



CHARLES SENAY

# **Nature Connection as a Physiotherapy Tool**

Background Research on Natural  
Environments Interaction with Human Health  
for Informative Articles Destined to  
Physiotherapists

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<p data-bbox="312 701 424 730">Abstract</p> <p data-bbox="312 772 1449 1171">           The impact human activities have on the planet's life-supporting systems is very well known to date. It is believed that a strong link subsists between our disconnection from the rest of nature and the human-generated environmental crisis we are facing. This crisis poses a serious threat to our species. This thesis aims to inform professionals in the field of physiotherapy about the present state of research on the possible benefits that connection with nature can foster in their clientele. Further on, it sheds light on whether human and nature connectedness (HNC) could be used as a clinical tool for physiotherapists. This work presents on one hand the literature review process that was used to collect background information on the subject, and on the other hand, the process and guidelines used to produce two informative articles, published on two different platforms.         </p> <p data-bbox="312 1214 1449 1541">           45 articles were selected out of 895 titles from 3 scientific databases. There was a prevalence of reviews about mental and psychological health and connected issues (32 publications). 17 mentioned findings on the physical health benefits of nature-based interventions (NBI), including immune functions, blood pressure, and cortisol levels. Additional interventions included indoor and virtual nature exposures. Finally came HNC as an outcome measure of diverse nature exposures. We concluded that HNC provided an interesting outcome measure as it had the potential to promote healthier lifestyles and nature-conserving attitudes in the studied populations, which is notable for physiotherapy purposes.         </p> <p data-bbox="312 1583 1449 1798">           It should be noted that further research is still needed to confirm the solidity of the points brought up throughout this thesis. However, the evidence is already showing great promise in the benefits of integrating nature elements into physiotherapy practice. HNC could eventually be considered a tool for this profession, as it presents a cost-effective, preventative solution that can be implemented in various ways, compatible with the healthcare clinical environment.         </p>		
<p data-bbox="312 1852 448 1881">Keywords</p> <p data-bbox="312 1890 1449 2000">           Physiotherapy, nature, human-nature connectedness, nature-based interventions, health promotion, literature review, environment, sustainability, Environmental Physiotherapy Association         </p>		

## PREFACE

The idea for this thesis subject was born before I applied to the physiotherapy program. I hesitated between this degree and one in outdoor adventure education because my goal was to nourish and share my passion for nature conservation. I concluded that as a physiotherapist, I would be able to reach people in a way that seemed more meaningful to me. When I found out about forest therapy as a scientific area of study, during one of my first courses, it confirmed I was truly on the right path.

Shortly after, I came across the Environmental Physiotherapy Association (EPA) while wandering the web in search of inspiration for my future career. I encountered like-minded people sharing thoughts and ideas, coming into action, and educating others about the importance of our environment and its conservation. I came in contact with Filip Maric (PhD), founder and executive chair of EPA and the discussion started about the contribution I could make to the association all the while producing my thesis. Shortly after, I took part in the *EPT Agenda 2023* (Maric et al., 2020) and presented my plan for this work, along with other students who presented their already published work or work in progress, in connection with EPA. This thesis was then officially ordered by EPA.

All this brought me to this very stage. I am proud to be part of a community of people who understand the importance of a healthy environment for the health of our species. I am grateful to Filip Maric for having shown so much enthusiasm for my work and my desire to contribute to this growing branch of physiotherapy. I am also grateful to my teachers who have supported this process, encouraged me on this path, and given me great opportunities to travel abroad while expanding my worldview, my knowledge, and my network greatly. This final work has been a decisive step on the path I am undertaking as a physiotherapist and as an actor in my community, while slowly pulling me towards further steps in the academic world.

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## 1 INTRODUCTION

At the forefront of combating the dire impact of human activities on our planet's life-supporting systems are dedicated healthcare professionals. Physiotherapists, with their unique competencies in teaching and counselling (Physiotherapy, 2019), play a pivotal role in promoting healthy habits and fostering well-being in the populations they serve. As the world grapples with the profound consequences of fossil fuel-based economies on both the environment and human health, it is imperative to recognize the critical role that physiotherapists can play in addressing these challenges.

The severe consequences of our reliance on fossil fuels have been well-documented in countless scientific publications since the rise of such economies (Brondizio et al., 2019; Díaz et al., 2019). These impacts are not confined to the natural world but extend to our health and well-being, with the prevalence of non-communicable diseases on the rise due to factors like air pollution and stressful lifestyles (Aerts et al., 2018; Herting et al., 2019). We stand at a pivotal moment in history, teetering on the brink of global and systemic changes. While some countries are beginning to take measured steps to reduce greenhouse emissions and avert irreparable damage, the transition remains sluggish, primarily because the very agents responsible for environmental disruption are deeply entrenched in the core of our economic systems.

Nonetheless, a fundamental shift in our approach is vital if we are to mitigate the exponential and potentially incalculable damage of rising global temperatures. One transformative approach is to reduce the environmental impact of healthcare services, which, in 2019, were estimated to contribute 4-5 percent of the world's total greenhouse gas emissions (Hensher & McGain, 2020). By curbing the prevalence of non-communicable diseases through health prevention practices, there exists the potential to directly reduce the global burden of environmentally costly healthcare services. The UN General Assembly recently declared that "access to a clean and healthy environment is a universal human right" (UN News, 2022) placing the onus

on healthcare providers, including physiotherapists, to ensure the realization of this right.

