2.5 of 5 points

Section B: The study results
- Have ethical issues been taken into consideration? 1
Yes, approval by ethics committee

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process) 0.5
Something is said about it, but very little.

- Is there a clear statement of findings? 0.5
Yes, but a bit vaguely described

- What is the effect of the study results? (e.g. do the study results give new information, are they valid) 0.5
Not a big impact, little new information is found, but they are valid.

Score section B: 2.5 of 4 points

Section C: The external validity
- Can the study results be applied to the target population? 1
Yes I think so, because of the big participant groups.

- Are the benefits of the study worth the harms and costs? 0.5
Not really. costs are high and results are not that valuable and new.

- How valuable is the research? 0.5
Gives new information, but not much. Also difficult to say how reliable the information is.

Score section C: 2 of 3 points

Final score of article quality: 7 of 12 points, which means a low/**moderate**/strong (underline the correct answer) article quality.

Appendix 13: Willert et al. (2014)

Quality Assessment Tool Worksheet: Case studies, longitudinal studies, observational studies, systematic reviews/meta-analyses

Article name: Rehabilitation of individuals on long-term sick leave due to sustained stress-related symptoms: A comparative follow-up study
Authors & year of publication: Willert, M.V., Thulstrup, A.M., Wieclaw, J. (2014)

How to use:
Answer each question if possible with: yes, no, or can't tell. When the answer to the question is 'yes', the question gets a one point score, if the answer is 'can't tell', the question gets 0.5 points, and if the answer is 'no', the question gets zero points. Further describe why you chose this answer in a few sentences. When the question cannot be answered with yes, no or can't tell, decide if the answer to the question deserves a point. To calculate the final score of the article quality, the points earned in each particular section can be added up at the end of the worksheet. That results in a total score on the quality of the article between 0 and 18 points:
When 0-4 points: Low quality
When 5-8 points: Moderate quality
When 9-12 points: Strong quality

Section A: The internal validity
- Are the research aims clearly stated? 1
Yes, clearly stated.

- Was the used methodology of the study appropriate for the research aim? 0.5
Not really, an experimental design would have been better suitable I think to measure the effects of both interventions. Although I do think that they did quite good with this design concerning the case-mix of individuals and the two programmes that looked a lot like each other.

- Did the study author(s) discuss why and how this methodology was chosen? 0
No

- Was the participant recruitment strategy of the study appropriate to the research aims? 0.5
Kind of, yes. Via work places (two job centres) all participants were recruited, to make this recruitment strategy better and the participant groups better representative for the population, the participants would have been recruited from various job centres.

- Has/have the researcher(s) critically examined their own role in the study? (e.g. potential bias/influence on study methodology and outcomes) 0
No

Score section A: 2 of 5 points

Section B: The study results
- Have ethical issues been taken into consideration? 1
Yes, approval by ethics committee

- Was the data analysis sufficiently rigorous? (e.g. in depth-description of analysis process) 1
Yes it was

- Is there a clear statement of findings? 1
Yes there is

- What is the effect of the study results? (e.g. do the study results give new information, are they valid) 0.5

The study results give new information (not sure how reliable it is): information that the treatment outside is not really better working than inside. The two participant groups were not really comparable for several reasons, so the study does not give really new reliable information.

Score section B: 3.5 of 4 points

Section C: The external validity
- Can the study results be applied to the target population? 0.5
Kind of, yes. Their goal was to picture the effect of the treatments of people in their municipality, and all participants came out of the municipality and the groups were quite big (although not quite comparable in other ways).

- Are the benefits of the study worth the harms and costs? 0
Not really, results are not very reliable and no effect was found of the experimental treatment. No much harms, but high costs, therefore not

really worth it. An effect is found, but how reliable is it?

- How valuable is the research? 0
Not really valuable

Score section C: 0.5 of 3 points

Final score of article quality: 6 of 12 points, which means a low/**moderate**/strong (underline the correct answer) article quality.

