



LIISA TYRVÄINEN, ANN OJALA, JAANA I. HALONEN, TUOMAS KARI, TYTTI P. PASANEN

## THE POTENTIAL OF NATURAL ENVIRONMENTS IN MENTAL HEALTH PROMOTION AND PREVENTION

### ABSTRACT

*Natural environments have been investigated for over two decades as determinants of mental health and wellbeing. However, urbanization has changed living environments, with more and more people spending time indoors and living in built environments that have limited access to natural ones. To provide a coherent view of the research evidence of nature environments on mental health in Nordic countries we conducted an extensive literature search spanning the years 2004 to 2025. The research evidence was narratively analysed by three age groups: children and youth, working-age and older adults, and separately for therapeutic settings. We found that the field has implemented many different definitions of nature exposure as well as outcome measures. High-quality evidence regarding the effects of nature on mental wellbeing of children and the older adults was limited. Studies on adults have been conducted in experimental and observational settings and provide more consistent evidence that nature environments can contribute to prevention of mental health problems. Studies comparing nature-based rehabilitation with other therapeutic approaches, including those using virtual nature exposures, suggest that both have potential for mental health promotion. This accumulated knowledge could be more widely integrated into preventive healthcare and actively promoted by healthcare professionals. In conclusion, to prevent mental health problems, it is essential to ensure equitable access to high-quality natural environments. This review also indicates that fully realizing the benefits of natural environments for mental health promotion and prevention requires tailored approaches depending on the target population.*

**KEYWORDS:** DEPRESSION, EXHAUSTION DISORDER, GREEN AREAS, FORESTS, MENTAL HEALTH, MENTAL WELLBEING, NATURE-ASSISTED TREATMENTS, STRESS, WORK STRESS

### INTRODUCTION

Urbanizing societies are globally increasingly facing public health challenges, particularly linked to mental health problems. Modern lifestyles have led to increased physical inactivity and exposure to environmental stressors, contributing to stress-related mental disorders such as depression. Moreover, urbanization has changed living environments, with more and more people spending time indoors and living in built environments that have limited access to natural ones. Linked to these societal and behavioural changes, visiting nature or engaging in physical exercise in natural settings have been proposed as convenient approaches to mental illness prevention and health promotion (1,2).

The first international environmental psychology studies on the beneficial effects of nature exposure on mental wellbeing were published already in the 1980s, and reported that viewing natural landscapes and images of nature improved mood and recovery from surgery (3). In Finland, studies on the wellbeing effects of natural environments began in the late 1990s. Since then, studies have focused on the wellbeing effects of visiting favourite places and the effects of recreational use of nature, as well as the importance of the quality and attractiveness of natural environments in generating wellbeing benefits (4,5). Korpela et al. (4) found that the most favourite places of the Finns are in nature. Typically, people visit these places to calm down and clear their thoughts, contributing to regulation of one's emotions (6).

The mental wellbeing effects of nature visits have further been studied with population-level surveys and experimental studies. These studies showed that visiting nature can improve mood (5,7) and recovery from stress (5) as well as support attention restoration (8). Exercising in nature has also been found to boost self-esteem and feelings of capability and ability (9). Moreover, physiological relaxation has been demonstrated, for example, in studying forest and park walks where heart rate was found to be lower and heart rate variability higher than when walking in a built environment (10). More recently, beneficial associations between natural environments and mental health outcomes have been identified in epidemiological research conducted in urban contexts, including a lower risk of psychotic and mood disorders (11), as well as depression and depressive symptoms (12,13), in areas with greater neighbourhood greenness.

Furthermore, experimental studies conducted in real nature environments have led to exploring the effects of virtual nature exposure indoors. These studies show that virtual nature experiences seem to have similar effects on mental wellbeing as real nature (7,14). Ojala et al. (15) found that 15-minute virtual nature breaks with high-quality nature videos with nature sounds were more effective than other breaks in recovering from stress during the workday. The positive effects were reflected both in psychological measures and in reduced central stress. The results suggest that virtual nature environments can provide a stress relief and restoration method during short breaks, for example, in workplaces and where nature is not easily accessible.

Based on this cumulated research knowledge, natural environments seem to hold significant potential for promoting mental health and wellbeing. These benefits of natural environments are typically derived from living and working environments, but also from nature walks and other leisure activities outside everyday settings. Although the number of local outdoor recreation visits has increased over the past ten years (16), there is also a mounting group of people with decreased contact with natural environments. The main self-reported motives for outdoor recreation include opportunities to maintain physical fitness, recover from stress, experience peace and quiet and enjoy beautiful natural landscapes (16).

Nature is experienced through multiple senses, and a significant proportion of the wellbeing effects, especially mental health benefits, require no effort (17). The health and wellbeing effects of nature are generated through many pathways, including lower exposure to noise and air pollution and high temperatures compared with built environments. Moreover, nature environments support stress reduction and relaxation and may also encourage people to be physically

active. They can also allow withdrawal from social interaction or support strengthening social connections, depending on situational needs. In practice, different pathways may operate simultaneously, and the significance of these pathways may vary among different individuals or in different natural environments. The benefits received are also influenced by the perceived quality of the nature site, the attractiveness of the environment, its suitability for personal use and the sense of safety (2).