With their expertise, physiotherapists are well-positioned as frontline healthcare professionals to instil healthy habits and well-being in the populations they serve. Practices like forest bathing and nature therapies, which have garnered increasing recognition, offer promising avenues for enhancing health and well-being and are supported by a growing body of research. Physiotherapists, as evidence-based practitioners, have a responsibility to foster an understanding of the direct link between environmental conservation and our health. In essence, they are integral to the efforts aimed at reducing the spread of illness and curbing public healthcare costs (Anttila et al., 2016).

While it might seem self-evident that natural spaces are beneficial for human health, historical records dating back 2500 years underscore the advantages of green spaces in densely populated areas (Hansen et al., 2017). However, current policies often fail to fully acknowledge the profound impact of our natural environment on societal well-being. A worldview that separates humans from nature, relegating the latter to the service of the former, undeniably distorts individuals' perceptions of nature's significance. Research has shown that people consistently underestimate nature's effects on their health, even after participating in experiments that unequivocally demonstrate these effects (Barragan-Jason et al., 2022).

This thesis seeks to empower professionals in the field of physiotherapy by providing an up-to-date review of research on the potential benefits of connecting with nature for their clientele. Furthermore, it sheds light on whether the concept of human and nature connectedness (HNC) could be harnessed as a clinical tool for physiotherapists. Numerous studies have demonstrated the positive effects of exposure to natural spaces on both the human body and mind, across a range of populations (Geneshka et al., 2021; Mygind et al., 2019; Park et al., 2022; Shim et al., 2022; Stier-Jarmer et al., 2021). This work encompasses two critical components: a comprehensive literature review that forms the foundation of this study and the processes and guidelines employed in crafting two informative articles. These articles, one published on the

Physiopedia website and the other as a blog post on the Environmental Physiotherapy Association (EPA) website, serve as vehicles for achieving the aforementioned aims.

## 2 THEORETICAL FRAMEWORK

To introduce the concept of human and nature connection as a tool for physiotherapy, this particular relationship was explored and defined. A literature review was performed – described in the following chapter – and from which several concepts emerged along with their implications. Indeed, to know whether physiotherapists could benefit from such a tool, the outcomes must be enounced and argued thoroughly. In this light, this section defines the terms and concepts used during the literature review section, where the health implications that human and nature connection may bring forward will be further explored.

This background research, and the arguments that surfaced from it, served as a template for the two articles that were then produced. As previously mentioned, one informal blog post that introduces the idea of human and nature connectedness as a physiotherapy tool, and an encyclopaedia article that dives deeper into the definition of terms and concepts. The latter further exposes ways in which physiotherapists can implement this tool.

This work presents terms and concepts related to nature and humans and their interaction, specifically nature's effects on human health and well-being. The following are the most used nomenclatures that were also used as search prompts through scientific databases. The following list serves also as a reference for readers while exploring this thesis.

## 2.1 Nature

The term *nature* itself may require some level of clarification. Different worldviews give different meanings for, and considerations towards nature. An anthropocentric worldview (centred on humans) separates and places humanity over nature, or nature at the service of humanity. In that sense, nature is viewed as a separate sphere that can or cannot influence human activities and well-being. From this perspective, nature can still emerge in the form of either “nature for itself” that closes access for humans to certain areas, “nature despite humans” that restores certain areas after exploitation, or “nature for humans” that protects certain areas for the benefits of human wellbeing (Howe et al., 2014).

Ecocentrism or Biocentrism (centred on nature) places humans within the sphere of nature and sees its interdependent qualities (Barragan-Jason et al., 2023). From this view, not only are the benefits of nature for humans considered but the relationship is seen as a “give-give” or “win-win” situation (Howe et al., 2014). Decisions and actions generated from this worldview take into consideration the well-being of all living entities (human and non-human).

## 2.2 Nature and Human Connectedness

Following the previously mentioned ecocentrism, nature and human connectedness (NHC) integrates human beings into nature to form a whole (Mohamed et al., 2022). It is when humans consider themselves as part of the natural world, therefore actions that benefit their interests are equally considered – or simultaneously – as the benefit of the rest of the biosphere. NHC can also be viewed as a state of mind where people feel connected to and deeply concerned with, their living environment.

## 2.3 Natural Environments and Parks

Natural environments or spaces are defined as areas that are devoid of industrial exploitation or alteration. These often are protected areas or conservation parks but



can be any other green spaces (forests, grasslands, etc.) or blue spaces (bodies of water like rivers, lakes, etc.) that are left to their wilderness state. Parks refer to similar areas, although often managed by human organizations. Another term used for parks is urban green spaces (World Health Organization, 2016).

#### 2.4 Forest Bathing or Shinrin-Yoku

Shinrin-Yoku, and its direct translation as forest bathing, have been known for centuries in Japanese culture as an activity to nourish the body and mind. Although, more recently it has been adopted by the Japanese government as a treatment to prevent and address stress-induced illnesses (Q. Li, 2018). This practice is described as simply being present in a forest and taking in stimuli from all five senses. It is a practice rather related to mindfulness, inviting the participant into a meditative state. No particular physical condition is required, as long as the participant can enter a forest space. There are mentions of digital Shinrin-Yoku where the immersion into forest spaces is done through 3D immersive technologies and sometimes additions of forest smells (Takayama et al., 2022).

#### 2.5 Nature-based Interventions

Interventions, such as physiotherapy sessions or other forms of therapies, that take place in natural environments are often referred to as nature-based interventions (NBI). It is generally an umbrella term that covers a wide range of interventions that are being explored for their effectiveness regarding nature as a main actor. Gritzka et al. presented a definition for NBI as follows: “[...] planned, intentional activities to promote individuals’ optimal functioning, health and well-being or to enable restoration and recovery through exposure to or interaction with either authentic or technological nature (Gritzka et al., 2020).”