Appendix 14: Results table

* The results table will be inserted for the final version of the thesis

Article name	Authors	Publication date	Study setting	Participant characteristics	NBT form	Study content	Study outcomes	Article quality
1) A long-term follow-up of the efficacy of Nature-Based Therapy for adults suffering from stress-related illnesses on levels of healthcare consumption and sick-leave absence: A RCT	Corazon, S.S., Nyed, P.K., Sidenius, U., Poulsen, D.V., Stigsdotter, U.K.	2018	Nacadia Nature-Based Therapy Garden in Copenhagen, Denmark.	<u>Participant number</u> Total of 72 participants NBT group: 37 CBT group: 35 <u>Participants' age and diagnosis</u> 20-60 years old Diagnosis of stress-related disorder/mood disorder <u>Mean age</u> NBT group: 47.9 years old CBT group: 44.9 years old <u>M/W ratio</u> NBT group: 18/82 % CBT group: 18/82 %	The experimental group did various nature-based activities, and the control group cognitive behavioural therapy (CBT).	<u>NBT</u> Individually and group therapy in groups of six people. Three times a week three hours, for ten weeks. Activities were therapeutic conversations, mindfulness exercises, gardening activities, relaxation time. <u>CBT</u> Indoor individual CBT sessions. One hour per week, during 20 weeks.	The two outcome measures of this study are sick leave and healthcare consumption. <u>Sick leave</u> *NBT and CBT* No significant change was found in sick-leave for participants from twelve months before treatment compared to twelve months after treatment ($p>0.05$). From twelve months before treatment sick leave levels increased, and from treatment's end to twelve months after treatment these levels decreased in a similar extent as the increase. However, a significant decrease was found in the experimental group and control group between sick leave levels one month before treatment and	13.5/18 points Quality: Strong

							twelve months after treatment (NBT: p<0.001; CBT: p<0.01). *NBT* 23 participants who were on sick leave prior to treatment, were not on sick leave anymore 12 months after the end of the treatment. *CBT* 15 participants who were on sick leave prior to treatment, were not on sick leave anymore 12 months after the end of the treatment. <u>Healthcare consumption</u> *NBT* The mean number of contacts with a GP decreased significantly from 18 to 13 number of contacts from 12 months before treatment to 12 months after treatment with an	

							effect size of r = -0.396 ($p<0.01$). *CBT* The mean number of contacts with a GP decreased significantly from 21 to 14 number of contacts from 12 months before treatment to 12 months after treatment with an effect size of r = -0.249 ($p<0.05$).	
2) Longer nature-based rehabilitation may contribute to a faster return to work in patients with reactions to severe stress and/or depression	Grahn, P., Pálsdóttir, A.M., Ottosson, J., Jonsdottir, I.H.	2017	The Alnarp Rehabilitation Garden in Southern Sweden.	<u>Participant number</u> Total of 106 participants <u>Participants' age and diagnosis</u> 22 to 63 years old Diagnosis of severe stress complaints and/or mild to moderate depressive episodes. <u>Mean age</u> 45.7 years old <u>M/W ratio</u> 12 / 88 %	Horticultural therapy	Rehabilitation programme in groups of eight participants for 8, 12 or 24 weeks. Individual rehabilitation plan for every individual for physical and psychotherapy outdoors. Rehabilitation sessions were 4 days a week, from Monday until Thursday for three and a half hours a day. Programme consisted of horticultural	The outcome measures of this study are self-rated RTW, occupational competence, SOC and personal control. <u>Self-rated RTW</u> 42 participants (44%) returned to full-time or part-time work after one year from the end of the treatment. Fourteen of them returned to full-time work. 53 participants did not return to paid work. 23 participants of these,	14.5/16 points Quality: Strong

						activities: gardening, walking and resting in the garden.	took part in a job training or other forms of work-oriented measures like job training. 30 participants of these, did not do any work-related activity one year after. There was no information obtained from eleven participants. The longer the rehabilitation period endured, the more patients returned to full-time work ($p<0.05$). Additionally, rehabilitation of twelve weeks reported significant higher RTW than the eight week program ($p<0.05$). Occupational competence, SOC and personal control did not predict return to work.	