#### AIMS OF THE STUDY

The aims of this study were to describe, summarize and evaluate the available research evidence on the effects of natural environments on mental health in the Nordic countries. Moreover, the aim was to identify key target groups studied, as well as characteristics and factors related to measuring nature exposure and health and wellbeing outcomes in this research area. We also discuss knowledge gaps in the research and the applicability of the research findings in practice.

An assessment of the available research evidence was initially conducted through an extensive literature search spanning the years 2004 to 2024, performed in February 2024. The results of this initial search were reported in a non-peer-reviewed report in Finnish, which also covered other dimensions of health and calculation examples of the economic value of the health benefits of exposure to urban nature environments in Finland (2). For the present article, the literature search was complemented in April 2025, covering the years 2024–2025. The review focused on Nordic studies for reasons of applicability and transferability, with a focus on urban areas, where most Nordic people live. Research evidence between nature environments and mental health was analysed by three age groups: children and youth (under 18 years old), working-age and older adults (typically over 70 years old).

In line with the dual continuum model of mental health suggesting that mental illness and positive mental health reflect distinct continua (18), we separately assessed studies examining positive mental health (e.g. subjective wellbeing) and negative mental health (e.g. psychological distress and disorders).

#### LITERATURE REVIEW

For the review of the available evidence for links between natural environments and mental health, a literature search was conducted for the period 2004–2024 (until April) according to the selected mental health outcomes. Search terms and search databases are listed in Supplement 1. The search was limited to peer-reviewed publications in English. After excluding

refereed articles that were clearly outside the objectives, the original search (2004-2024) and the renewed search for period 2024-2025 (until April) produced altogether 661 articles.

The titles and abstracts of the publications were reviewed by one researcher initially, and unclear cases were discussed with two or three researchers. Peer-reviewed publications with original results from at least one Nordic country were selected for review. They had to include results for mental health diagnoses (such as depression and schizophrenia), short-term outcomes (such as mood and stress) or positive mental health (such as subjective wellbeing).

In addition, the publications selected for the review had used a quantitative measure of the nature exposure, such as the amount of greenery in a residential area measured by a vegetation index (e.g. Normalized Difference Vegetation Index, NDVI) or biodiversity index, or the number of visits to natural areas. Finally, a few other articles known to the research team that did not appear in the search results, but which were considered by the experts to be significant, were added to the review.

An article was excluded from the analysis if it was not peer-reviewed and did not contain actual result estimates or an interpretation of results from any of the Nordic countries. In addition, publications were excluded if they did not define the exposure measure in a comprehensible way or in a more specific way than the general context (e.g. description of agricultural environment, rural vs. urban environment, virtual nature, natural elements indoors). Studies with a small number of observations (less than 20 participants in intervention studies, less than 100 participants in observational studies) and intervention studies with no control group or using covid pandemic as the intervention were also excluded. In addition, studies using only qualitative research methods, on animal-assisted therapy, learning and development, and sleep or body image were excluded. After these selections, 55 scientific articles remained from the original literature search and 10 articles from the complementary search for further review and analysis. As the research area was relatively new in the beginning of the 2000s, the research methods and indicators used were not yet well established. As a result, many of the pioneering studies in the field were not included in this review. Since the literature was highly heterogeneous, we analysed the data narratively.

## HOW NATURE CONTRIBUTES TO MENTAL HEALTH AND WELLBEING

### *USED MEASURES FOR NATURE EXPOSURE, HEALTH AND WELLBEING*

The research has implemented a relatively large number of different definitions of exposure to nature as well as outcome measures. Differences in research design were partly due to the different scientific backgrounds of the researchers and partly to the type of nature exposure in the study setting. In Finland, for example, wellbeing benefits of forests has been studied, while in Denmark and southern Sweden interest has focused on gardens and parks. In recent years, the number and scale of research have increased, with a growing focus on the effects of the provision and use of urban nature at the population level. Furthermore, larger and higher quality experimental studies in different types of urban areas have been conducted during the past five years ([Table 1](#)).

The exposure measures used in observational studies included, for example, self-reported or measured distances to the nearest green space, park or forest, as well as objectively quantified supply of green areas in the home environment using indicators such as the NDVI, which is based on satellite data. Moreover, studies included self-reported measures quantifying the actual use of nature environments such as frequency of visiting nature or participation in outdoor activities.

Table 1. Used measures for nature exposure in Nordic mental health studies.