### 3 LITERATURE REVIEW

#### 3.1 Methods

PubMed, Google Scholar, Cochrane Library, and Science Direct were selected as sources of publications. Search terms ("nature therapy" OR "nature assisted therapy" OR "forest therapy" OR "shinrin-yoku" OR "forest bathing" OR outdoors OR forest OR "green space\*" OR "blue space\*" OR nature) AND ("mental health" OR wellbeing OR physiological OR psychological) were used to search for relevant literature in PubMed library and Google Scholar. Search terms (nature OR "green space" OR outdoors OR "blue space" OR forest) were prompted in Science Direct and Cochrane Library. Additional filters were used, including papers published between 2012 – 2023, systematic reviews, and freely accessible articles or via Unpaywall (Else, 2018), an open database of freely accessible scientific publications. It was concluded that the most appropriate way to reach the set goals would be, to sum up the most studied health outcomes of nature exposure in the most studied populations. Therefore, publications dating from the last decade were included to obtain the most up-to-date data. Some articles were added with the snowball search method.

706 articles came out from PubMed using these defined search terms, 102 articles from Google Scholar, and 77 from Science Direct. Following the gathering of articles from the aforementioned libraries, inclusion and exclusion criteria were applied using the PICO model (Nishikawa-Pacher, 2022) to further increase the general quality of selected articles. Publications that did not respond to PICO model criteria or that did not include nature-based interventions were excluded. After which, duplicates were removed, using Ryyan online software. A total of 45 publications remained.

Table 1: Database Search Results

	PubMed	Google Scholar	Science Direct
Entry terms	706	102	77
Additional filters	19	59	21
Duplicates removed	45		

### 3.2 Results

Results of the selected studies were compiled through abstract screening in most cases, and full-text screening in some cases where abstracts were either incomplete or unclear. Populations included and outcomes of the studies were identified and summarized in the following section. Overall, the mental and psychological effects of natural environments on children, adults, and older adults comprised most of the reviews' focus. Physical and physiological outcomes were the focus of the remaining publications with a preponderance of adult subjects. Table 2 summarizes these outcomes. Additionally, the concept of human and nature connectedness (HNC) came up in several studies reviewed and was dived into more specifically in two publications that will be covered at the end of this section.

Table 2: Reported Outcomes per Age Groups

	Physiological (17)	Psychological (35)
<i>Children 0-18</i>		
	Physical activity (1)	Anxiety and depression (4)
	Stress (2)	Cognition (2)
		Developmental problems (1)
		HNC* (1)
		Overall mental health** (7)
		Resilience (2)
		Self-esteem (1)
		Social wellbeing (1)
<i>Adults &amp; Students 18+</i>		
	Cardiovascular (1)	Anxiety & Depression (4)
	Diabetes (1)	Cognition (3)
	Hypertension (1)	HNC* (1)
	Immune system (1)	Overall mental health** (3)
	Inflammation (1)	Positive/Negative affect (1)
	Obesity (1)	
	Physical activity (1)	
	Recovery/Restoration (1)	
	Stress (3)	
<i>Older Adults</i>		
	Physical activity (1)	Cognition (1)
		Life satisfaction (1)
		Psychological wellbeing (1)
		Social wellbeing (1)
		Subjective wellbeing (1)

In parenthesis: number of systematic reviews.

\*Human and nature connectedness (HNC). \*\*Overall mental health refers to a range of reported outcomes that include; positive mood, better emotional well-being, improved mental health, and behaviour, decreased psychological distress, mood and affect, perceived restoration, energy, self-concept, and pro-social behaviour.

### 3.2.1 Mental and Psychological Health

There was a prevalence of reviews about mental and psychological health, and connected issues, with 32 publications out of the 45 selected. Some of which included research on all aspects of human health. As an example, a systematic review summarizing the psychological and physiological effects of nature-based outdoor activities found much more conclusive results on mental health (Coventry et al., 2021). This may be explained by the increasing number of people at risk for serious mental health issues, notably due to stressful living situations. It is estimated that 55% of the world's population is living in urban areas (Bray et al., 2022) which has been linked to high levels of stress.

Fifteen of those studies focused on children and adolescent populations. Intervention types varied between arts-in-nature (Moula et al., 2022), outdoor physical activity (Park et al., 2022), simple blue and green-space exposure both in outdoor and indoor settings (Bray et al., 2022; Buczyłowska et al., 2023; D. Li et al., 2021; Rowley et al., 2022), and comparison between screen-time and green-time (Oswald et al., 2020). Outcomes included increased self-esteem, self-efficacy, resilience, and academic and cognitive performance (Mygind et al., 2019).

Seven reviews focused on adult subjects (>18 years old) and the possible effects that natural spaces can have on stress reduction as a main factor in measuring mental health. Interventions reported included workplace nature-based interventions (Gritzka et al., 2020), forest bathing (Park et al., 2022; Yi et al., 2022), and physical activities in natural settings (Coventry et al., 2021; Thompson Coon et al., 2011).

Forest bathing was found to be effective in reducing symptoms of depression in adult populations (Yi et al., 2022). Forest bathing, known as *Shinrin-Yoku* in Japan, has seen an increase in public recognition around the world ever since its implementation in 1982 within the Japanese healthcare system as a preventive medicine method (Rajoo et al., 2020). Meta-analyses support the conclusion that forest therapy is an effective treatment for improving mental and emotional states in healthy adults and suggest equal effectiveness in people suffering from ill mental and physical health.

