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Green Infrastructure: A Nature and Health Perspective for the Municipality of Oslo

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Abstract

Oslo is a green city by both meanings of the word. The focus on sustainability and climate friendly politics are key components in the municipality's plans and programs as well as Oslo being green in terms of having a lot of parks and greenspaces. Oslo enjoyed the title of the European Green Capital of 2019 and was awarded this title as a result of amongst other measures the management of its green and blue spaces. Coincidentally there has in recent years been a lot of international research on the potential health benefits of exposure to nature encompassing many scientific fields and disciplines. As the literature on this broad topic of nature and health has been growing steadily there has not been a direct approach related to this perspective of nature and health in Oslo. That would seem to be a missed opportunity for a city and municipality that is otherwise doing so much in their sustainability efforts. For that reason, the objective of this thesis was *to explore the scientific literature on the associations between nature and health, apply it to the context of Oslo to investigate how this perspective exists within the municipality and then provide recommendations for how this can be further accomplished.*

To achieve this objective an overview of the literature was created through a literature review to the degree it was possible to include as much relevant research within the timescale and with the resources available. Further, an analysis of the documents most closely related to the topic of nature and health was performed to see to what extent a nature and health perspective exists within the plans and programs of the municipality of Oslo. The document analyses were further complimented by three semi-structured interviews with employees in the municipality that hold relevant positions to the topic to uncover potentially overlooked positions relevant to include. The thesis operates within the theoretical frameworks of the biophilia hypothesis, attention restoration theory (ART) and stress reduction theory (SRT). The theories seek to explain how the interaction between humans and their natural surroundings facilitate for improved or sustained physical and mental health and overall well-being. The research literature provides clues that are valuable for urban developers and politicians, but still needs to be integrated into plans and programs to be fully utilized. As such it is essential for the municipality of Oslo to integrate a nature and health perspective to further develop a healthy and sustainable home for its inhabitants.

Acknowledgements

I have through the experience of writing this thesis experienced many highs and some lows. With the global eruption of the COVID-19 pandemic the process of research and writing was disrupted. At the very end I realize this affected me more than I wanted to admit at first. I would not have been able to come through this experience without the help and support of the NMBU staff, friends and family.

I would like to send out a special thanks to Arild Vatn, Pål Vedeld and Norun Hjertager Krog. Our conversations, short and long, provided me with perspective and interest to pursue this topic with the faith that I needed to manage this process. Arild's initial conversations about direction and value. I hope you are doing well. Pål's last minute guidance on "basically everything". Norun's shared interest in the value of greenspaces in urban planning for the context of Oslo.

I would also like to acknowledge the support and understanding from all NMBU staff in the disrupted process and how much it meant to have their backing and understanding. I know that my own dedication to this specific topic has been somewhat new to the advisers and NORAGRIC faculty. It meant a great deal to me that I was allowed to pursue this topic.

Finally, I would like to thank you Aino. Without your patience and support I do not know how this would have been possible. You always brought me back to a positive mindset when I was in doubt. You made me take breaks and helped me take my mind off the work when it was stagnant. You helped me more than I think you know.

Abbreviations

ART - Attention Restoration Theory

GHG - Greenhouse Gas

MMP – Municipal Master Plan

PD – Psychological Distress

SDG - Sustainable Development Goal

SRT - Stress Reduction Theory

UEP – Urban Ecology Programme

WHO - World Health Organization

Prologue

One aspect related to green infrastructure and public health within the context of Oslo is *Marka*. *Marka* which is the name of the forest(s) surrounding Oslo are for many inhabitants of Oslo related to recreation and the experience of nature. It was deliberately excluded from this thesis as *Marka* is a well-known area in Oslo and not really considered as an urban greenspace. It has been used as a recreational area for hundreds of years and has its own history and laws. I believe that it has so much importance for Oslo that it has the potential to be its own thesis and has been before. When that is said, I believe *Marka* serves a role for inhabitants in Oslo that is more than just recreation and physical activity. It is a part of the identity of Oslo. If anything, I hope that the qualities of *Marka* and what *Marka* means for Oslo can be transferred to the urban greenspaces in Oslo so that they can to some extent facilitate the same qualities which makes *Marka* unique.

Further, I would like to mention that I grew up in Oslo and have enjoyed many moments in both *Marka* and the multiple greenspaces around the city and municipality. I recognize my own subjective preference for Oslo and its urban greenspaces. Writing this thesis was in parts influenced by an aspiration to give something back to Oslo. In the form of an idea that the unique green infrastructure that Oslo enjoy can serve the overall health and well-being of its inhabitants.

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1. Introduction

1.1 Theme

Intuitive and anecdotal knowledge tells us that a “walk in nature” or otherwise common activities in natural environments can be beneficial for our subjective well-being. In order to reduce stress, exercise, reflect on life etc. The use of nature for its subjective beneficial purpose is something that we can consider to be universal. Across temporal and spatial scales. That is to say that it is a phenomenon that we find all over the world in different cultures and natural environments (ecosystems). Regardless of whether the natural environment is grassy plains, coniferous mountain forests, rivers and lakes, oceans or deserts. There is always a local cultural association to that environment present. This phenomenon is something that was further developed and can be seen through the logic of Edward O. Wilson in his Biophilia hypothesis (1984) which states that indications of the human tendency to maintain contact with nature can be seen throughout history. In ancient Egypt, Persia and China, to name a few examples, we see how important gardening was and to the extent these cultures went to maintain a close relationship with nature in their new sprawling urban environments (Gullone, E., 2000, p. 293).

In recent years there has been an increased focus, within various scientific disciplines, on how exposure to nature can positively affect our physical and mental health and overall well-being (Capaldi, Passmore, Nisbet, Zelenski & Dopko 2015; Van den Berg & Van den Berg 2015; Markevych et al., 2017). Empirically we find exposure to natural environments useful in promoting health and well-being and are arguably rather universally accepted. However, as institutions and actors outside academia might not fully comprehend or utilize the potential of a nature and health perspective in urban planning and development, it is even more so important to highlight the research being done and its policy implications (Markevych et al., 2017).

With focus on sustainability from national and international institutions, political agendas globally reflect the Sustainable Development Goals (SDG's) as presented by the UN. A nature and health perspective fits well into these sustainable political agendas as it finds support in **SDG #3** (Ensure healthy lives and promote well-being for all at all ages), **SDG #11** (Make cities and human settlements inclusive, safe, resilient and sustainable) and **SDG #13** (Take urgent action to combat climate change and its impacts*) (UN, SDG #3; UN, SDG #11; UN, SDG #13). *Nature and health*

is a big topic however, and that is why in this thesis the focus will be further continued to natural environments in the form of urban greenspaces and health with a broad focus on physical health, mental health and well-being.