Research on children and adolescents	Reference
<b>Intervention studies</b>	
Classes indoors vs outdoors in nature	Mygind et al. (2018)
<b>Observational studies</b>	
Green and open spaces or parks within 800m or 5000m from home	Nordbø et al. (2020)
Normalized Difference Vegetation Index (NDVI)	Engemann et al. 2018; 2020b, Thygesen et al. 2020, Fernandes et al. (2024)
Frequency of outdoor recreation activities, e.g. hiking and cross-country skiing	Redzovic et al. (2025)
Time spent outdoors	Wales et al. (2024)

  

Research on adults	Reference
<b>Intervention studies</b>	
Less than an hour visit to a green space (urban parks, urban forests, health forests)	Tyrväinen et al. (2014), Lanki et al. (2017), Ojala et al. (2019), Stigsdotter et al. (2017)
Daily 15-minute walk in a park during lunch break for two weeks (in comparison to relaxation indoors or normal lunch break)	de Bloom et al. (2017)
Workplace greenery index, based on view and access to green outdoor environment at work	Lottrup et al. (2013)
Nature-based rehabilitation. Visits to green areas near healthcare centres, biodiverse green and blue areas, activities in nature such as gardening, guided walks or relaxation practises	Hyvönen et al. (2023), Sahlin et al. (2015), Kolster et al. (2023), Høegmark et al. (2021), Gonzalez et al. (2011), Dolling et al. (2017)
90-min visits to three different forest environments and one city environment in randomized order	Sonntag-Öström et al. (2014)
Between individual comparisons using 3-hour group sessions with individual therapeutic conversation and individual nature-based activities introduced by the gardener. Individual 1-hour therapeutic conversation sessions with one therapist. Both lasted for 10 weeks	Stigsdotter et al. (2018)
3-hour nature therapy sessions three times a week, during a ten-week treatment period	Corazon et al. (2018)
10 3-hour sessions all of which took place at the University of Copenhagen's therapy garden	Corazon et al. (2024)
Rehabilitation after stroke in rehabilitation garden scheduled for 2 days a week, with each session lasting 3.5 hours	Pálsdóttir et al. (2020)
<b>Observational studies</b>	
Access to garden or nearby green space, self-reported distance to nearest recreational area (own estimate), number of visits to different types of green areas per week	Nielsen and Hansen (2007)
Number of or presence of nature qualities of the neighbourhood (within 300m or within 1km² from home); serenity, wildness, species richness, spaciousness and cultural history were defined with land use data	Annerstedt van den Bosch et al. (2015), Weimann et al. (2015)



Self-reported distance to nearest green space, frequency of visiting nature (different types asked separately)	Toftager et al. (2011), Stigsdotter et al. (2010)
In rural or suburban areas qualities of the neighbourhood; serenity, wildness, species richness, spaciousness and cultural history (serene, space, wild, culture, lush) combined with Corine land cover dataset	Annerstedt et al. (2012)
Distance (m) to the nearest park and forest as the crow flies based on Corine land cover dataset	Rautio et al. (2024)
Vegetation cover greenness within an area (median size 0.02–0.6 km <sup>2</sup> ) based on satellite images in 10 categories, e.g. water (0 % greenness), dense urban settlement (10 %), grass, agricultural land, deciduous and mixed forest, marshland (100 %)	Ihlebaek et al. (2018)
Availability of accessible green space near home/in the home neighbourhood based on land use data	Ihlebaek et al. (2018), Klein et al. (2022), Stenfors et al. (2024)
Normalized Difference Vegetation Index (NDVI)	Kivimäki et al. (2021), Engemann et al. (2019; 2020a; 2020b; 2020c; 2021), Rautio et al. (2024), Gonzales-Inca et al. (2022), Cadman et al. (2024)
Proportion of green and blue areas within 1km buffer around home	Turunen ym. (2023)
Number of visits to nature/green area/blue area	Hiscock et al. (2017), Vitale et al. (2022), Stigsdotter et al. (2010), Turunen et al. (2023), Klein et al. (2024), McDougall et al. (2024), Nordbo & Nordh (2024)
Satisfaction with distance to green space	Hiscock et al. (2017)
Physical activity in nature	Pasanen etc. (2014, 2018, 2021), Kajosaari and Pasanen (2021), Konijnenberg et al. (2023)
5 profiles based on frequency of nature visits during leisure time in summer and winter, the frequency of nature visits at work, and the types of outdoor activities in nature environments during leisure time: high, versatile, unilateral, average and low (ref.)	Hyvönen et al. (2018)

Research on older adults populations	Reference
<b>Observational studies</b>	
Self-reported access to green space	Lyshol & Johansen (2024)
Shannon Diversity Index (SHDI), based on Corine Land Cover classes at 500m zone around home	Rantakokko et al. (2018)
Frequency of visiting garden or being in the balcony overlooking the garden at a long-term care facility	Rappe and Kivelä (2005)
An index based on the total number of natural view components and natural elements in the garden/patio area	Dahlkvist et al. (2016)

The articles on effects of nature exposure on mental health had also used many outcome variables reflecting the diversity of the scientific fields. To illustrate the breadth and diversity of the research approaches, the outcome measures used in studies are listed by population group in [Table 2](#). The studies focusing on children and youth targeted inattention and hyperactivity, depression and anxiety, as well as changes in wellbeing, using altogether nine different outcomes and measurement scales. Studies focusing on adults and the older adults examined the effects of nature exposure on morbidity and depressive symptoms, using a total of 12 different outcome scales. The studies examining effects on mental wellbeing and mood also employed a relatively large number of outcome measures, with eight different scales used. Additionally, stress and restoration were assessed in a considerable number of studies.

Table 2. Outcome measures used in studies by population group.