An additional two reviews focused on outcomes of nature exposure in older adult populations, with a particular focus on subjective, psychological well-being through gardening (Yeo et al., 2020) and urban nature exposure (Xu et al., 2022). The latter explored the effects different variables would have on the use and efficacy of these spaces, such as size, proximity, biodiversity, and presence of built facilities. The authors concluded that urban green spaces had the potential to alleviate stress and anxiety in older adult populations, as well as promote social inclusion and increase subjective psychological well-being.

### 3.2.2 Physical and Physiological Health

Seventeen studies mentioned findings on the physical health benefits of nature-based interventions (NBI). Outcome measures included immune functions, blood pressure, and other biological indexes such as cortisol levels (stress biomarkers). Six of them limited their search to adult participants, Two to young participants (children, adolescents, and young adults) and the rest did not take into consideration a specific population other than human beings.

One review (Chae et al., 2021) reported studies on the effects that forest bathing has on the immune system. Natural Killer (NK) cell count was used as a determinant of immunity response, a cell type responsible for eliminating pathogens in the bloodstream. NK cells are important first-line defence players as they search and destroy virus-infected cells and cancerous cells. NK cells have been observed to be particularly vulnerable to chronic stress, which limits their proliferation, but incremented by exercise-induced stress (Vivier et al., 2008). Many articles in this review reported the effects of phytoncides, a volatile compound produced by trees which, when entering the human body through the airways, results in rising levels of NK cells (Q. Li et al., 2006). Levels of NK cells have been observed to be higher even 30 days after visiting a forest (Q. Li et al., 2010).

One of those selected reviews had a focus on cardiovascular functions with forest bathing (Ideno et al., 2017). The review authors conducted a thorough meta-analysis of 20 trials that observed the blood pressure lowering effect of forest bathing in different populations and different baseline blood pressure levels. It was found that in both high and low blood pressure individuals, the difference was significant after the interventions. To lower the heterogeneity of the results, the intervention types were also divided into sub-groups: walking and non-walking. This was done to identify whether the effects were due to physical activity rather than the presence in a forest environment. Further on, age groups and gender groups were divided. In all cases, the same conclusions were drawn; forest bathing has lowering effects on blood pressure in populations of all ages, sexes, and blood pressure baselines, in both active and non-active interventions. Moreover, subjects with higher baseline blood pressure had more significant effects from these experiments. Based on the data collected in this review, forests may have a direct effect on lowering the sympathetic nervous system, resulting in augmented parasympathetic nervous system activity. This explains the mechanisms behind the blood pressure lowering effects of forest bathing on humans.

NBIs, in particular forest bathing, have also been shown to reduce cortisol – a glucocorticoid hormone secreted by the adrenal glands – levels in the bloodstream, therefore reducing subjective stress. One systematic review with meta-analysis (Antonelli et al., 2019) explored these outcomes in healthy individuals. The authors reported not only the cortisol-lowering effects of forest bathing but also the mere anticipation of visiting a forest has shown significant results. More importantly, the difference in cortisol levels between the control and experimental groups was most significant before the interventions and with low to moderate levels of heterogeneity, confirming the anticipatory placebo effects play a strong role. Interestingly, according to their findings, it appears that the most important aspect of the stress-lowering effects of forest bathing lies in the viewing of nature. The authors also noted the studied effects of the aforementioned phytoncides on the immune system.

### 3.2.3 Nature Connectedness and Health

In their systematic review, Barragan-Jason et al. (Barragan-Jason et al., 2023) explored the relationship that humans have with their environment and the possible implications for their health. The authors shed light on the idea that fostering a sense of connection between human and non-human beings (i.e., plants and animals) would result in actions that promote nature conservation. The review argues that only by allying knowledge and understanding of natural environments benefits for humans from different spheres of science (health, education, psychology, and biology), can societies reach the UN's sustainability agenda. It also argues the concept of nature connectedness has the potential to change the overall attitude towards nature-based interventions as a clinical tool to address both physical and psychological health. The authors bring about a study (Nisbet & Zelenski, 2011a) that demonstrates how people tend to underestimate the value and benefits of spending time in nature and that it is due to governmental agencies not taking it seriously despite the growing scientific evidence on the subject.

In their previous review, the same authors (Barragan-Jason et al., 2022) presented their findings about diverse approaches that were most conclusive in fostering human nature connectedness. They found that exposure to real nature (both outdoors and indoors) and virtual nature (through immersive experience or images) had positive effects on NHC. More importantly, mindfulness practices coupled with these exposures had the greatest demonstrated effects. Figure 1 further illustrates their findings.

Furthermore, they explored correlated aspects that had positive or negative effects on HNC. Namely, healthy behaviours, pro-environmental or non-environmental values/behaviours, and environmental education were put in relation and showed direct incidence on levels of HNC in the subjects. Non-environmental values such as materialistic values or conservatism political views resulted in a significantly lowered feeling of connectedness with nature. Incidentally, populations that were happier and healthier demonstrated much higher care for their natural environment.