3) Nature-based solution for improving mental health and well-being in urban areas	Vujcic, M., Tomicevic-Dubljevic, J., Grbic, M., Lecic-Tosevski, D., Vukovic, O., Toskovic, O.	2017	A botanical garden in Belgrade, Servia.	<u>Participant number</u> Total of 30 participants Experimental group: 16 Control group: 14 <u>Participants' age and diagnosis</u> 25-65 years old Diagnosis of adjustment disorder, depression disorder or severe stress complaints <u>M/W ratio</u> 30 / 70 % <u>Mean age</u> 45.35 years old	The experimental group followed horticultural therapy, and the control group art therapy and conventional therapy.	Horticultural therapy for three days a week for one hour, during four weeks. Every day had another programme, during which the participants did various daily activities such as walking and resting in the garden, gardening, and art therapy like drawing natural elements. Parallel with the experimental group, the control group followed art therapy and occupational therapy without plant environment during the same time and frequency as the experimental group.	The outcome measures of this study are stress, anxiety and depression levels. These were measured by the DASS-scale. <u>Stress</u> A significant change in stress level was found from pre- to post-design in the experimental group, the stress level change was significantly higher in the experimental group than in the control group (F: 5.442, $p<0.05$). <u>Anxiety</u> No significant difference in anxiety level change between the experimental and control group was found. One remarkable finding regarding anxiety level change, was that the anxiety levels of male participants from the experimental group were reduced to a	13/18 points Quality: Strong

							bigger extent than the anxiety levels of the male participants in the control group. This effect was not found between the female participants of the experimental and control group. This is only a remarkable result, not a significant trend (p=0.171). <u>Depression</u> No significant difference in depression level change within and between the experimental and control group was found.	
4) Using Nature-Based Rehabilitation to restart a stalled process of rehabilitation in individuals with stress-related mental illness	Sahlin, E., Ahlborg, G., Tenenbaum, A. & Grahn, P.	2015	The venue consisted of a small house with a conservatory, a garden, and a greenhouse. A 222-acre nature reserve was nearby. The study took place in the region	<u>Participant number</u> Total of 102 participants Experimental group: 57 Control group: 45 <u>Participants' age and diagnosis</u> Experimental group: 26 – 63 years old	The experimental group did various nature-based activities, and the control group followed conventional therapy.	The NBT programme consisted of two parts, and endured in total for six months: a 16 week rehabilitation programme, followed by a 12 week programme of partial return to work or study with more and more time at work or	The outcome measures of this study are burn-out, depression level, anxiety level, well-being, sick leave, and healthcare consumption. Outcomes were measured at baseline (T1), at the end of the treatment (T2), after six months after	10/12 points Quality: Strong

			Västra Götaland, Sweden.	Control group: 32 – 61 years old Diagnosis regarding stress-related mental illness, such as Exhaustion Disorder (ED), depression and anxiety. <u>Mean age</u> Experimental group: 45 years old Control group: 49 years old <u>M/W ratio</u> Experimental group: 7 / 93 % Control group: 0 / 100 %		studying with a corresponding decrease in participation in the NBT programme. The rehabilitation included garden activities, weekly guided walks in the nature reserve, therapeutic painting, therapeutic group and individual conversations, guided relaxation in nature and indoors (mostly mindfulness and breathing techniques), body awareness and information about stress (reactions) and the benefits of physical activity, as well as about nature's role in health and stress reduction. These activities took place in groups with a maximum of eight participants.	treatment (T3) and a year after treatment (T4). For the control group, only sick-leave and health-care utilization were measured. <u>Burn-out</u> Burn-out was measured by a self-assessed survey, in which one point means completely no complaints and seven points means very many complaints. The results reduced significantly from 5.2 at T1, to 4.4 at T2 (CI: 8.6; 36.9), to 4.26 at T3 (CI: 7.9; 38.2), and 4.12 at T4 (CI: 19.6; 55.8). <u>Depression</u> Depression was measured by a self-assessed survey for which the maximum score is 63 points. The results significantly reduced from 23.2 at T1 to 15.7 at T2, to 14.2 at T3 to	

						The participants of the control group followed an individually planned rehabilitation plan, based on five key principles: increased physical activity (prescribed), counselling, medication, individual-adapted prescribed complete or partial sick leave, and close dialogue with the employer/manager. These individual plans endured six months in total.	13.0 at T4. All reductions had p-values beneath the significance threshold $p<0.05$, those were $p<0.0001$. Also, the number of participants experiencing moderate or severe depression decreased from 52% at T1 to 26% at T3 and decreased further to 21% at T4. <u>Anxiety</u> Anxiety was measured by a self-assessed survey for which the maximum score is 63 points. The results reduced significantly from 17.2 at T1 to 12.8 at T2 ($p=0.001$), to 12.1 at T3 ($p=0.005$) to 10.2 at T4 ($p<0.0001$). Additionally, the number of participants scoring moderate to severe anxiety decreased significantly from 47% at T1 to 34% at T3, to 19% at T4.	