Population	Mental health dimension	Measure
Children	Inattention and hyperactivity	Teacher ratings by Early Childhood Attention Deficit Disorders Evaluation and Treatment Scale (ECADDES), and Strengths and Difficulties Questionnaire (SDQ)
		Parent ratings
		Self-rated
		d2 Test of Attention
	Depression and anxiety	The Depression, Anxiety and Stress Scale-21 (DASS-21)
		Symptoms Checklist 5 (SCL-5)
	Wellbeing	Short Mood and Feelings Questionnaire (SMFQ)
		Life Satisfaction Scale (SLSS)
		Multidimensional Student Life Satisfaction Scale (MSLSS)
		Rosenberg's Self-Esteem Scale (RSES)



Population	Mental health dimension	Measure
Adults & older adults	Morbidity and depressive symptoms	Beck Depression Inventory (BDI)
		General Health Questionnaire (GHQ12 & GHQ60)
		Psychiatric disorders
		Psychotropic medication use
		Symptom Checklist Core Depression Scale (SCL-CD6)
		Centre for Epidemiologic Studies Depression Scale (CESD)
		Zung Self-rating Depression Scale (SDS)
		Hopkins Symptom Check List (HSCL-5; mental distress)
		General Anxiety Disorder scale (GAD-7)
		Depressive symptoms Patient Health Questionnaire (PHQ-9)
		Symptoms Distress Checklist (SCL-90)
		Edinburgh Postnatal Depression Scale (EPDS)
	Mental well-being and mood	Warwick-Edinburgh Mental Well-being Scale (WEMWBS)
		Psychological General Well-Being Index (PGWBI)
		World Health Organization's subjective well-being scale (WHO5)
		WHO Quality of Life-BREF scale (WHOQOL-BREF), psychological domain
		State-Trait Anxiety Inventory (STAI)
		Positive and Negative Affect Scale (PANAS)
		Profile of Mood States (POMS)
		Short Form Health Survey (SF-36/RAND-36), emotional wellbeing subscale/mental component score (MCS)
	Stress and restoration	Perceived stress scale (PSS)
		Restoration outcome scale (ROS)
		Single-item on stress
Employees	Burnout	Shirom-Melamed Burnout Questionnaire (SMBQ)
		Bergen Burnout Inventory (BBI)
	Occupational wellbeing	Job satisfaction
Patients		Sick leaves
		Healthcare consumption
		The Mental Fatigue Scale (MFS)
		The Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS)



## BENEFITS OF NATURE ENVIRONMENTS FOR CHILDREN

We identified five studies involving children that met our inclusion criteria. Mygind et al. (19) conducted a quasi-experimental study in Denmark to assess attention task performance among 10–12-year-old pupils from two outdoor-oriented schools. Participants attended a class either indoors or outdoors in a natural setting. The study found no significant differences in attention scores between the two learning environments. Nordbø et al. (20) linked cross-sectional cohort data from Norwegian 8-year-old children with geospatial data using the NDVI. The analysis revealed no statistically significant association between children's wellbeing, measured using the Short Mood and Feelings Questionnaire (SMFQ), and distance from home to green spaces. Fernandes et al. (21) conducted a large European cohort study investigating the association between residential distance to green space and various health outcomes in children from birth to 12 years of age. Outcomes included attention deficit hyperactivity disorder (ADHD) symptom scores and neurodevelopmental assessments. No significant associations were observed in the Nordic countries (Denmark and Norway). Redzovic et al. (22) examined associations between wildlife activities and anxiety and psychological distress in a cross-sectional study of Norwegian adolescents aged 13–19. An unexpected weak but statistically significant relationship was observed between higher levels of wildlife activity (time spent outdoors) and elevated levels of psychological distress, with a multivariate linear regression effect estimate for the Symptoms Checklist 5 (SCL-5) of 0.05 ( $p < 0.001$ ). Wales et al. (23) explored the relationship between time spent outdoors, perceived environmental quality and psychological wellbeing among Swedish adolescents aged 12–15. Time spent outdoors, perceived benefits of outdoor activity and the quality of outdoor life were positively associated with self-esteem and negatively to the scores on the Depression Anxiety Stress Scales (DASS-21).

Six observational nationwide cohort studies from Denmark investigated the associations between growing up surroundings and the prevalence of psychiatric disorders later in life. Engemann et al. have published altogether five studies using the cohort sample of individuals born in Denmark between 1985 and 2003. Of those, two studies showed that living at the highest levels of nature elements during childhood (NDVI at age 10), compared to those living at the lowest levels of nature elements, was associated with fewer diagnoses of various mental illnesses in adolescence or adulthood (24,25). Three studies

concentrated exclusively on childhood living environment and schizophrenia diagnosis. Living with the lowest amount of green space was associated with a 1.52-fold increased risk of developing schizophrenia later in life compared to persons living with the highest level of green space (26). The protective effect seemed strongest for blue space, followed by farmland and then near-natural green space, compared to growing up in urban environments (27). The protective effect of childhood green space exposure against schizophrenia was independent of genetic liability (28). In addition, a cohort study by Thygesen et al. (29) included individuals who were born in Denmark between 1992 and 2007 and who were diagnosed with ADHD from age 5 during the period 1997–2016. The study showed that individuals living in the lowest decile of NDVI had an increased risk of developing ADHD, compared with individuals living in areas within the highest decile of NDVI (IRR=1.55; 95% CI: 1.46, 1.65).