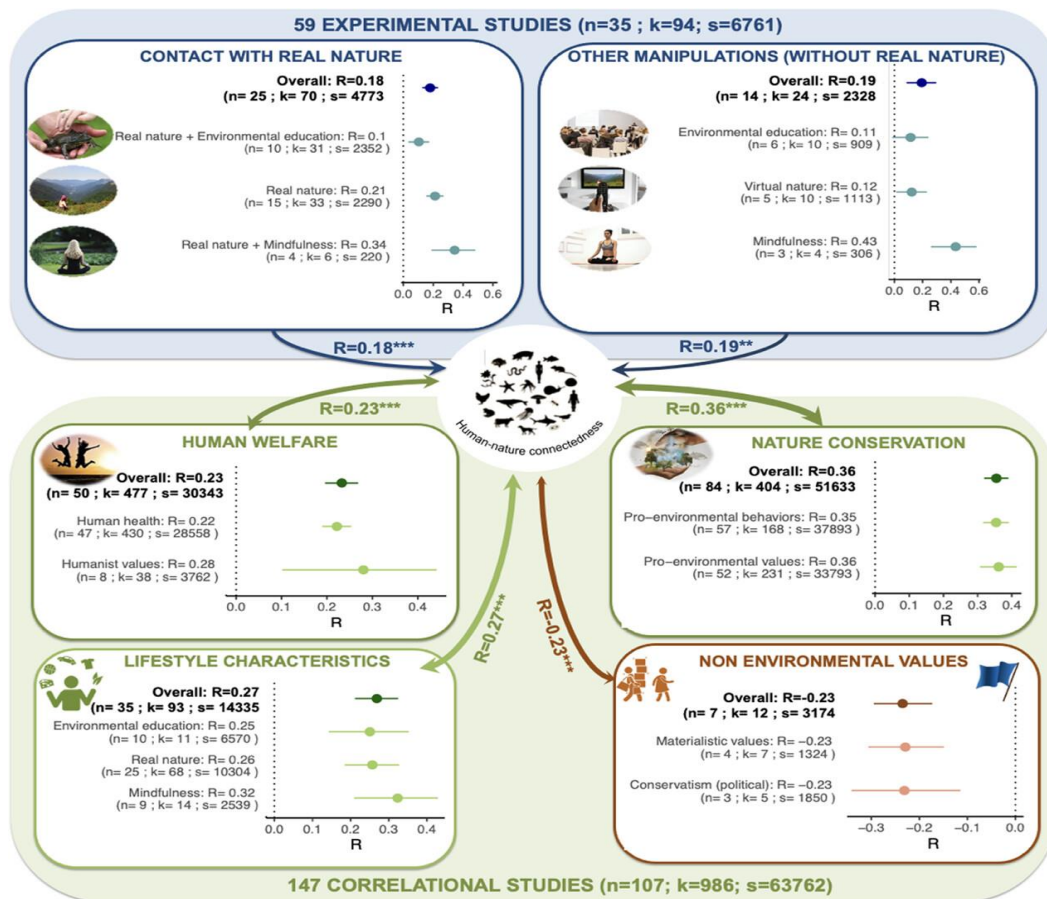


Figure 1: “Results from meta-analyses of experimental (blue background and text) and correlational (green and orange backgrounds and text) studies. Each dot represents the average R estimate for each factor obtained after transforming averaged standardized effect sizes (Fisher’s Z for correlational data and Hedges’ g for experimental data) with n, k, and s referring to the number of papers, number of effect sizes and number of participants, respectively. Horizontal lines indicate the 95% confidence intervals for each factor and cross the vertical dot lines when nonsignificant (i.e., environmental education in experimental studies). Single-headed arrows refer to causal relationships while double-headed arrows refer to correlational links. Overall R estimates from each broad category are in bold. Details are provided in Methods, Appendix 5, Tables S2–S4, and Figure S4. Experimental studies show that exposure to nature and mindfulness practices improve HNC. Correlational studies confirmed experimental studies and show that HNC is positively linked to nature conservation and human welfare and negatively linked to nonenvironmental values. \*\* $p < 0.001$ ; \*\*\* $p < 0.0001$  (Barragan-Jason et al., 2022)”.

### 3.2.4 Indoor Presence of Nature

A few reviews brought up the possible effects of indoor plants or indoor nature viewing on health and wellbeing. Indeed, a large number of people spend most of their time indoors and sometimes have difficult or no access to outdoor natural environments, the question has been raised. As mentioned earlier, there are strong leads suggesting that viewing nature has the greatest observed calming effects (Antonelli et al., 2019). One review (Jo et al., 2019) focused particularly on this phenomenon and reached a similar conclusion that suggests that viewing images of nature has a positive effect on cerebral functions and the parasympathetic nervous system.

Additionally, following the leads that human contact with nature has various demonstrated outcomes in students' stress levels, academic success, and general wellbeing, one group of researchers attempted to demonstrate the role of nature in these outcomes (van den Bogerd et al., 2020). Once again, their findings were limited by the level of heterogeneity and bias of the included studies but could provide promising leads for policymakers on the importance of incorporating indoor greenspaces (potted plants, green walls, nature prints, etc.) in academic environments.

## 3.3 Conclusions and Discussion

### 3.3.1 Mental and Psychological Health

Although the number of both qualitative and quantitative research publications is growing constantly, reaching their conclusions on the benefits of nature-based interventions on the mental and psychological health of human subjects, it is yet too early to draw any firm conclusions on the mechanisms at play. The majority of systematic reviews included in this section drew similar conclusions; the heterogeneity of methods used, and sometimes poor quality of the studies were reasons to conclude the infancy of this research domain. In their literature review, Gritzka et al. (Gritzka et al., 2020) noted that "caution must be given when interpreting the current evidence in

this emerging research field because of the diversity of NBI and the overall high risk of bias in the individual studies.”

Nevertheless, the similarity in results presented in many of the studies – though heterogeneous as they are – support some level of evidence that such interventions may have a significant, positive effect on the mental and psychological well-being of populations of all ages. This is an important lead that shows the potential of nature-based interventions in the social and health departments and sustains an interest for policymakers and investors to further research in the field.

### 3.3.2 Physical and Physiological Health

Research reporting the physical and physiological effects of different NBIs has reached somewhat stronger conclusions than with mental and psychological effects. This is greatly due to the ease of gathering quantitative data from biomarkers such as cortisol and conducting meta-analyses with this data. Stress levels and immune and cardiovascular functions were the most mentioned subjects in this literature review, with a focus on working-age adults or higher education student populations.