							<u>Well-being</u> Well-being is measured by a self-assessed survey for which the scores vary between 22 and 132 points, the higher the score the better the well-being. The results significantly increased from 41.9 at T1 to 46.7 at T2 ($p=0.001$), to 47.8 at T3 ($p=0.005$), to 49.1 at T4 ($p<0.0001$). <u>Sick-leave</u> The number of sick leave days were measured over three periods. Period 1 (P1): six months before treatment to treatment start. Period 2 (P2): from completion of the treatment to six months ahead. Period 3 (P3): from completion of the 16 weeks of rehabilitation	

							and seven to twelve months thereafter. The experimental group showed a significant decrease in the number of sick leave days. The amount of sick leave days decreased from 7204 days at P1 to 5335 days at P2 (CI: 24.5; 60.5) to 3982 days at P3 (CI: 6.0; 55.5). The control group showed increased and decreased numbers of sick leave days. The number increased significantly from 3897 days at P1 to 6997 days at P2 (CI: -93.0; -44.8), and decreased non-significantly to 3951 days at P3. <u>Healthcare consumption</u> The experimental group showed a significant decrease in healthcare	

							consumption (visits to medical professionals), the visits decreased from 19.2 visits at P1 to 10.8 visits at P2 (CI: -12.0; -4.7). The control group showed a significant decrease in healthcare consumption between P2 and P3: the visits decreased from 17.6 visits at P2 to 11.0 visits at P3 (CI: 3.7; 9.4).	
5) Nature-assisted rehabilitation for reactions to severe stress and/or depression in a rehabilitation garden: Long-term follow-up including comparisons with a matched population-based reference cohort	Währborg, P., Petersson, I.F. & Grahn, P.	2014	Green rehabilitation garden in Alnarp, Southern Sweden.	<u>Participant number</u> Total of 779 participants Experimental group: 103 Control group: 678 <u>Participants' age and diagnosis</u> 30 – 64 years old Diagnosis of severe stress and/or mild to moderate depression. <u>Mean age</u> Experimental group: 45.9 years	The experimental group followed horticultural therapy, and the control group conventional therapy.	The programme lasts for 12 weeks, for three and a half hours per day. The schedule varies from one half day to four half days a week: - First week: one half day. - Second week: two half days. - Third to tenth week: four half days. - Eleventh week: two half days. - Twelfth week: one half day.	The outcome measures of the study were sick leave status and healthcare consumption. <u>Sick leave status</u> There were no significant differences found in sick-leave status within or between the experimental group and the control group before or after the treatment.	7/12 points Quality: Moderate

				old Control group: 46.3 years old <u>M/W ratio</u> 11 / 89 % 11.5 / 82.5 %		The programme starts with individually adapted time for active participation in the activities. After that, more activities with groups with a maximum of eight participants will take place. An individual rehabilitation plan is designed for each participant. Most of the time is spent outdoors in gardening activities, relaxation exercises, psychotherapeutic activities, walking and resting in the garden.	<u>Health-care consumption</u> The number of visits to any kind of healthcare contact of the experimental group, reduced significantly from 28.7 one year before treatment to 24.1 one year after the end of the treatment (a reduction of 16%) (CI: 0.81;0.87) ($p<0.05$). The corresponding numbers of the control group also reduced, but-non-significantly ($p>0.05$).	
6) Rehabilitation of individuals on long-term sick leave due to sustained stress-related symptoms: A comparative follow-up study	Willert, M.V., Thulstrup, A.M., Wieclaw, J.	2014	Outside in the Mariendal Gardens (MG) in Aarhus, Denmark. In case of bad weather inside a green house in the MG.	<u>Participant number</u> Total of 93 participants Experimental group: 48 Control group: 45 <u>Participants' age and diagnosis</u> 25 – 59 years old Diagnosis: suffering	The experimental group did various nature-based activities, the control group did the same activities, which took place inside.	The nature-based therapy consisted of educational (information sessions) and physical activities (walking outside), yoga and mindfulness exercises outside or in the greenhouse	The outcome measures of the study are changes in stress-related health symptoms, stress management skills, daily functioning and work-ability. These factors were measured by self-report	6/12 points Quality: Moderate