## BENEFITS OF NATURE EXPOSURE TO ADULT POPULATION

The adult population has been the most commonly studied group. Studies involving adults have been conducted in both experimental and observational settings.

### EXPERIMENTAL STUDIES

Experimental studies in Nordic countries have shown generally positive effects of nature exposure on psychological and physiological wellbeing. In Norway, Konijnenberg et al. (30) studied the effects of a snowy winter nature walk on anxiety, perceived stress and cortisol levels in a university campus, compared to treadmill walking indoors without windows. Both the winter nature and indoor treadmill walks reduced significantly cortisol levels. In Denmark, therapeutic forest walks improved mood and reduced fatigue more effectively than urban walks among young adults aged 20–36 years. However, no strong associations were found in blood pressure (31). In Finland, participants visited urban park, urban forest and city centre as a control, for stress reduction after their working day. The forest and park visits enhanced restoration, increased positive emotions and reduced negative emotions compared to city centre visits (5). Forest environment was especially effective for participants who were less urban-oriented or noise-sensitive (32). Physiologically, lower heart rates and higher heart rate variability during forest and park visits suggest greater relaxation (10). In the randomized field experiment by Korpilo et al. (33), psychological and physiological restoration



was significantly greater in environments with higher visual (% of visual natural elements) and acoustic (Normalized Difference Soundscape Index (NDSI)) naturalness, such as beach and forest, compared to urban park (control).

For studies targeting employees, we found one intervention that met the inclusion criteria. De Bloom et al. (34) conducted two randomized controlled trials in the spring and fall, using the same protocol, to examine how different lunch break activities affect recovery from job stress among Finnish knowledge workers. Participants engaged in daily 15-minute sessions over ten working days, assigned to one of three groups: park walking, indoor relaxation exercises or a control group continuing their normal lunch break activity. In the spring trial, recovery and wellbeing improved only slightly, with the greatest gains seen in the control group that did not receive the intervention. In the fall trial, both a 15-minute park walk and indoor relaxation exercises during lunch breaks over two weeks improved wellbeing and recovery compared to the control group.

## OBSERVATIONAL STUDIES

We found seven longitudinal and five cross-sectional studies examining mental health (see used outcomes in Table 2), mostly in relation to the availability of nature near residence, measured using geospatial data. Two studies used visits to green/nature areas as the exposure indicator.

In a nationwide Finnish study by Gonzales-Inca et al. (12), the availability of nature, based on NDVI, was examined at 100, 500 and 1,000 metre zones around residence. The study showed that over a five-year follow-up, NDVI between 0.5–0.7 at a 100 metre range was associated with smaller odds of depression diagnosis compared to an NDVI value below 0.3. The result was similar over a 14-year follow-up period. Similarly, Kivimäki et al. (11) observed that as the greenness of the residential area (likewise measured with NDVI) increased during a five-year period from below to above the median level over a five-year follow-up, the risk of psychotic and mood disorders decreased compared to situations where greenness remained below median. A decrease in greenness, however, did not associate with the risk of psychotic or mood disorders.

In a longitudinal Swedish study, mental health improved more likely among those who had moved to an environment with more serene nature. Other examined landscape qualities such as wildness or spaciousness (Table 1) were not associated with mental health (35). In two other longitudinal Swedish studies, higher self-assessed quality of nearby green areas was either weakly associated with better mental health (36) or the association was found only among women for a specific quality

factor (37). Klein et al. (38) examined visiting different types of nature areas in relation to anxiety and depressive symptoms, cross-sectionally and longitudinally. They concluded that the respondents who visited nature more frequently (during the pandemic) reported less symptoms both cross-sectionally and longitudinally. Almost all different types of nature areas – e.g. gardens, parks, forests – were associated with less symptoms, except for green playgrounds which showed few associations.

In a cross-sectional Norwegian study, Ihlebæk et al. (39) observed that the likelihood of mental health disorders was lower in greener residential areas (measured by NDVI) compared to the least green areas. The association between green areas assessed by land use classification and mental health disorders was similar but weaker and not statistically significant. Two cross-sectional studies examined residential environments in relation to depressive symptoms. In a Finnish study, depressive symptoms were less frequent if there was more overall greenery (13), but there was no association with distance to the nearest green area (13) or green areas within 50–500 metres from home in a Swedish study (40). In a study conducted across 12 European countries, post-partum depression was examined in relation to NDVI and access to green and blue spaces. Associations between nature exposure and post-partum depression were found to be close to null in the Danish and Norwegian cohorts (41).