With institutional and political focus on sustainability and climate change also exist unique opportunities to create “win/win outcomes” that benefit societies and individuals alike. I am referring to a “win/win situation” as any situation or outcome where all participants, active or passive, benefit from the outcome. The first “win” I argue is resulting in more sustainable and climate friendly physical urban environments. Considering three arguments that are reflecting the scientific literature; by consciously implementing green infrastructure cities will **(1)** absorb more (depending on the existing green infrastructure) CO₂ and other greenhouse gasses (GHG), **(2)** make modes of transport such as walking and cycling more attractive, thus further reducing GHG emissions by reducing dependency on modes of transportation dependent on fossil fuels, and **(3)** help promote a greater human-nature connection in urban residents and in turn promote more environmentally friendly behaviors (Ives et al. 2017; Seymour 2016). The second “win” comes in regard to human health. According to the scientific literature, more consciously implemented green infrastructure in urban areas can have a positive effect on public health and the overall well-being of urban residents (Capaldi, Passmore, Nisbet, Zelenski & Dopko 2015; Van den Berg & Van den Berg 2015; Markevych et al., 2017). The key word I conscious. Conscious of the diverse health benefits.

Table 1: Win/Win outcomes of consciously implemented green infrastructure

Win/Win of Consciously implemented Green Infrastructure	
Win-1 (Sustainability) <ul style="list-style-type: none">• Absorb more GHG• Facilitate for low-emission modes of transport• Promote human-nature connections	Win-2 (Public Health) <ul style="list-style-type: none">• Positive effects on:<ul style="list-style-type: none">• Physical health• Mental health• Overall well-being

Finally, before ending the introduction to the theme of the thesis I want to mention one aspect of nature and health research that is important to keep in mind. Underlying socio-economic and cultural institutions are important to be considered when talking about nature and health research and the potential benefits to public health. Increased exposure of the general population to urban greenspaces and overall green infrastructure cannot overshadow the skewed underlying economic and social realities that are important to consider when talking about public health and overall well-being. Neither do I, nor is it my impression that researchers looking into the topic of nature and health consider it to be a “quick-fix” to larger societal or public health challenges. However, research has shed some light on mitigation effects of exposure to natural environments in relation to social and economic contexts. This will be further explored in the main body of the thesis.

1.2 Context

The municipality of Oslo (the capital of Norway) is as mentioned above the context to where the scientific literature and evidence of a nature and health perspective has been looked at in relation to this thesis. Oslo has received a lot of national and international attention for its approach to creating a sustainable “green” capital and urban region as can be seen in its allocation for the European Green Capital of 2019 (European Commission, 2019). The title was awarded Oslo for amongst other feats and features its ongoing work in maintaining, restoring and developing its green and blue infrastructure.

As Oslo transitions to a more sustainable urban region a core component is the establishment and maintenance of infrastructure and public spaces in favor of green and blue spaces as well as a reduction of carbon-emitting modes of transportation and activities (The Urban Development of Oslo, 2018). As stated in the vision and overall objective for Oslo’s Urban Ecology Programme “Oslo will be a sustainable urban community where everyone is entitled to clean air, clean water and access to attractive outdoor recreation areas (Urban Ecology Programme, 2011).”

As the municipality of Oslo has a wide focus that touches on many elements important in a “green” agenda it would be the running argument of this thesis that a nature and health perspective would greatly benefit the political support and public understanding for why it is beneficial for residents with a “greener” political agenda. From a governance and public health point of view there seems to be good opportunities to incorporate current research and findings on nature and health into how city planners and private developers design and construct new urban landscapes and urban greenspaces with a nature and health perspective in mind.

The challenge lies in how to accomplish this successfully. As mentioned in the literature, there is an urgent need for a shared framework that encompasses all the elements required for successful implementations of a nature and health perspective (Bratman et al. 2019). There are many arguments for why this is important and to mention one, for the context of Oslo, it is that it would be a unifying platform for all the work Oslo is currently pursuing.

1.3 Justification

Physical activity has a positive impact on our physical health and mental health. This concept has a central role in the World Health Organization's (WHO) work on public health (WHO, 2018). It is what one could consider to be a universally established truth because of the rich history and scientific literature that exists on the topic within various fields and disciplines. Not to undermine the value of strong intuitive knowledge that comes empirically from exercising or performing other novel physical activity. To establish the same understanding and recognition for how important and advantageous natural environments can be for human health it will be crucial to further develop and expand the existing scientific literature and knowledge foundation on the topic of nature and health. Equally important will be the implementation of a nature and health perspective with its corresponding research findings into policy in governmental organizations and with private developers. That is why I have chosen this topic for my thesis and why I have chosen to apply it to a specific geographical and political context. To highlight the research findings as they appear today and to show why it could be beneficial to act upon these findings by those invested in urban development and public health. My objective was therefore to *(1) explore the scientific literature on the associations between nature and health, (2) apply it to the context of Oslo to investigate how this perspective exists within the municipality and then (3) provide recommendations for how this can be further implemented.* To do this, the following research questions were asked:

RQ 1: What does current research literature say about the associations between nature and health?

RQ 2: If, then to what extent does there exist a nature and health perspective within the municipality of Oslo?

RQ 3: How can Oslo adapt a nature and health perspective that compliments its already existing green infrastructure?

By a nature and health perspective I am referring to the broad understanding of how human interactions with natural environments can provide various health benefits that in turn can provide social and potentially economic value.

2. Background

In this section background information relevant to the topic of nature and health is provided in more depth. First, the topic of nature is presented in a way as to understand how the phrase is used in this thesis and the different ways to interpret it. Secondly, the topic of urban greenspaces are presented as to explain the various ways that it has been defined and how it has been thought of in this thesis. Thirdly, the relationship between humans and nature is described in short by reference to the term human-nature connection or as it is also referred to as HNC.

2.1 Nature

In this thesis I chose to focus on nature in the form of urban greenspaces. However, before I further introduce urban greenspaces and the operational definition that is used in this thesis I believe “nature” is a complex topic that deserves a thorough introduction. “Nature” in the pure objective sense of the word refers to the “... physical features and processes of nonhuman origin that people ordinarily can perceive, including the “living nature” of flora and fauna, together with still and running water, qualities of air and weather, and the landscapes that comprise these and show the influence of geological processes” (Hartig et al. 2014, p. 208). This objective understanding of nature is often used interchangeably with “natural environment”, which in turn describes an environment where there exists little to no evidence of human presence or interference (ibid).

In this thesis the topic of interest in relation to nature is urban greenspaces. Urban greenspaces exist in artificially constructed spaces that do not meet the criteria of a “natural environment” but are arguably still nature as understood by the objective understanding explained above. In other words, “urban nature” and “urban greenspaces” are themselves their own antithesis. They are themselves examples of how contact with nature in urban environments are shaped by the frames of references that are available to us within our societies and cultures (ibid).

By accepting that contact with urban greenspaces also takes place on a subjective level within a specific cultural setting, the experience of that urban greenspace or *nature experience* derived from it is both a social construct as well as an objectively observed phenomena (ibid). By *nature*

experience Hartig et al. (2014) is referring to the “*subjective perception and evaluation of relevant environmental features*” (Hartig et al. 2014, p. 209). When we understand a *nature experience* on a subjective level it can help us better understand in what ways an experience of an urban greenspace, the “nature experience”, can have on human health and especially mental health.