				from sustained stress-related complaints Mean age Experimental group: 45.3 years old Control group: 44.7 years old <u>M/W ratio</u> Experimental group: 21 / 79 % Control group: 13 / 77 %		outside. Besides, the participants learned about work-related arrangements for being on sick-leave and returning to work to initiate a RTW-process. The control group followed therapy that had the same content and duration, but these activities were carried out mainly inside. Participants of the experimental and control group, were assigned to groups of 12 participants per session, and met on Monday to Friday from 9 AM till afternoon for 16 weeks. Several activities were carried out with the whole group, like having lunch together and walking in nature, while other activities were carried out	questionnaires. The outcomes were measured at baseline, at the end of the programme, and at three month follow-up. <u>Stress-related health symptoms</u> In both groups, there was a significant medium reduction in the stress-related health symptoms. In the experimental group, the symptoms reduced from 25.15 at baseline (SD: 7.20) to 20.54 three months after treatment's start (CI: 0.38; 0.94) ($p<0.01$). In the control group, the symptoms reduced from 23.91 at baseline (SD: 7.48) to 19.75 three months after treatment's start (CI: 0.23; 0.93) ($p<0.01$). There was no significant difference in reduction between the groups.	

						individually by the participants, like mindfulness exercises and talks with a health practitioner. Most of the activities are shared, but as the programme progresses, more activities become individually tailored.	For quality of sleep, there was a small significant positive effect in the control group (this can be because of the poorer quality of sleep at baseline of this group) (p=0.01). <u>Stress management skills (SMS)</u> For the mindfulness skill 'acting with awareness', a significant large effect was noted for the experimental group from 19.07 at baseline (SD: 6.47) to 24.79 three months after treatment (CI: 3.95; 7.45, p<0.01). In the control group, a significant small effect was noted from 22.80 at baseline (SD: 6.68) to 25.31 three months after treatment (CI: 0.28; 4.74, p=0.03). For the second mindfulness skill 'non-judgment of inner experience', there was	

							a significant difference between the two groups at baseline, the experimental group SMS were significantly lower ($p<0.01$). This skill significantly increased in the experimental group from 22.62 at baseline (SD: 7.69) to 27.81 three months after treatment's start (CI: 3.18; 7.21, $p<0.01$) and in the control group from 26.87 at baseline (SD: 7.98) to 31.73 three months after treatment's start (CI: 2.34; 7.39, $p<0.01$). The third mindfulness skill 'non-reactivity to inner experience', had a significant small effect for the experimental group and a large effect for the control group. The skill increased from 18.74 at baseline (SD: 4.98) to 20.94 three months after treatment's start (CI:	

							0.88; 3.52, p<0.01) in the experimental group, and from 19.36 at baseline (SD: 5.11) to 23.49 three months after treatment's start in the control group (CI: 2.42; 5.84, p<0.01). For 'self-efficacy' the effect sizes were medium for both groups. Self-efficacy increased in the experimental group from 13.22 at baseline (SD: 5.00) to 15.86 three months after treatment's start (CI: 1.39; 3.88, p<0.01). It increased in the control group from 14.01 at baseline (SD: 5.17) to 17.08 three months after treatment's start (CI: 1.54; 4.59, p<0.01). There was no significant difference between the groups. <u>Daily functioning</u>	

							There was a significant medium effect of the treatment for the experimental group: the level of daily functioning increased from 13.22 at baseline to 14.86 three months after treatment's start (CI: 1.39; 3.88, p<0.01). There was a significant small effect for the control group: the level of daily functioning increased from 14.02 at baseline to 15.08 after treatment's start (CI: 1.54; 4.59, p<0.01). <u>Work-ability</u> Work-ability increased in the experimental group from 2.24 at baseline (SD: 2.31) to 4.05 three months after treatment's start (CI: 1.09; 2.52, p<0.01), and in the control group from 2.41 at baseline (SD: 2.40) to 3.51 three months after treatment's start (CI: 0.22; 1.98, p=0.01).	