Turunen et al. (42) reported that green space around home was not associated with the use of psychotropic medications, but visits to green areas were. Those who reported 1–2 visits to green areas per week, compared with less visits, had a lower likelihood of using psychotropic medication. The association strengthened with more frequent visits. Stenfors et al. (43) likewise assessed medication use as the outcome, in relation to residential green space at 50m, 100m, 300m and 500m zones. More green space was associated with lower odds of depression medication use cross-sectionally (all zones) and longitudinally during a 3-year follow-up (at 50m range). Generally, lowest odds ratios (OR) were observed at smaller zones.

*Mental wellbeing* was measured using indicators such as positive mental health, stress and psychological recovery (Table 2). Almost all studies addressing these were cross-sectional and based on self-reported surveys. In contrast, exposure to nature was measured using multiple indicators (Table 1).

A total of seven observational cross-sectional studies examined nature exposure in relation to mental wellbeing. All of these found some positive associations. Visiting or being physically active in nature (44–48), shorter self-assessed distance to green areas or satisfaction with green areas (44,47) and spending time near blue space during childhood (48) were

associated with higher mental wellbeing. Two studies examined nature using objective geospatial data.

Engemann et al. (49) assessed green space at current and childhood residence and found that both current and childhood residential greenness were associated with higher mental wellbeing, but the associations disappeared when the degree of urbanization and air pollution were controlled for. Blue spaces such as rivers, lakes and seas were not associated with mental wellbeing in these analyses. McDougal et al. (50) examined associations between self-reported visits to green or blue spaces the day before and visits in the past 4 weeks in relation to four dimensions of subjective wellbeing, including cohorts from Finland and Sweden. In the Finnish sample, no associations were found. In the Swedish sample, having visited a greenspace the day before was positively associated with happiness (in line with the majority of the other 16 countries) but no other associations were found (50).

Four observational articles examined nature visits in relation to stress or psychological restoration. All reported a positive association with at least one type of nature exposure. In the study by Stigsdotter et al. (47), shorter distance from home to green areas and more frequent visits were associated with a lower likelihood of being stressed. Kajosaari and Pasanen (51) compared different types of outdoor environments for physical activity and associated benefits and observed that stress reduction was most common if physical activity took place in large forests (>30 hectares) and near water areas, compared with built outdoor environments, smaller urban forests (<30 hectares) and maintained green environments (e.g. parks and gardens). Nielsen and Hansen (52) divided survey respondents into four equally sized groups based on their stress levels and found that weekly visits to green areas and access to a garden were associated with a lower likelihood of belonging to the more stressed groups. However, there were some inconsistencies in the results, and the confidence intervals were large. Pasanen et al. (53) compared recalled psychological restoration from the most recent bout of physical activity and found that restoration was overall slightly greater after physical activity in natural environment compared with indoor or built outdoor environments.

Two observational cross-sectional surveys targeting work wellbeing reported some positive associations between nature near or visible from workplace (54) or nature exposure during work and leisure time (55) and work wellbeing, measured either as stress (54) or burnout symptoms (55). However, both used very different, non-standardized measures, making it difficult to generalize the results.

## WELLBEING EFFECT OF NATURE ON OLDER ADULTS

Four observational studies focused on older adults residing either in nursing homes (56,57) or in their own homes (58,59). In each of these studies, both nature exposure and mental health were defined in different ways. A Finnish study (n=848), conducted through home interviews, found no association between biodiversity within 500 metres of the home and depressive symptoms (58). The other study for home-dwelling older adults, conducted in Norway, found that the odds of low mental distress were greater among those who evaluated their access to nature or recreational areas to be good, even after controlling for confounders and health status (59). Among older adults residing in nursing homes, Rappe and Kivelä's (57) study (n=30) found a weak association between visits to the garden or balcony facing the garden and fewer depression symptoms. However, the study did not control for potential confounding factors. In another study conducted in a nursing home environment (n=290), an indirect association was observed between green views and various green elements and better perceived health, mediated by psychological restoration. Green views or elements did not, however, have a total effect on health (56).

## MENTAL HEALTH BENEFITS OF NATURE-BASED INTERVENTIONS IN THERAPEUTIC SETTINGS

A total of eleven studies included participants with impaired physical health or mental health conditions. Comparing these studies is challenging due to considerable variation in how health status, treatment modalities and environmental settings were defined. In most cases, the intervention was not limited to a single type of environment; rather, it often included a combination of activities such as gardening, walking in various settings or engaging in structured tasks across different natural environments.

Several studies compared nature-based rehabilitation with other therapeutic approaches. For example, Corazon et al. (60) and Stigsdotter et al. (61) examined the effects of nature-based interventions in comparison to cognitive therapy. Corazon et al. (62) further explored the impact of psychoeducation, relaxation and physical activity exercises conducted in a forest therapy garden. Other studies included comparison between nature-based activities and craft-based activities (63), health-promoting physical activity interventions (64) or standard care and rehabilitation practices (65–68). Moreover, one

study specifically compared visits to different types of forest environment (69).