2.2 Urban greenspaces

There does not exist a common accepted definition of what an urban greenspace is in regard to its health and well-being aspects. Still, and despite the lack of a universally agreed upon definition there are certain elements in everyday speech that are referred to as urban greenspaces.

“Urban green spaces may include places with ‘natural surfaces’ or ‘natural settings’, but may also include specific types of urban greenery, such as street trees, and may also include ‘blue space’ which represents water elements ranging from ponds to coastal zones” (Thompson et al. 2016, p. 3).

However, depending on operational definitions many other elements can be included such as “... private gardens, woodlands, children’s play areas, non-amenity areas (such as roadside verges), riverside footpaths, beaches, and so on. The definitions are nuanced and context-specific” (ibid).



Figure 1: Photos of roadside greenspace

A systematic review by Taylor and Hochuli (2017) on the term [greenspace] found that in all of the articles they reviewed less than half of the papers failed to provide an explicit definition. In the papers that did provide a definition six (6) different variations were identified and can be seen in the table below (Taylor & Hochuli, 2017). To further highlight the point about no current agreed upon definition the authors also identified discrepancies within disciplines, as well as in between disciplines, about references to “greenspace” (ibid).

Table 2: Definitions of “greenspace” from Taylor & Hochuli, Defining greenspace: Multiple uses across multiple disciplines (2017, p. 28)

Table 2

Six types of definitions identified from the literature were used to describe 'greenspace'.

Definition type	Description	Example
Acknowledged range (n=5)	A definition that acknowledged the range of what can be considered 'greenspace'	"greenness describes level of vegetation, ranging from sparsely-landscaped streets to tree-lined walk-ways to playfields and forested parks.(Almanza et al., 2012)
Definition by examples (n=17)	Examples were provided to illustrate what is meant by greenspace	"combined areas of open land, cropland, urban open land, pasture, forest, and woody perennial" (Tavernia & Reed, 2009)
Ecosystem services (n=3)	Examples that embody ecosystem services, such as urban agriculture, and/or a reference to serving human needs	"a type of land use which has notable contributions to urban environments in terms of ecology, aesthetics or public health, but which basically serves human needs and uses" (Aydin & Cukur, 2012)
Green areas (n=4)	A reference to 'green' and/or 'natural' areas without further explanation	"the area investigated included substantial green elements"(Gentin, 2011)
Land uses (n=6)	Generic land uses described as greenspace	"recreational or undeveloped land" (Boone-Heinonen, Casanova, Richardson, & Gordon-Larsen, 2010)
Vegetated areas (n=21)	Areas that feature vegetation	"green in the sense of being predominantly covered with vegetation" (Heckert, 2013)

What did come out of the systematic review by Taylor and Hochuli (2017) was that they identified two interpretations of “greenspace”. The first interpretation looks at greenspaces as nature. By this definition, nature is referred to as an overarching concept and land cover is thought of as either urban or natural in a dichotomous way. When thought of in this way, on a macro scale, “greenspaces” is understood as a synonym of nature and natural land cover and an antonym of urbanization (ibid).

The second interpretation views greenspace as an “urban vegetated area”. According to the authors this interpretation of greenspaces can be considered a subset of an overarching notion

of greenspaces. Confined to urban environments and open spaces. It reflects an anthropocentric view of greenspaces that includes the human involvement in planning and maintaining it for its desired value (ibid). For the purpose of this thesis the term “urban greenspace(s)” follow the interpretation of greenspace as nature by the objective understanding of the word as described by Hartig et al. (2014).

Table 3: Greenspace interpretations from Taylor & Hochuli, Defining greenspace: Multiple uses across multiple disciplines (2017, p. 29)

Table 3

Examples show how the two different interpretations of greenspace are used.

Greenspace as nature	Greenspace as urban vegetated space
<p>“[Greenspaces] broadly encompass publicly accessible areas with natural vegetation, such as grass, plants or trees [and may include] built environment features, such as urban parks, as well as less managed areas, including woodland and nature reserves.” (Lachowycz & Jones, 2013)</p>	<p>“Greenspace is defined as any vegetated land adjoining an urban area . . .and includes bushland, nature reserves, national parks, outdoor sports fields, school playgrounds and rural or semi-rural areas immediately adjoining an urban area.” (Chong et al., 2013)</p>
<p>“The conceptualisation of greenspace in this review includes both urban and nonurban green, from natural and semi-natural landscapes to the countryside and urban parks.” (Kloek, Buijs, Boersema, & Schouten, 2013)</p>	<p>“urban green spaces – that is forests, trees, parks, allotments or cemeteries – provide a whole range of ecosystem services for the residents of a city” (Bastian et al., 2012)</p>
<p>“...daily lives involve and take place in parks, allotment gardens, cemeteries, at lakes and beaches and in other green and blue areas...” (Petersen, 2013)</p>	<p>“... we defined a garden as the private spaces adjacent to or surrounding dwellings.” (Lindemann-Matthies & Marty, 2013)</p>
<p>“... ‘natural’ green space environments such as woodlands, parks and gardens...” (White et al., 2013)</p>	<p>“...vegetated areas located within built-up areas, including natural and planted trees, grass, shrubs and flowers.” (Lo & Jim, 2012)</p>
<p>“Our main focus is on land cover (including green and blue space types).” (MacKerron & Mourato, 2013)</p>	<p>“[The] sum of all woody and associated vegetation in and around dense human settlements” (Strohbach & Haase, 2012)</p>

2.3 Human-Nature Connection

The call to reconnect with nature has been voiced by many in the sustainability research field and has literature that spans disciplinary and conceptual fields (Ives et al. 2017). Along with the urgent need for sustainability and environmentally friendly practices to care for the natural world in order to assure our continuous existence in it, there is also a case to be made for how this affects our understanding and connection to these same natural systems that sustain us. This has been referred to in various ways such as connectedness with nature, nature relatedness, or as it will be referred to in this thesis, the human-nature connection (from here on referred to as HNC) (ibid).

In the review by Ives et al. (2017) "*Human-nature connection: a multidisciplinary review*", the authors identified 475 publications on HNC. They identified three subgroups of publications. "(1) HNC as **mind**, dominated by the use of psychometric scales, (2) HNC as **experience**, characterised by observation and qualitative analysis; and (3) HNC as **place**, emphasising place attachment and reserve visitation (Ives et al., p. 1)." Even though the three subgroups are identifying separate pathways to understanding HNC they are not isolated from each other. They are independently useful to better understand the complex ways that nature and urban greenspaces can influence human health but when combined provide the best understanding of how to be useful in practice.

HNC is for the context of this thesis to be understood as another justification for green infrastructure besides from mitigating GHG and provide public health benefits. Because of the urgent need to take climate change and sustainability seriously in all levels of society HNC is another pathway for this to happen. Combining both the need for a healthy environment and optimal human health.