7) A prospective study of existential issues in therapeutic horticulture for clinical depression	Gonzalez, M.T., Hartig, T., Patil, G.G., Martinsen, E.W. & Kirkevold, M.	2011	At four urban farms and outside in therapeutic gardens in Oslo, Norway.	There were two participant groups described in the article, who both underwent the same nature-based treatment but the study groups differ in the used outcome measures. <u>Participant number</u> Group 1: Total of 18 participants Group 2: Total of 28 participants <u>Participants' age and diagnosis</u> Group 1: 27 – 65 years old Diagnosis of major depression, dysthymia, or have been in the depressive phase of bipolar II disorder. Group 2: 25 - 64 years old Diagnosis of major depression, dysthymia, or have been in the	Both study groups did various nature-based activities, mostly horticultural activities but also walking and sitting on benches in the natural environment.	The nature-based therapy is a 12 week intervention programme, in which the participants had to join the intervention garden activities twice a week in three hour group sessions. Most of the activities were in groups of three to five participants, but the programme also left room for being alone. The nature-based therapy consisted of active and passive gardening activities. Active activities included sowing, germinating, potting, planting, composing beds, cultivating vegetables and rooting various flowers and herbs. Passive activities included walking, picking flower bouquets, sitting on benches outside and watching natural environments.	The outcome measures of group 1 are depression severity and the experience of existential issues. The outcome measures of group 2 are depression severity and SOC. The study outcomes were measured at several points in time, they were measured at baseline (T1), right at the study start (T2), at the end of the 12 week programme (T5) and after three months of follow-up (T6). The measurements at T3 and T4 are left out of this study because these results were not relevant for the conclusion of this study. <u>Study outcomes group 1</u> *Depression severity* The level of depression severity significantly reduced	7/12 points Quality: Moderate

				depressive phase of bipolar II disorder. <u>Mean age</u> Group 1: 49.7 years old Group 2: 44.1 years old <u>M/W ratio</u> Group 1: 17 / 83 % Group 2: Not exactly clear, but the ratio is statistically equivalent to the M/W ratio of group			from 27.3 points at T2 to 17.6 points at T5 (F: 36.247, $p<0.10$). After three months follow-up at T6, the level significantly increased to 20.8 at T6. Despite of this increase, still the level of depression severity has significantly declined from T2 to T6 (F: 3.435, $p<0.05$). *Experience of existential issues* There were no significant changes in the experience of existential issues throughout the studied period. There was a moderate relationship between the existential issues outcomes and depression severity outcomes at T5, which had an r of $r = 0.44$. <u>Study outcomes group 2</u> *Depression severity*	

							There was a significant reduction in the level of depression severity from 24.1 points at T2 to 19.6 points at T5 (F: 8.436, p<0.007). After 3 months of follow-up, the score was 20.4 at T6. A change in depression severity was noted from T2 to T6, but although the measured score at T6 was higher than that of T5, this trend was not significant (F: 4.187) (p=0.052). *SOC* Over the studied period, no significant effects of the treatment were found in the SOC score. Significant relations were noted between level of depression severity and SOC: from T2 to T5 a moderate relationship with an r of r = 0.43, and a moderate relationship between	

							T2 and T6 with an r of r = 0.5.	
8) Can rehabilitation in boreal forests help recovery from exhaustion disorder? The randomised clinical trial ForRest	Sonntag-Öström, E., Nordin, M., Dolling, A., Lundell, Y., Nilsson, L., Järvholm, L.S.	2015	In eight different forest environments at Bäcksjön, 17 km outside Umea in the boreal zone in Northern Sweden. Patients could choose in which forest environments they wanted to walk.	<u>Participant number</u> Total of 99 participants Experimental group: 51 Control group: 48 <u>Participants' age and diagnosis</u> 24 – 60 years old Diagnosis: Exhaustion-disorder (ED) related symptoms <u>M/W ratio</u> Experimental group: 20 / 80 % Control group: 9 / 91 % <u>Mean age</u> Experimental group: 44.6 years old Control group: 44.5 years old	For 12 weeks, the experimental group followed forest therapy and the control group did not follow any kind of therapy. After 12 weeks, at the end of the forest therapy sessions, both groups started conventional therapy (CBT) until the total therapy time endured for one year.	The forest therapy was a 12 week programme. The first week was introduction to the forest environments. After that, the participants went twice a week for a forest visits which endured for 11 weeks. The length of the time in forest depended for example of the amount of daylight there was. Each forest visit lasted for four hours in total, of which two hours were spent alone in a preferred forest setting. Transport to and from the forest was by car. Same schedule for every forest visit. At 10 AM the participants entered	The outcome measures of the study are long-term psychological health, sick leave, mental state and attention capacity, and preferred forest setting during treatment. Measurements were done at baseline, at the end of the intervention and one year after the start of the intervention. There were no significant differences at baseline between the two groups regarding characteristics such as sex, age, or time of onset of significant ED. <u>Long-term psychological health measures</u> The psychological health outcomes all improved significantly between measurement at baseline and after	13/18 points Quality: Strong