All studies reported some positive effects of the interventions on participants. However, only a few demonstrated statistically significant differences between treatment groups. For instance, Kolster et al. (64) found improvements in mental health following nature visits, whereas no significant changes were observed in the physical activity group. In the study by Høegmark et al. (65), the only significant difference between the intervention and control groups after six months was in self-reported physical health. Sahlin et al. (67) reported that participants in the nature-based rehabilitation group experienced reductions in burnout, depression and anxiety, along with increased wellbeing and decreased healthcare consumption. Similarly, Gonzalez et al. (70) found that a 12-week small gardening group programme provided alongside standard care led to reduced stress, increased positive affect, decreased negative affect and reduction in depressive symptoms. However, only the reduction in depressive symptoms persisted at the three-month follow-up. In a study involving individuals with post-concussion symptoms, Corazon et al. (62) reported a significant decrease in mental fatigue scores following a nature-based intervention ( $p < 0.01$ ), with a moderate effect size ( $r = 0.55$ ). Although the mean score remained above the suggested threshold of 10.5 (indicating no to mild symptoms), the mean improvement of 3.48 points on the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) exceeded the minimal clinically important difference ( $> 3$ ).

## DISCUSSION AND CONCLUSIONS

### KEY RESEARCH FINDINGS

Over the past two decades, a substantial body of evidence has accumulated demonstrating the benefits of natural environments for mental wellbeing and health in the Nordic countries. Most studies have been conducted in Finland, Sweden and Denmark, while relatively few have been carried out in Norway and Iceland. The overall findings indicate that exposure to green environments is associated with significant improvements in mental wellbeing and the prevention of mental health disorders. Documented benefits include, for example, stress reduction, enhanced mood and increased vitality needed in everyday life.

The evidence base is strongest for adult populations, supported by a relatively large number of good-quality studies. Most evidence suggests that visiting or being physically active in nature is associated with higher mental wellbeing. There is also increasing evidence that high provision of green areas around home environments may protect individuals from mental

health disorders. In contrast, evidence for children and older adults remains limited, primarily due to the small number of experimental studies and their relatively small sample sizes.

High-quality evidence regarding the effects of nature on children's mental wellbeing remains limited. There are only a few studies focusing on younger children, and findings from the Nordic countries indicate no significant effects of nature exposure in this age group. Studies involving adolescents have reported mixed associations between nature exposure and wellbeing outcomes. The cohort studies from Denmark show promising results about the importance of childhood exposure to nature in reducing the risk of developing mental disorders later in life.

Considerable heterogeneity in study designs and outcome measures further limits comparability across these studies. The effects of nature exposure during childhood on mental health in adulthood were mainly conducted in Denmark during the past five years using register-based data. While register-based studies may have large sample sizes, like the Danish studies (24–28), they are not able to control many behavioural variables possibly affecting mental health outcomes.

Variability in findings may be partly attributed to differences in research design and limitations in the measures employed. For instance, a well-documented limitation of using spatial data to quantify residential greenness—as a proxy for nature exposure—is that it fails to account for time individuals spend in nature, the types of activities they engage in or the extent to which green spaces are accessible and suitable for residents' own use (42). Thus, the mere presence or area of green space, as used in most studies to date, may not adequately capture its usability, quality or attractiveness from the perspective of potential users.

The Nordic countries have been at the forefront of piloting various types of nature-assisted therapies. These typically involve the use of garden or forest environments for specific groups, such as people with mental health problems or older adults. Overall, most interventions conducted in the Nordic countries have demonstrated a broad spectrum of positive outcomes (71). However, most of the intervention studies conducted to date were excluded from this review because they were pilot studies with small sample size and had methodological limitations, e.g. lacked a control group without therapeutic intervention.

Although qualitative studies were excluded from this review, they should be acknowledged as a valuable source of information for understanding the perceptions and responses of smaller user groups, as well as the complex behavioural and contextual factors associated with the benefits of nature-

based interventions in mental healthcare. Such groups include, for example, young children, diverse patient populations, veterans and immigrants. While qualitative studies cannot be generalized to larger populations and do not provide effect estimates indicating strength of associations, they offer essential insight that complement quantitative findings and deepen our understanding of how and why nature-based approaches may be effective.

Further research is needed on the effects of natural environments on mental health, with particular attention to actual usage patterns, individual-level responses to nature exposure and findings from population-based longitudinal studies. A more nuanced understanding is required concerning the type and extent of nature exposure. This includes measuring the frequency and duration of visits to natural environments and the specific activities undertaken. Analysing the dose–response relationship across different population groups, including among the vulnerable children and older adults, as well as the long-term impact on mental health and wellbeing are also of importance. Furthermore, research is needed to identify which types of natural and green spaces are most effective in promoting health and wellbeing outcomes.

More detailed information is also needed on the use of natural environments in care and nursing environments in promoting the wellbeing of children, youth and the older adults. This knowledge can help to identify critical points in the life course when exposure to natural environments is most beneficial and to understand the different mechanisms through which disease prevention and health can be promoted.

Rigorous evaluation of structured nature-based interventions—such as nature prescriptions—should also be expanded across diverse patient populations, both within the context of health promotion and as part of rehabilitation and secondary prevention strategies for mental health disorders.