3. Theory

For this thesis it was important to convey that the existing literature and current knowledge foundation is wide and carries multiple scientific schools of thought and approaches to cover the topic of nature and health in its broadest sense (Van den Berg & Van den Berg 2015; Annerstedt & Währborg, 2011). The initial argument that there exists a positive association between human beings and natural environments can be interpreted from an *anthropocentric* and *biocentric* perspective. An *anthropocentric* position holds the welfare and progress of humans as the moral argument for why it is important to create a sustainable and environmentally friendly civilization, while a *biocentric* perspective includes non-human organisms and nature as a whole in its moral argument on sustainability and nature conservation (Rottman, 2014). **For this thesis I have chosen a biocentric perspective as it carries the argument of a positive association between human beings and nature in its “essence”. Human beings are included in the biosphere and are inherently and inescapably connected to the rest of their environment on a microscopic and macroscopic level.**

The Biophilia Hypothesis serves as a theoretical foundation for how a connection between humans and nature can be formulated and avoids excluding potential pathways of interaction between human beings and the biosphere. Other theories have been developed for this purpose such as the Stress Reduction Theory (SRT) and the Attention Restoration Theory (ART). Both theories seek to explain different pathways of interaction between humans and their natural environment that again provide psycho-evolutionary rationalizations for why we see certain health benefits that fit the Biophilia Hypothesis.

3.1 Biophilia Hypothesis

With increasing quantities of literature being produced in support of the intricate relationship between human beings and nature it is showing support for Edward O. Wilson’s Biophilia Hypothesis. As described by Wilson in his book *Biophilia* (1984) humans have an “innate tendency to focus on life and lifelike processes.” In all recorded history, throughout the world, evidence seems to support this statement. “The homes of the ancient Egyptian nobility, Persian settlements, and medieval Chinese villages were all marked by extensive and elaborate gardens

demonstrating that people went to considerable lengths to maintain contact with nature” (Ulrich, 1993). In the 20th and 21st century we also see how nature keeps creeping into our modern industrialized environments through parks and greenspaces.

These urban greenspaces are often popular destinations amongst residents and visitors alike. Examples are many and truly global phenomena. Central Park in New York City is one of the most famous landmarks, and in Singapore large resources are put into developing the “garden city” and more is in the works. The urban greenspaces are only one example. National parks and nature reserves are popular travel destinations and people travel in increasing numbers to remote places to experience the “the wild” or areas “untouched” by human activity.

The Biophilia Hypothesis builds upon evolutionary theory as well as genetic and cultural foundations thus combining natural and social sciences. The “essence” as mentioned in the introduction to this chapter is that a majority of *homo sapiens* history has been in the form of hunter-gatherer communities, and even the agricultural societies only represent a fraction of our common history. Even less so the modern urban technologically dominated lives of the industrialized 21st century nation states.

“In short, the brain evolved in a biocentric world, not a machine-regulated world. It would be therefore quite extraordinary to find that all learning rules related to that world have been erased in a few thousand years, even in the tiny minority of peoples who have existed for more than one or two generations in wholly urban environments” (Wilson, 1993; p. 32).

The Biophilia Hypothesis can be said to experience a boost in popularity, or at least a revival, in today’s world with the *de facto* existential threat of climate change. Originating within the field of evolutionary psychology, today it is also being applied to other schools and fields such as design and architecture to name two examples (Kellert & Calabrese, 2015).

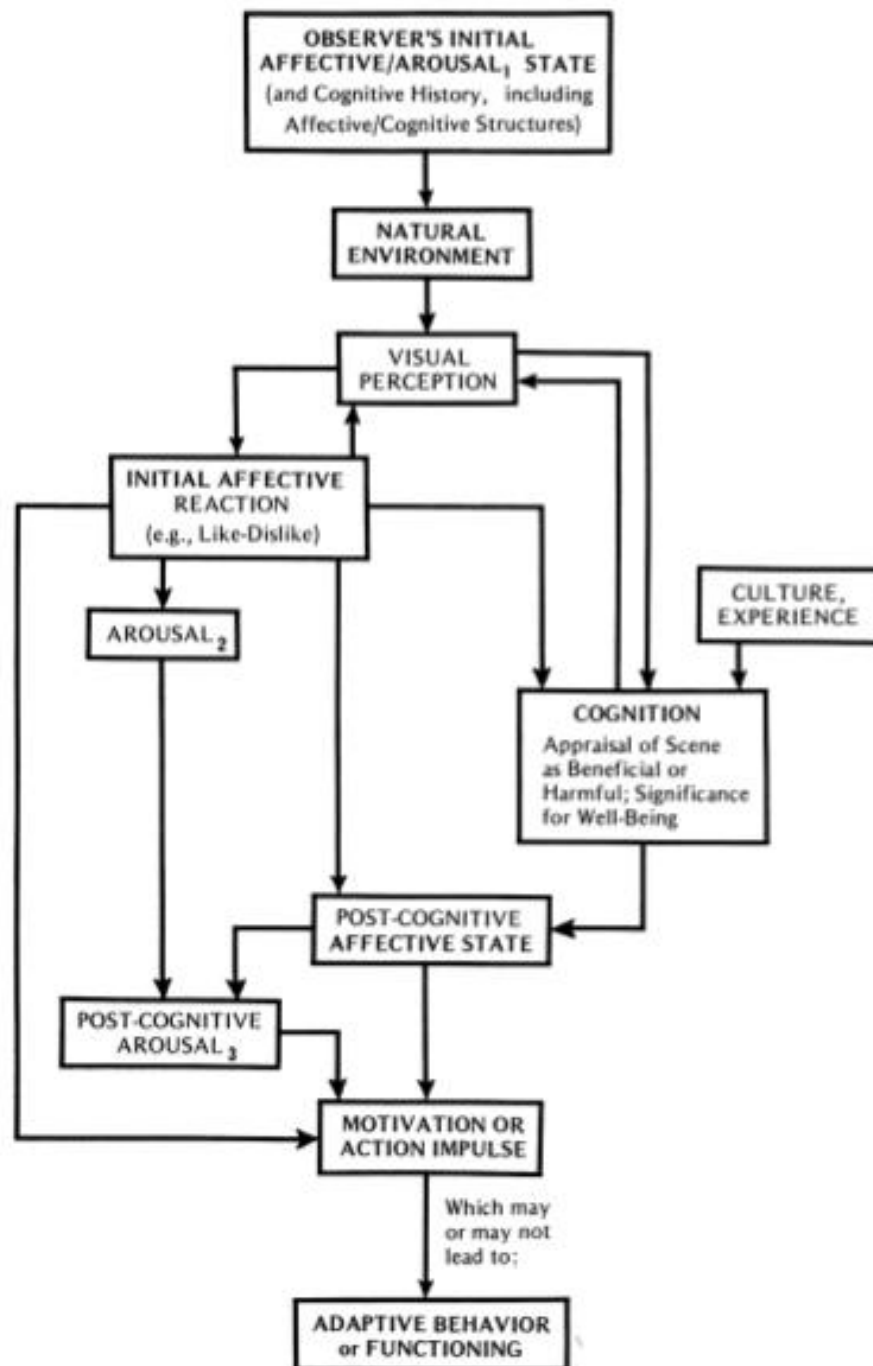
3.2 Stress Reduction Theory (SRT)