There are strong leads suggesting that NBIs, particularly in forest environments, have remarkable effects on human body functions that are at the very core of health integrity. Boosting the immunity of the subjects being exposed to those modalities, with lasting effects, lowering blood pressure in healthy populations, as well as individuals with high blood pressure, and lowering the levels of cortisol in the blood are considerable outcomes. Indeed, when considering the prevalence of stress and cardiovascular-induced illnesses, physiotherapists are bound to encounter patients suffering from the above. Promoting lifestyle changes are considered an important part of the treatment of those ailments, therefore, NBIs may offer one such tool to be implemented into patients' life that has the potential for sustainable results.

### 3.3.3 Human and Nature Connectedness

HNC could prove to be an essential aspect to implement when considering natural spaces as a clinical environment for physiotherapy sessions. Researchers have observed that, regardless of the benefits obtained from such spaces, study participants often diminished or disregarded the role of nature as a main facilitator of those benefits (Nisbet & Zelenski, 2011b). Indeed, when considering lifestyle changes, one must be first convinced of the effectiveness of a particular treatment or aspect to be changed.

Although the authors noted the high level of bias in subjects' age (mostly adults) and nationalities (solely from industrialized nations), the results show great promise in promoting HNC to attain the UN's 17 sustainable goals by 2030. Consequently, future research must be conducted while allying all spheres of science exploring the relationship between human and nature and their outcomes, while also expanding the research population to the worldwide communities.

### 3.3.4 Indoor Presence of Nature

These findings – although needing stronger backing – have the potential to so-called “bring nature indoors” and provide demonstrated health effects of natural environments even to those who are bound to indoor spaces. From a health promotion perspective, it could incite the incorporation of plants, nature prints, or essential oils in indoor spaces where a large number of people spend their time nowadays. Future studies could compare health outcomes with people of various age groups and nationalities spending time either in contact with outdoor nature or indoor nature.

### 3.3.5 Discussion

The above-mentioned modalities of exposure to natural spaces, both outdoors and indoors, and in urban or wilderness areas, suggest important leads toward healthier human beings of all ages. Evidence shows a strong correlation between urbanization and increased resurgence of illnesses, due to lower air quality, high levels of noise,

and other stress-inducing factors (World Health Organization, 2016). Therefore, both the presence of elements of nature (trees, plants, water bodies) in urban areas – both indoors and outdoors – and of humans in natural spaces (parks, forests, etc.) have been the subject of numerous studies in different spheres of science. Being a relatively new area of study, there is still a high level of heterogeneity across most studies included in the presented reviews. This may be explained by the many variables that are present in the definition of natural spaces and in the difficulty of producing solid double-blinded studies.

Nevertheless, there are strong leads that support the many positive effects of natural environments on human health and well-being. Those include both physiological and psychological outcomes. Indeed, research suggests positive effects on blood pressure, cortisol levels, immune functions, mood, and well-being in healthy populations. There is also evidence suggesting the particularly positive effects in people affected with high blood pressure (Ideno et al., 2017), high levels of stress (Corazon et al., 2019), depression and anxiety (Bray et al., 2022), and some other forms of chronic conditions (Taylor et al., 2022). These alone point out a direction that we may already be aware of; fostering the conservation of – and accessibility to – healthy natural environments will play an important role in the promotion of our health.

Furthermore, the presence of these many systematic literature reviews and meta-analyses demonstrates the potential of this research area and the potential evidence that will emerge from clearly defined future study directions. Additionally, linking the already existing evidence from different spheres of science that support the importance of natural environments – and the human interaction with them – may translate into concrete actions from decision-makers. Such actions could very well be seen in the healthcare sector, particularly health promotion, as low-cost interventions to mitigate the load of most common non-communicable diseases in the worldwide society.

## 4 METHODOLOGY

As this thesis is an article-based work, two platforms, using two different styles of publications, were selected as outputs for reaching the aims previously described. An article will be published on the website of Physiopedia, and a blog post will be posted on the dedicated web page of the Environmental Physiotherapy Association. For both platforms, guidelines and procedures are demanded and are to be respected.

These two styles of publications are complementary in that they use two different literary approaches and are addressed to different readers. A blog giving a short overview of the research work and conclusions, in a more accessible, less formal way. Following is the background information of both publication outputs and their relevance to the subject and aims of this thesis, along with their specific guidelines.

### 4.1 Environmental Physiotherapy Association

Environmental Physiotherapy Association (EPA) regroups clinicians, students, researchers, and educators in the field of physiotherapy and occupational therapy who share the view that to preserve our health we must preserve our environment (and vice versa). Its executive committee includes 10 members from across the globe and held its first meeting in October 2019 (Environmental Physiotherapy Association, 2019a). The EPA also launched its Environmental Physiotherapy (EPT) Agenda 2023 in March 2020 which aims at “the integration of planetary health, environmental and sustainability perspectives into entry-level physiotherapy education around the world” (Environmental Physiotherapy Association, 2019c). It is also building a repository of open-access courses designed by supporting organizations and participating institutions as well as tips and material to promote active implementation of environmentally friendly practices.

EPA’s website is a platform for anyone working in – or associated with – the field of physical therapy who wishes to learn or share about ways that their practice is connected to our environment and how to sustain a healthier connection with it. One

way that is set for this purpose is the blog post page (Environmental Physiotherapy Association, 2019b). Guidelines on the format the posts should respect and how to proceed with submissions can be found on this page. Each submission will then be reviewed by the board members before being published on the web page.