						the forest and had breakfast in groups of maximum eight people. Thereafter, they carried out short relaxation exercises for five to ten minutes. At 11 AM, two hours of solitude in the forest setting started, participants could only be active when cold. Participants spent time alone in peace and quietness. After these two hours, everyone returned and had lunch together. The participants were transported back from the forest at 2 PM. Content therapy control group: Were on waiting lists during those 12 week intervention programme. These participants only visited the physician when needed.	the end of treatment and one year after the end of the treatment for the experimental group (all outcomes were $p<0.001$) and the control group (all outcomes were $p<0.003$). No significant differences were found between the psychological health outcomes between the experimental group and the control group. <u>Sick leave</u> There was no significant difference in the level of sick leave between the level of sick leave before and after treatment in both groups. There was also no significant difference found in the level of sick leave between the two groups one year after treatment. <u>Mental state and attention capacity</u>	

						At the end of the 12 week forest therapy programme, both groups followed conventional therapy in the form of CBR (Cognitive Behavioural Rehabilitation). This therapy consisted of vocational rehabilitation and advice on physical activity. The CBR endured for 24 weeks.	Six mental state variables were used in this study, these are relaxed-tense, alert-exhausted, happy-sad, harmonious-irritated, peaceful-restless, and clear-headed-mentally distracted. All mental state variables showed significant improvement for single exposure (E) after the two-hour forest visit (all p-values were $p<0.001$). During the rehabilitation period, significant improvements were found in all mental state variables compared to the beginning (all p-values are $p<0.03$) except for the irritated/harmonious scale ($p=0.109$). Attention capacity improved significantly for single exposures in the forest. After two hours solely walking	

							in the forest, participants experienced fewer spontaneous reversals (p=0.04) and focused reversals (p=0.009). <u>Preferred forest setting</u> The most preferred forest setting was 'Forest by the lake', this forest was visited 238 times. The least preferred forest setting was 'Mire by the rock outcrop', this forest was visited 12 times. 'Forest by the lake' was the most preferred forest during the autumn with 162 visits, while 'Rock outcrop' was most preferred during the spring with 103 visits. The authors discuss the possible impact of factors on the patients' preferences, factors as light, water and openness of the forest space.	
9) "Nature's effect on my	Sonntag-Öström, E.,	2015	Same as article 8	Same as article 8	Same as article 8	Same as article 8	The outcome measure of this study design is	13.5/18 points

mind'' – Patients' qualitative experiences of a forest-based rehabilitation programme	Nordin, M., Dolling, A., Lundell, Y., Nilsson, L., Järvholm, L.S.						the experience of the NBT by the participants. The experiences were measured by semi-structured interviews with open-ended questions, based on the Grounded Theory by Glaser & Strauss (1967). 19 participants were once interviewed for 10-70 minutes each. Nine participants were from the participant group that followed the NBT during spring, and the other ten were from the group that followed the NBT during autumn. The interview themes covered experiences as thoughts and feelings of the time spent in the forest, earlier natural experiences, the transportation and staff, their everyday life during the intervention period, and about the future.	Quality: Strong

							The study outcomes were all structured by several themes, that were ‘striving for serenity’, ‘frustration in adaptation to nature’, ’peace of mind’, ‘more positive thinking’, and at the end of the programme ‘desire for change’. *Striving for serenity* was a theme that recured in the interview results, because the participants started the NBT with the longing for peace of mind and recuperation of their mental complaints. When starting with the NBT, *frustration w*as a recuring phenomenon: the participants were frustrated when they experienced their time alone in the forest, because of the confrontation with their own thoughts and the new and unfamiliar environment around them. After a few	