Stress Reduction Theory (SRT) proposes that through exposure to greenspaces or otherwise natural landscapes human beings can enhance the recovery from stressful events. As proposed by Roger S. Ulrich (1983) from the existing research evidence at that time “...restorative influences of unspectacular natural scenes, compared to urban views, may be most pronounced when the observer's initial state is one of stress and excessive arousal” (Ulrich, 1983, p. 116). From its

evolutionary roots, SRT identifies natural landscapes that provide the most beneficial psychological responses to landscapes that would have for a majority of human life represented resources and views that allowed for anticipation of predators; two stress inducing factors for early humans (Sullivan, 2014). That is to say how a lush vegetated scenery would signal resources and survival (positive emotion), and how a view of potential predators would minimize injury or death (absence of negative emotion or stress). From the same evolutionary foundation, we know from neuroscience that the limbic system is central to affect (emotion) and precedes cognition which is a process found in the neocortex. As to say that the emotional processing area of the brain developed before the higher-order functions such as cognition. Emotional stimuli circumnavigate the logical (or illogical) stress inducing factor.

Today, the same pathways that served a role in the survival of early humans can be seen in different examples of how nature can reduce stress levels in modern scenarios. One example can be university students. Evidence suggests that viewing normal and unspectacular natural sceneries, compared to urban sceneries lacking natural elements, are significantly more effective in promoting recovery in the psychological component of stress (Ulrich, 1991). The results are credited to natural scenes and components in that they help elicit positive feelings, reduce negative emotions such as anger, fear and sadness, effectively hold attention and interest, and as a result also might block out or reduce stressful thoughts and emotions (ibid). As well as providing positive effects on psychological components of stress, there is also evidence of the positive benefits on the physiological factors of stress. From laboratory research, visual exposure to normal everyday nature produced significant recovery from stress measured by blood pressure and muscle tension (ibid).

The framework developed by Ulrich (1983) is simplified in a model illustrating the various steps that are present in an interaction between a person and the environment, and how this interaction can influence the emotions and behavior of that person. In this model the person's past and present history (cognitive and emotional) is included, perception of the environment in the moment, and behavior as a result of the interaction. It provides a simplified, but yet effective way of understanding how and why nature can positively impact mental health. Still, it is important to remember that there is a subjective level to this experience that can dictate how effective this can be depending on subjective indicators and context.



Source; Ulrich, *Aesthetic and Affective Response to Natural Environment* (1983, fig. 1, p. 91)

Figure 2: Aesthetic and affective model of responses to natural environments from Ulrich, *Aesthetic and Affective Response to Natural Environment* (1983)

3.3 Attention Restoration Theory (ART)

“ART proposes that individuals benefit from the chance to (1) “be away” from everyday stresses, (2) experience expansive spaces and contexts (“extent”), (3) engage in activities that are “compatible” with our intrinsic motivations, and (4) critically experience stimuli that are “softly fascinating” (Ohly et al., 2016).”

Attention Restoration Theory (ART) is another theory similar to SRT that seeks to explain the way natural environments can have an impact on human health. ART relies on the concepts within psychology that focus on what is called direct (or voluntary) attention. Direct attention is considered to require (conscious) effort, focus, is of voluntary control, and thus as a result is susceptible to fatigue or depletion otherwise known as *directed attention fatigue* (Kaplan, 1995). The restoration of directed attention is where ART tries to explain the usefulness of natural sceneries as an alternative to other forms of rest such as sleep. How this transpires is as a result of the proposition of four key elements that from the author’s perspective are essential by themselves, or together, in restoring directed attention (ibid).

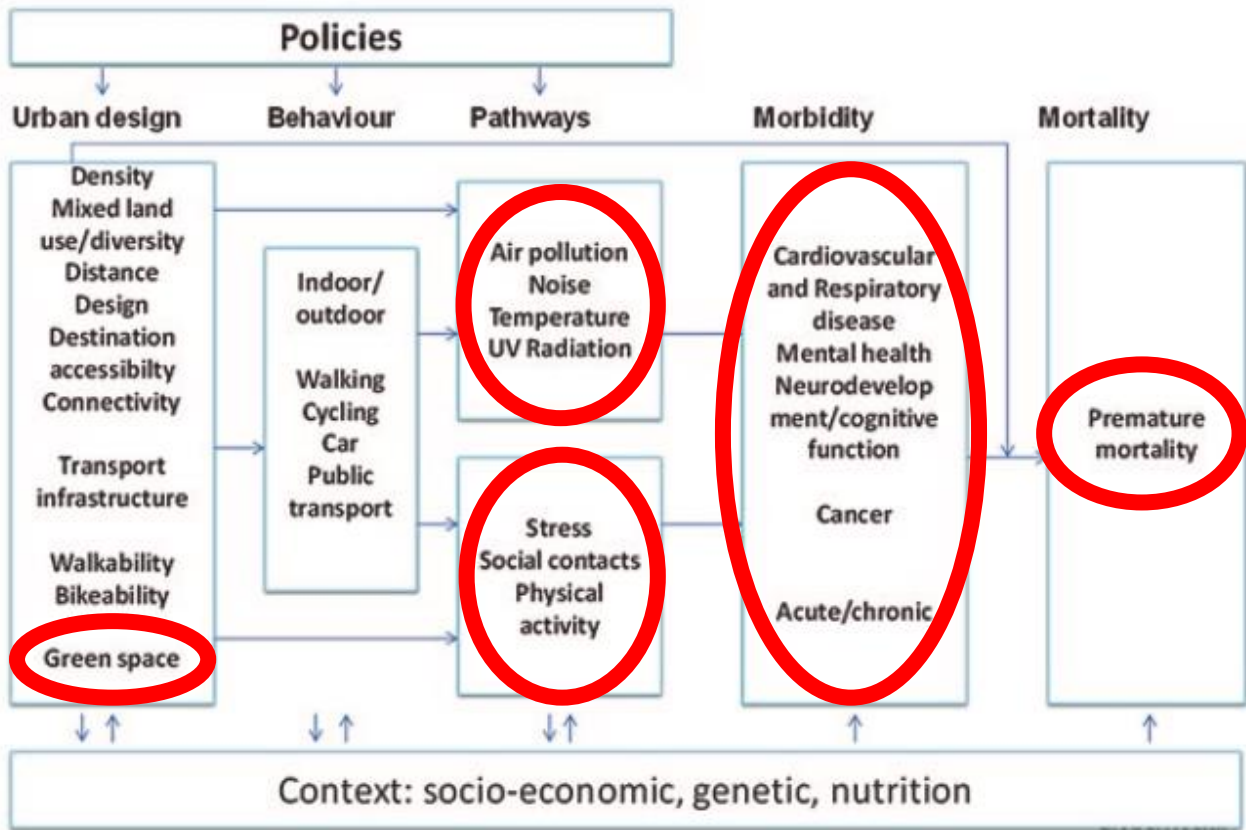
(1) “*Being away*”, depending on context and starting point, are for many people a preferred way of resting and restoration. Depending on personal preference this can be mountains, the ocean, lakes, forests or other environments that are “somewhere else” than the normal environment one operates in daily life, which for many people is some form of an urban environment. **(2)** “*Fascination*”, as a form of attention that does not require extensive effort to experience. Examples of natural phenomenon such as clouds, sunsets or sunrises, snow cover, autumn colored scenery, are examples of how natural sceneries that according to Kaplan (1995) leave room for thinking about things other than what is demanding ones directed attention in the first place. **(3)** “*Extent*”, thought of as distance (physical or mental) or different dimension from where one would commonly experience or conduct the directed attention depending on the activity conducted. In the words of Kaplan: “*In the distant wilderness, extent comes easily. But extent need not entail large tracts of land. Even a relatively small area can provide a sense of extent. Trails and paths can be designed so that small areas seem much larger*” (Kaplan, 1995, p. 174). **(4)** “*Compatibility*”, thought of as the ease of functioning in a natural environment seems to require less effort (not necessarily for everyone) than functioning in more urban settings (Kaplan, 1995).