## 4.2 Physiopedia

Apart from their webpage and blog platform, members of EPA have been using Physiopedia and Physioplus to publish articles and courses to inform physiotherapists about the concepts that they bring. Physiopedia – and their associated learning platform Physioplus – is an open-source, online encyclopedia focussed on physiotherapy-related topics. The website was founded and run by a group of volunteers who ensure the quality and exactitude of the information shared on their platforms. To help sustain this goal, guidelines for publications are accessible to all who wish to add to the encyclopedia. Trainings for individuals (e.g., students, clinicians, researchers) who wish to be part of the volunteer group, or simply learn how to use Physiopedia’s content editing functions, are organized frequently.

Guidelines for the creation of a new page on Physiopedia are clearly stated and tools are offered to follow those guidelines. The online publishing tools – including font, layout, media linking format, etc – ensure a smooth continuity between all published content.

## 4.3 Writing Process of the Articles

The blog post, entitled “Nature Connection as a Physiotherapy Tool”, was first submitted for review to EPA on October 2023. The first draft received edits and suggestions, which were implemented into the final draft and submitted again. It was convened that it would be submitted in full – including images, a short biography of the author, and a link to this thesis – once the present document was finalized and published. The blogpost had then to be put on a waitlist, behind other submitted articles and would appear online one to two months later.

The writing process for the Physiopedia article took longer than the blog post and was started in April 2022. The article followed a six-month online and part-time training – started in November 2022 – offered by the Physiopedia team that aimed at forming volunteers to contribute to the creation and upkeep of the website’s database. The values and guidelines of the organization were first presented, followed by an introduction to content editing. Part of the process involved editing or updating some already existing pages. This served as a practice to then be able to create an entirely new page. This is when the page entitled “Nature Therapy” was created.

As the title suggests, the article focuses primarily on NBI and particularly on the therapeutic effects of being in natural spaces. Terms and concepts are first introduced, following tools and ideas for physiotherapists to use as their intervention or to accompany their sessions with their clientele. Supporting media is linked, along with a list of benefits for human health and well-being found in the literature review that this present work described earlier. The article followed Physiopedia’s layout guidelines and referencing format. Since it is an open-source platform, others have also contributed to the article by adding some information, external links, and references. The page was reviewed by the content editing team, edited for web accessibility, and made publicly available (Senay et al., 2022).



## 5 CONCLUSION

This thesis' main goal was to present an evidence-based tool for physiotherapists to use that has the potential to be adaptable to various age groups with various health conditions. The topic of human and nature connectedness was chosen as it can be adapted to all clientele spectrums that physiotherapists encounter, it presents low-cost solutions for policymakers concerned with health promotion, and it addresses environmental issues simultaneously. As the authors of one included review argued, fostering the sentiment of connection with natural environments has been observed to lead to a more concerned attitude towards nature conservation and even healthier life habits altogether (Barragan-Jason et al., 2023). This concerns physiotherapists as they have strong competencies in health promotion and education. Providing cost-effective care that will lead to healthier populations while also protecting the integrity of the environment are important aspect of their profession (Physiotherapy, 2019).

This above-mentioned goal was attained by searching for recent systematic reviews and meta-analyses that summed up the last decade of research on human health in interaction with natural spaces. The results of this literature review were then summarized into an informal blog, published on the Environmental Physiotherapy Association's (EPA) website, and an informative article on Phsiopedia's open web-encyclopedia. This paper served as an explanatory piece that dove deeper into the process and guidelines behind the two pieces of literature, and into the results found during the literature review part of this thesis.

The literature review shed light on important, growing evidence of the positive effects of natural elements – forests, gardens, parks, bodies of water, indoor plants, etc. – on human health and wellbeing. Several high-quality systematic reviews found promising leads on these effects, although most found generally high levels of heterogeneity across experimental studies and bias on the included participants. These are indeed important aspects to take into consideration when deciding whether an approach or tool is deemed appropriate for treating physiotherapy service users. Furthermore, they

can give valuable indications for future studies to bridge the subsiding gaps of evidence in this research domain.

There is, nevertheless, already sufficiently strong evidence to safely state that contact with natural environments is beneficial for human physiological and psychological well-being. The recently highly discussed topic of the disruption of the Earth's climate systems and its impact on the integrity of human society supports this statement. That, along with the proven health dangers of air and water pollution, densely populated areas, and the prevalence of mental health conditions in highly urbanised areas compared to rural areas point in the same direction.

There appears to be a great need for our societies at large to cultivate a re-connection with our natural environment, which could directly result in healthier, more conscious individuals who are concerned with the state of our climate and the state of their health. As healthcare professionals, physiotherapists must encourage lifestyles and behaviours that support the conservation of a healthy environment for healthy individuals. Human beings are dependent on their environment to thrive and survive. Activities that nurture nature connectedness are ways to achieve that, while also promoting well sought-after health benefits across age groups and genders.

Throughout this thesis process, we have found that natural elements can be added to a physiotherapy session to foster a human and nature connection. Adding plants or images of nature spaces in the treatment rooms, and carrying sessions in forests, parks, or nature conservation areas are ways to achieve the aforementioned benefits. Activities can vary from high-intensity sports to walking, to simply sitting and observing or creating art. As we found that only looking at natural elements or smelling certain trees or plants' essential oils can also result in health benefits, HNC is an easy tool to implement into the physiotherapy treatment curriculum. Figure 2 illustrates the diverse tools that can be used during a physiotherapy session and that can nourish a sense of HNC.