#### IMPLICATIONS TO MENTAL HEALTH PROMOTION AND TREATMENT OF MENTAL DISORDERS

Overall, the growing body of research suggests that natural environments offer substantial potential for mental health promotion and prevention, as well as for reducing related healthcare costs. Although the mental health benefits of nature are increasingly recognized, they are not yet well integrated into preventive healthcare or widely utilized in the treatment of mental disorders. Nonetheless, such approaches could support mental wellbeing at the population level and potentially generate positive economic impact through decreased healthcare expenditure.

Recently, Tyrväinen et al. (2) presented illustrative calculations of potential cost savings in a scenario where the health benefits of nature were more effectively integrated into health promotion efforts in Finland. One of the three examples focused on the impact of changes in the provision of local supply of green areas on the incidence of depression. The model estimated how a 10% decrease or increase in the availability of green areas could affect the annual treatment costs of depression within the urban population. The modelling was based on findings from a Finnish study by Gonzales-Inca et al. (12), and it assumed that the effects of green space availability in the residential environment would continue across the lifespan. The estimated potential economic benefits from increasing nearby residential green space by 10% included €45 million in direct and indirect cost savings, and an additional €26–79 million in welfare gains through quality-adjusted life years (QALYs), resulting in a total annual benefit of €71–150 million, depending on the valuation of QALYs.

To date, the most robust evidence derives from intervention and epidemiological studies, which demonstrate that regular exposure to natural environments or greater availability of green space in residential areas can significantly enhance mental wellbeing and overall health. Therefore, this knowledge should be more widely utilized in preventive healthcare. In contrast, the evidence supporting nature-assisted treatments (e.g. therapies) to promote mental health remains weaker, primarily due to the smaller scale and limited number of studies. Nevertheless, these approaches also show considerable potential for practical applications.

The findings of Hyvönen et al. (66), for example, suggest that nature-based treatment models can be safely integrated in the secondary and tertiary prevention of mental health disorders in health services and rehabilitation centres. An increasing number of countries have implemented or are piloting nature prescription initiatives, encouraging a patient to spend time in nature to improve their mental health or nature-assisted therapies within healthcare systems. Nature prescriptions typically involve self-directed visits to natural environments recommended by healthcare providers, whereas nature therapy consists of professionally guided interventions conducted in natural settings. However, empirical evidence on their effectiveness remains limited.

One of the key steps towards integrating nature more comprehensively into mental healthcare is raising awareness among healthcare professionals about the health benefits of nature environments. Nature-based interventions should not be viewed as replacements for conventional medical or mental health treatments, but rather as complementary approaches. Instead



of emphasizing potential risks or discouraging engagement with nature environments, health professionals could actively promote their benefits, bearing in mind safety considerations possibly related to engagement with nature. To this end, social and healthcare providers should systematically encourage more nature visits for suitable target groups, such as people with high risk for mental disorders but no mobility limitations, potentially in collaboration with non-governmental organizations active in engaging people with nature. Occupational health services could also advise employers to facilitate breaks in local nature environments during the workday and encourage employees to engage with nature during their leisure time.

Furthermore, in places where people work or study and where nature is not easily accessible, exposure to virtual nature could bring similar types of mental health benefits as visits to real nature. Findings from Nordic studies (72–76) align with international systematic reviews, which have demonstrated virtual nature’s potential to induce positive outcomes in psychophysiological wellbeing (77). Further, studies (78,79) have shown that solutions utilizing virtual nature have potential in promoting green exercise. However, some studies have observed real nature to be more restorative than its virtual counterpart (7). Hence, virtual nature should not be understood as a replacement but rather as an alternative to real nature in specific situations. For example, virtual nature environments could be more widely integrated into hospitals, clinics, high-stress job settings and other relevant workplaces with limited access to nature to promote relaxation and support stress recovery.

## CONCLUSIONS

In summary, fully realizing the benefits of nature environments—both real and virtual—requires tailored approaches depending on the target group. To prevent mental health problems at the population level, it is essential to ensure the availability of natural environments in residential areas and to provide good, equitable access to them. Achieving these calls for the involvement of municipal and regional actors in land use planning as well as green space planning and management. For promoting mental health in specific treatment groups, a good understanding of user needs and clearly defined goals, such as reducing anxiety, enhancing recovery or improving staff wellbeing, is crucial. Co-design processes involving end users and stakeholders are therefore essential in developing effective nature-based services for mental wellbeing and health.

## Supplementary Material

Supplementary data are available at [Psychiatria Fennica online](https://www.psychiatria.fennica.fi/).

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## Authors

Liisa Tyrväinen<sup>1</sup>  
Ann Ojala<sup>1</sup>  
Jaana I. Halonen<sup>2,3</sup>  
Tuomas Kari<sup>1</sup>  
Tytti P. Pasanen<sup>2</sup>

<sup>1</sup>Natural Resources Institute Finland, Helsinki, Finland, Latokartanonkaari 9, 00790, Helsinki

<sup>2</sup> Department of Public Health, Finnish Institute for Health and Welfare, Helsinki, Finland

<sup>3</sup> Division of Psychobiology and Epidemiology, Department of Psychology, Stockholm University, Stockholm, Sweden

## Correspondence

Liisa Tyrvainen  
E-mail: [liisa.tyrvainen@luke.fi](mailto:liisa.tyrvainen@luke.fi)

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