The benefits of ART that I focused on in this thesis is the potential of creating green infrastructure that will positively contribute to the restoration of mental faculties that become depleted through mental exhaustive tasks that are commonly associated with urban life. It illustrates how urban greenspaces can serve a role in maintaining and improving the general health and well-being of residents in urban areas.

3.4 Theory and Context

To better explain how the context of Oslo relates to the topic of nature and health it is useful to apply a framework. With the municipality of Oslo being very forward thinking on the topic of sustainability and climate change, presenting policies, plans and programs to develop Oslo in that direction, it provides an opportunity to incorporate a nature and health perspective to support these efforts. As SRT and ART seek to explain in a theoretical way how nature can affect human health they do not explain any further how this fit with current trends in urban development. This is where the municipality of Oslo comes in as a context. By applying the research and theoretical foundations to policy and urban development it can highlight how cities and communities should consciously think about how green infrastructure can serve multiple purposes as mentioned in the “win/win” outcomes earlier.

In the figure below one can see how policies are a key aspect in shaping how urban greenspaces can influence public health. Another key aspect are the societal contexts such as socioeconomics, genetics and lifestyle choices (nutrition being the example used in the framework). For Oslo a lot of the necessary policies and societal contexts necessary to bring a nature and health perspective into public awareness exists. Thus, as the framework highlight, it should be possible for the municipality of Oslo to capitalize on its green infrastructure to promote public health in a passive way without further investment into traditional healthcare infrastructure.



Source; Nieuwenhuijsen & Khreis, *Urban and Transport Planning, Environment and Health* (2018, fig. 1.1, p. 7.)

Figure 3: Framework of greenspace interaction with pathways and outcomes

4. Methods

Research into the potential benefits of exposure to natural environments for human health are not existing under a single research strategy, but it rather consists of a large group of scientists and researchers that are looking into the topic from various angles and institutions (Annerstedt & Währborg, 2011; Van den Berg & Van den Berg 2015). This provided a challenge in extracting the most useful information and insights within the most relevant categories. That is why it was deemed necessary, between me and my supervisor, to apply the snowball sampling method after the initial literature search to uncover as much relevant literature as possible.

To be able to answer **RQ 1** (What does current research literature say about the associations between nature and health?) it was essential to extract key findings from existing research. For **RQ 2** (If, then to what extent does there exist a nature and health perspective within the municipality of Oslo?) it was necessary to apply the findings from the research literature and evaluate the municipality of Oslo in a way that illustrated how to improve the green infrastructure of Oslo to better accommodate for the potential public health benefits provided by urban green infrastructure. For **RQ 3** (How can Oslo further develop its green infrastructure to accommodate for a nature and health perspective?) it was crucial to understand how Oslo is currently working on sustainability issues related to urban development, and how a nature and health perspective could complement the existing work.

This was done in two parts. First, a literature search was conducted to uncover the extent of research literature that existed on the topic of nature and health. Secondly, a review of the public documents related to the topic of nature and health within the municipality of Oslo was done to uncover positions and relevant projects related to the topic. Further, to better understand the way the municipality of Oslo perceives and works on the topic of nature and health, I conducted **three interviews** with employees within the municipality of Oslo that hold relevant positions relative to the topic.

For the literature search and subsequent literature review I first used Google Scholar and then a search method known as snowball sampling. The reason for why I chose a snowball sampling method was that the experience from preliminary literature searches on the topic of nature and

health using Google Scholar did not provide the necessary accuracy. For this reason, the “snowballing” method of uncovering literature proved especially helpful.

Further, it was necessary to uncover how Oslo viewed the concept of nature and health and to the extent this is incorporated into policy and programs. To do this I reviewed the relevant publications from the municipality where a nature and health perspective could be relevant. In order to compliment the review of the public documents I also chose to conduct three interviews with staff in the municipality that held relevant positions to the topic.

Originally, I explored the idea of conducting an experiment where I would examine the self-reported physical and mental health of participants over the course of 1-2 months, and interview participants on their use of urban greenspaces or other forms of nature within the municipality of Oslo. However, this quickly became too challenging within the timeframe, and in hindsight it would have been complicated to accomplish with the onset of the COVID-19 pandemic and the subsequent shut-down of Oslo. The COVID-19 situation did also bring certain challenges for the work on this thesis, especially in relation to interviewing staff within the municipality.

4.1 Google Scholar Search

With a quick search in Google Scholar when only typing in the phrase “nature and health” the search provides about 4,130,000 search results. To make this task manageable obvious delineations were necessary. Since a central part of the topic for this thesis was nature in the form of urban greenspaces this became the substitute for nature. Similarly public health was substituted for health to be more specific. With this updated search criteria “urban greenspaces and public health” the search results are about 22,100. To further delineate the search criteria, I kept the search phrase “urban greenspaces and public health” but sorted by year. When updating these search criteria “urban greenspaces and public health”, between 2000 and 2020, the search results were about 17,600. Thus, further delineations were necessary. By including the search “urban greenspaces and public health”, but only in the title the search provides 0 results. I then replaced the words “public health” with “mental health”, but with no change in results, which led me to try a different spelling of “greenspaces” as two separate words “green spaces”, which led to 8 results. Out of these 8 results it was one result, Andreucci et al. (2019) that proved to be most useful.

4.2 Snowballing

Because the theme in this thesis does not exist under a common strategy or framework the literature that exists was hard to find through traditional search methods such as Google Scholar. For this reason, the “snowballing” method of uncovering literature proved especially helpful. “Snowballing” is one example of data collection where one uncovers more literature by looking at references used and the references in the references and so on. This method was in the end the most successful one as it provided much more relevant literature that covered the topic in a much more complex way depending on the scientific field and approach. As identified by Greenhalgh & Peacock (2005):

“Systematic review of complex evidence cannot rely solely on predefined, protocol driven search strategies, no matter how many databases are searched. Strategies that might seem less efficient (such as browsing library shelves, asking colleagues, pursuing references that look interesting, and simply being alert to serendipitous discovery) may have a better yield per hour spent and are likely to identify important sources that would otherwise be missed” (Greenhalgh & Peacock, 2005).