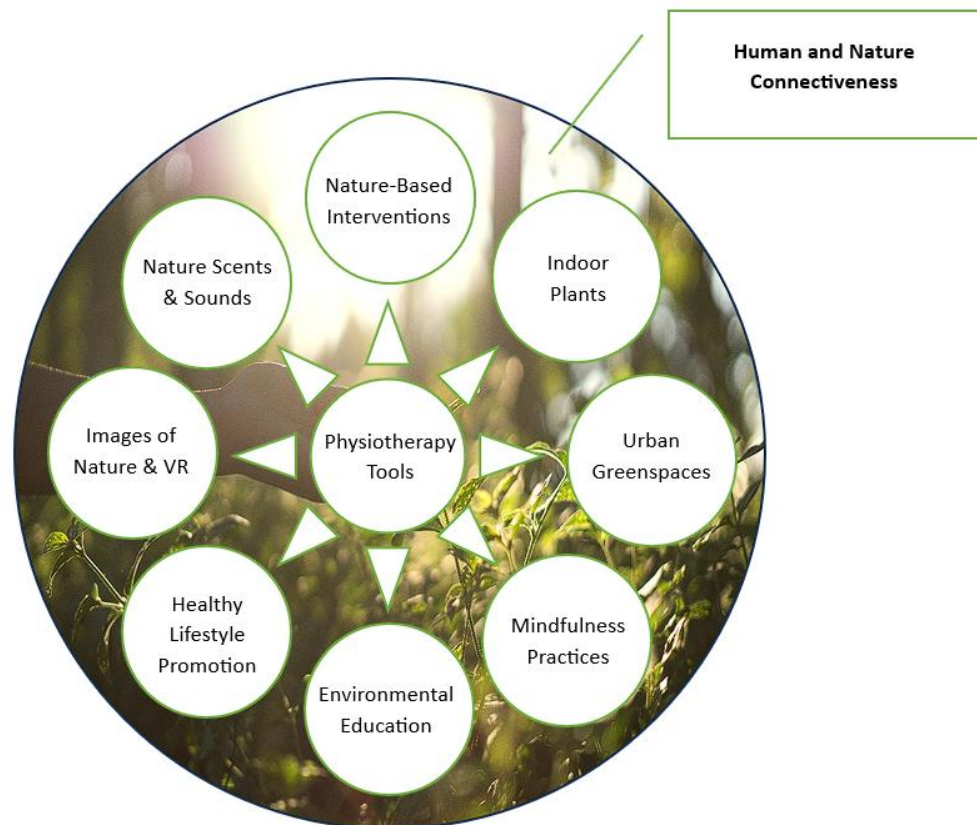


Figure 2: Physiotherapy tools that can nourish HNC, as proposed by Barragan-Jason (Barragan-Jason et al., 2022, 2023).

Finally, physiotherapy defines itself as an evidence-based profession, its practice must take into account the latest systematic research evidence, clinical observations, and patients' values (Veras et al., 2016). The modalities exposed in this work do respond to those criteria and therefore have their place in physiotherapy practice. The arguments presented throughout this work were rooted in a health promotion perspective, as the findings from the included literature explored broader elements such as physiological and psychological well-being experienced while diminishing stress factors. These elements address areas of physiotherapy practice linked more specifically to psycho-somatic perspectives (self-awareness and relaxation methods) but could also support practices focused on musculoskeletal disorders and therapeutic exercises. Future research on these domains will thus be needed.

## 6 DISCUSSION

Tackling the environmental crisis that we are facing requires an all-hands-on-deck approach if we want a chance to avert devastating consequences across the globe. Physiotherapists have as much a responsibility to address issues on individual and professional levels (i.e., mitigating the impacts that their actions have on the environment) as on the educational level (i.e., guiding and educating their patients towards and about sustainable actions). This can take many forms, but one that stood out from the rest while reviewing literature that connected human health and the health of the environment was precisely cultivating human and nature connectedness (HNC). This has indeed been shown to result in more nature conservation attitudes and healthier lifestyles altogether. These findings show strong promise in making HNC an integrated tool for physiotherapists as well as for other healthcare professionals.

Additionally, this tool is adaptable to the clinical reality of those professions. Photos of nature spaces, diffused essential oils, or mindfulness practices have shown great potential in solidifying this sought-after connection. But the even more profound health effects that presence in real, outdoor nature has on the human body and mind, all the while nurturing HNC, should still be considered seriously. Bringing patients – when possible – to green and blue urban spaces or nature parks and reserves can help restore and promote their health and wellbeing in many ways. That is a critical factor for the good functioning of our society at large, as it can reduce the economic weight of healthcare by investing in cost-effective prevention methods that will lessen the number of patients altogether.

Furthermore, the more concerned – or connected – we feel with the rest of nature, the more concrete and effective our actions to protect our environment will become. We could even argue that the more connected we feel, the healthier and more meaningful our lives will become. With the increasing prevalence of chronic stress and pollution-induced ill conditions, it is easy to conclude that our disconnection from the rest of nature plays a major role here. Yet, we are still heavily dependent on this very part we

have dissociated from. And, like a body part suffering from dissociation or neglect, physiotherapists have the competencies to help recover the missing link.

This thesis aimed at informing practising physiotherapists of the benefits and usability of HNC in their work. The articles that were published (the blogpost and Physiopedia page) introduced the concept itself, along with the health outcomes connected to it. Using two different platforms and writing styles raised the chances of efficiently reaching more professionals. These two platforms have the advantage of providing readers with already filtered evidence-based knowledge while minimising the time-consuming task of searching through scientific publications.

Finally, since HNC is a relatively new concept and field of scientific study, this work and its connected articles offered an introduction for some and complementary knowledge for other physiotherapists. It should be noted that further research is still needed to confirm the solidity of the points brought up throughout this thesis. However, the evidence is already showing great promise in the benefits of integrating nature elements into physiotherapy practice.

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