							forest visits, most of the participants found favourite places to stay during forest visits and so found *peace of mind* during the visits. When the participants were able to find peace of mind during the forest visits, they could start to *reflect upon their life*, and this led to *ambitions to change their life situation*.	
10) Can the boreal forest be used for rehabilitation and recovery from stress-related exhaustion? A pilot study	Sonntag-Öström, E., Nordin, M., Järvholm, L.S., Lundell, Y., Brännström, R., Dolling, A.,	2011	In six different forests in the boreal zone nearby Umea, Northern Sweden.	<u>Participant number</u> Total of six participants <u>Participants' age and diagnosis</u> 41 – 57 years old Diagnosis: Stress-related exhaustion, also depression- and anxiety related symptoms <u>M/W ratio</u> 50 / 50 % <u>Mean age</u> 49.8 years old	Forest therapy	The forest therapy endured for 11 weeks and consisted of 22 forest visits. The forest visits took place twice a week. Each session had the same content and time schedule. The therapy sessions started at 10 AM at the forest side, where the participants had breakfast together and did mindfulness exercises together for five minutes. Thereafter, the	The outcome measures of the study are change in mental health state before and after each forest visit measured by self-reported questionnaires, and the practical arrangements, the participants' experiences of the treatment and the participants' preferences of the forest settings. <u>Change in mental health state</u>	8/12 points Quality: Moderate

						participants chose one of the six forests where they wanted to walk, each participant chose individually the forest of his or her preference. After that, the participants went for a walk in the forest of their choice for two hours straight. The forests differed in the amount of light and stimuli there was. Thereafter, the participants had a simple lunch by the fire and left the forest at 2 PM.	Questionnaires to measure mental health state were filled in by the participants before and after the seventh forest visit and onwards. This resulted in mental health state data from 16 forest visits of each participant. The results from the third, seventh, 11th and 15th forest visit could be used for the statistical analysis of the occasion factor, due to the small participant group. Firstly, significant effects were found for a positive change from before to after the forest visits in feeling more relaxed, feeling more happy, feeling more harmonious and feeling more peaceful (for all mentioned measures $p<0.05$). Secondly, there were also significant effects found for the relation	

							between time and mental state after the forest visits, and for the relation between occasion and mental state after the forest visits. These both effects were found on the irritated-harmonious scale ($p_t<0.01$, $p_o<0.05$). Significant relationships between time and mental state after the forest visits were found for the tense-relaxed scale ($p<0.001$), the sad-happy scale ($p<0.01$) and the restless-peaceful scale ($p<0.01$). Thirdly, the relative treatment effects (RTE's) on mental state before and after visiting the forest, nearly reached or reached the significance threshold on the irritated-harmonious scale ($p=0.006$ and $p<0.005$). This implies	

							that the participants possibly have become more harmonious over time during the treatment period and after each forest visit. <u>Practical arrangements, treatment experiences and forest preferences</u> Interviews were carried out at the treatment's end, to measure the experiences of the practical arrangements of the treatment, the experiences of the treatment itself, and the preferences regarding the forest environments of the participants. The few main categories that summarize the interview answers are *light/darkness, perception, previous experiences, demands, environment, social aspects and freedom*. *Light/darkness*	

							The amount of light/the level of brightnes in the forests was an important positive factor for participants selecting a location in which to spend the two hours alone in the forest. The brighter forests were selected more often by the participants and were so more preferred. *Perception* Variation in observed stimuli in the forest was an important factor too for selecting a forest setting. Change in scenery in the forest, by seeing, smelling or hearing other stimuli, was appreciated by the participants, as long as the stimuli were naturally apparent and belonged in the forest. *Previous experiences* Participants recorded that previous experiences of forest	

							visits were often connected to feelings of safety, and so, being in the forest environment brought back old memories and gave the participants again that feeling of safety. *Demand* Many participants associated the forest environment with rest and with no demands. The forests were referred to as restful places, were no demands need to be done, but where participants could just be in. *Environment* The participants generally spoke very positively about the different forest settings. The forest by the lake, the outcrop and the forest with a small stream were the areas that were seen as most warmly.	

							Social aspects The social activity by the fire before and after the two hours of solitude gave a chance to talk together, the participants appreciated these moment, but also appreciated the time they spent alone in the forest. *Freedom* The participants appreciated freedom in reality and in their own imagination. The forest settings that were open and free were preferred by the participants. They also stated that it was important to be alone with their own thoughts, so the participants also appreciated (or needed) freedom in being in their head and thinking about what they wanted.	