From “snowballing” Andreucci et al. (2019), I found several sources that again provided rich literature on the topic of nature and health. Especially useful was the review: *WHO (2016). Urban Green Spaces and Health – A review of Evidence* (Thompson et al. 2016) in providing literature that covered the topic from various approaches and scientific disciplines.

One challenge with the snowball sampling method is that the searches are happening retrospectively and thus will not uncover any sources that are newer than the original source. However, I was fortunate to have supervisors that also helped with uncovering recent literature and where to look for it, using other criteria or by referring to specific literature that they were aware of.

4.3 Review of municipal documents

The review of documents and material published by the municipality of Oslo was reserved to those that would provide or be relevant to information about the topic of nature and health. This came down to four documents; the Municipal Master Plan (Municipal Master Plan, 2019), the

political platform for the city council (Byrådsplattformen, 2019-2023), the Urban Ecology Programme (Urban Ecology Programme, 2011), and websites plus documents related to Residential Area Politics (Områdepolitikk) (Programbeskrivelse for Groruddalssatsingen; Områdesatsingene i Oslo: Delprogram nærmiljø). In the review of these documents I was looking for any direct or indirect mentioning of anything that could be related to the topic of nature and health. The goal was as reflected through **RQ 2** to see if there existed anything similar to a nature and health perspective.

4.4 Interviews

Interviews for this thesis were carried out with official municipal employees. As mentioned above, the national circumstances as a direct result of COVID-19 greatly limited the number of interviews that I was able to conduct and the way in which they were conducted. However, the interviews were originally meant to complement the published documents available and therefore did not limit my work too much. However, COVID-19 quickly made me discard the idea of completing interviews with local residents in the Grorud Valley area to further compliment the information provided by the municipal employees to see how much they align or not. Question about ethics in regard to this thesis and the interviews specifically has not been considered to be an issue. This conclusion is mainly drawn on the basis that the municipal documents reflect a larger context and that the interviews were conducted with municipal employees which for the purpose of this thesis were communicating the municipal strategies. All interview subjects were also given anonymity to keep the focus on the municipal strategies.

4.5 Limitations

The first limitation I would like to mention is that the literature review on the topic of nature and health is not exhaustive and is likely to lack findings that could have been relevant to include. Because of the nature of the topic itself does not existing under a predefined theoretical framework and research strategy it becomes difficult to ascertain that no valuable data and information is left out. This is also emphasized by many of the researchers in this sprawling field (Annerstedt & Währborg, 2011; Van den Berg & Van den Berg 2015; Andreucci et al., 2019). Hartig et al. (2014) mentions methodological challenges such as measuring the exposure to nature, measuring outcomes and understanding mechanisms, demonstrating causality in populations, and effect size in comparisons to other influential factors. The lack of frameworks and strategies can further

be said to affect the validity of research produced. However, as positive associations are uncovered consensus around the importance of the topic will hopefully establish sounder research strategies and frameworks.

The second limitation I would like to mention is that the review of municipal documents and websites does not necessarily provide insight into a specific approach to the topic of nature and health and thus might not be the best way to cover the topic from the municipal point of view. But I would argue that it is possible to deduce and understand the municipal point of view and perspective on the topic by looking at how they plan and present their policy as this becomes the overarching goals where this would be included, directly or indirectly.

Lastly, I would like to mention that the interviews did not provide as much complementary information as I had expected. I believe this was a result of not being able to conduct them in person and thus missing the situational understanding and flow of conversation that could have led to the uncovering of certain aspects about the topic in relation to the municipality and the topic of nature and health.

5. Results & Analysis

5.1 Introduction

In Section 5.2 - Literature Review, I will present the selected research findings that has been gathered on the topic. The selected research findings will represent a wide selection but will not provide the same depth that could be expected from a specific discipline or single research angle. In the following section, Section 5.3 – Municipality of Oslo, I will present the ways in which a nature and health perspective has been implemented and can be traced into policy or strategies. Directly or indirectly. Lastly, in Section 5.4 - Results, there will be a summary of thoughts from the analysis of municipal documents and impressions from the interviews with municipal employees. This will eventually result in recommendations for how to further integrate a nature and health perspective in the municipality.

5.2 Literature Review

In the multiple research articles referred to below the common denominator is the theme of nature and health in some way or another. In the chapter on theories SRT and ART seek to provide a theoretical framework that explain at least some of these associations between nature and health. Some of the evidence presented that strongly support these theories are related to improved relaxation and restoration. Evidence exists in the form of physiological measurements such as hormone levels (Lee et al., 2011; Park et al., 2007) and blood pressure (Hartig et al., 2003, Ottosson & Grahn, 2005, Ulrich et al., 1991). Further evidence that supports the theoretical foundation of SRT and ART can be seen in the evidence for beneficial mental health outcomes from interacting with nature. As Pope et al. (2015) show in their research, psychological distress (PD) such as anxiety and stress in deprived UK populations, show a positive association with access to and quality of greenspaces and a reduction of PD. Many more studies on greenspaces and mental health could be mentioned, and more will in following section, but the relevance for SRT and ART is the relationship between stress and mental health. Stress can take on many forms and be experienced different for everyone but is closely connected to mental health and well-being.

In the table below is a short summary of the various findings from the research literature and the potential value it can bring to the municipality of Oslo and its inhabitants. It should be noted that some points are not included in the added value for Oslo, which does not mean that the value cannot be experienced for individual inhabitants, but that there are many variables that needs to be considered.

Table 4: Summary of findings in the literature and implications for Oslo

	Findings from the literature	Value for Oslo
Pathways to health	<ul style="list-style-type: none"> • Improved relaxation and restoration • Improved social capital • Improved functioning of the immune system • Enhanced physical activity • Noise buffering • Reduced exposure to air pollution • Reduced urban heat island effect • Enhanced pro-environmental behaviors • Exposure to sunlight 	<ul style="list-style-type: none"> • Positively influence inhabitants' stress levels and recovery from stress • Help promote social interaction and strengthen communities and social cohesion • Reduction of sound pollution • Lower the urban heat island effect and reduce the negative health outcomes that are associated with it
Positive Evidence Base	<ul style="list-style-type: none"> • Improved mental health and cognitive functioning • Reduced cardiovascular disease • Reduced prevalence of type-2 diabetes • Improved pregnancy outcomes • Reduced Mortality 	<ul style="list-style-type: none"> • Enhance pro-environmental behaviors and provide support for sustainable urban development • Reduce mental health challenges in the general population and passively improve mental health
Potential Negative Outcomes	<ul style="list-style-type: none"> • Increased exposure to air pollutants • Risks of allergies and asthma 	<ul style="list-style-type: none"> • Reduce prevalence of somatic diseases and improve conditions for those

	<ul style="list-style-type: none"> • Exposure to pesticides and herbicides • Exposure to disease vectors and zoonotic infections • Excessive exposure to UV radiation • Vulnerability to crime 	<ul style="list-style-type: none"> • suffering from somatic diseases • Improved conditions for pregnant women and new mothers • Reduced overall mortality • Improve conditions for inhabitants that suffer from socioeconomic disadvantages • Improve the overall health and well-being for senior citizens
Specific Characteristics	<ul style="list-style-type: none"> • Size of greenspaces • Presence of facilities • Tree cover and canopy density 	
Differential Health Benefits	<ul style="list-style-type: none"> • Children and adolescents • Older adults • Deprived subpopulations and minority groups • Populations of various countries and geographic locations 	

5.2.1 Pathways

In the literature, there are identified various pathways of how urban greenspaces can lead to or influence improved health. In a WHO report by Thompson et al. (2016) the authors identified different pathways that lead to improved health from exposure to natural environments. As these pathways are complex and continuously interacting with each other it is necessary to understand them from a holistic perspective.

5.2.1.1 Improved relaxation and restoration

As already mentioned, there are two important theories that aim to explain the phenomena of reduced stress and improved attention restoration which are respectively *Stress Reduction Theory* (SRT) and *Attention Restoration Theory* (ART). The theories have support in findings from

studies on physiological responses correlated with being in or viewing greenspaces (Thompson et al. 2016). Some of these findings include reduced blood pressure (Hartig et al., 2003, Ottosson & Grahn, 2005, Ulrich et al., 1991), heart rate (Ottosson & Grahn, 2005, Ulrich et al., 1991) and skin conductance and muscle tension (Ulrich et al., 1991). On the neurological level, evidence indicate psychoneuroendocrine responses (hormone relationship to behavior) from exposure to natural environments (woodlands) such as reduced cortisol levels, lower pulse rates and blood pressure, increased parasympathetic nerve activity and reduced sympathetic nerve activity, compared to more urban environments (Lee et al., 2011; Park et al., 2007).

5.2.1.2 Improved social capital

The anticipated positive effects on human health of social relationships on human well-being is obviously a well-known phenomenon, as well as how the opposite, how social isolation is a predictor of increased morbidity and mortality (Nieminen et al., 2010; Pantell et al., 2013; Yang et al, 2016). Evidence points towards the important role that [urban] greenspaces can play in promoting social interactions and also in promoting a sense of community and belonging (Kim and Kaplan, 2004). In a study from the Netherlands from 2013, the authors found an association between the quantity and quality of greenspaces and the perceived social cohesion on the neighborhood scale. Quality of greenspace in this study outweighing the quantity (Vries et al. 2013). The study defined social cohesion as “a sense of community, with a focus on trust, shared norms and values, positive and friendly relationships, and feelings of being accepted and belonging” (Thompson et al. 2016, p. 5). In contrast, when there is less greenspaces in an environment, there are correlations to feelings of loneliness and lack of social support (Maas et al., 2009; Thompson et al., 2016).

Regardless of how one interprets the kind of findings presented above it is crucial to remember how complex the relationships between social well-being and urban greenspaces are. Observational studies highlighting correlational relationships do not reveal any underlying mechanisms that are important to understand for how to best utilize urban greenspaces for maximum health benefits and social well-being (Thompson et al. 2016, p. 5). One example of how urban greenspaces can work to the disadvantage of social well-being and community is if a greenspace is perceived or considered to be unsafe for various reasons. This is why it is important to consciously construct and maintain greenspace to secure the potential social and health

benefits (ibid). Some research is also shedding light on the potential of urban greenspaces to reduce crime in disadvantaged neighborhoods (Branas et al., 2011; Chong et al., 2013).

5.2.1.3 Improved functioning of the immune system

In Japan, studies on relationships between hiking or visiting forested areas (referred to as “forest bathing”) can produce positive immune responses, and even evidence of anti-cancer proteins (Thompson et al. 2016, p. 5). The mechanisms are not necessarily perfectly understood, but it can be imagined that being exposed to natural environments provides psychological relaxation or exposure to physical or chemical factors that are beneficial to the immune system. Studies have also shown that children with high exposure to allergens and bacteria during their first 12 months are less likely to react to allergies and develop respiratory symptoms later (ibid). Another imagined pathway with regards to the immune system is that by exposure to natural environments one is also exposed to diverse microorganisms that can play an immunoregulatory role (Rook, 2013).

5.2.1.4 Enhanced physical activity, improved fitness and reduced obesity

As mentioned briefly in the introduction the link between physical activity and health benefits are widely understood and accepted. Several studies from various countries have demonstrated that access to and use of greenspaces show increased physical activity and reduced time spent sedentary in all age groups (Wendel-Vos et al., 2004; Epstein et al., 2006; Kaczynski & Henderson, 2007; Kaczynski et al., 2008; Sugiyama & Ward Thompson, 2008; Sugiyama et al., 2008; Cochrane et al., 2009; Astell-Burt et al., 2013; Schipperijn et al., 2013; Lachowycz and Jones, 2014; Sugiyama et al., 2014; Gardsjord et al., 2014; James et al., 2015).

5.2.1.5 Anthropogenic noise buffering and production of natural sounds

Living in cities and urban areas there comes an unquestionable side effect of exposure to noise pollution. Noise from traffic, industrial activities and less availability of quiet places in urban centers is estimated by WHO to present 1.0 - 1.6 million Disability Adjusted Life Years in the European Region alone (WHO, 2011). Evidence does however show that consciously and well-

designed urban greenspaces buffer noise from non-natural sources and provide relief to urban dwellers (González-Oreja et al., 2010; Irvine et al., 2009).

5.2.1.6 Reduced exposure to air pollution

Research has shown that urban greenspaces have a positive effect on reducing anthropogenic air pollutants in cities (Bowler et al. 2010). Urban greenspaces in the form of vegetation such as trees, shrubs, herbs and grass can lessen the impacts of urban pollution sources such as traffic and industry and in turn provide benefits for public health.

5.2.1.7 Reduction of the urban heat island effect

Urban centers, especially in warmer areas of the world, are prone to what is called the Urban Heat Island Effect. During heat waves and extreme heat events urban centers become a source for public health concern as vulnerable populations such as elderly are at heightened risk of increased morbidity and mortality (Smargiassi et al., 2009; Basagaña et al., 2011). Bowler et al. (2010a) conducted a systematic review and meta-analysis that showed an average cooling effect from parks in urban areas by approximately 1°C. From the same study the authors suggest that urban greenspaces might mitigate the Urban Heat Island Effect in wider urban areas up to 1 km from the park boundaries (Bowler et al. 2010a). In another study by Jenerette et al. (2011) the authors emphasized the role urban greenspaces play in reducing surface temperatures in Phoenix (Arizona) and that urban greenspaces can play a role in more equitable access and reduction of *“inequality in exposure to extreme heat and protect vulnerable groups, such as elderly individuals”* (Thompson et al. 2016, p. 8).

In a study from Oslo by Venter, Krog, & Barton (2020) looking at the green infrastructure and the health risks from urban heating the researchers found that there was a significant difference in temperatures between landscapes consisting of complete tree canopy cover or mixed vegetation compared to landscapes of paved or midrise to lowrise buildings . Using satellite measures from one of the hottest days in 2018 the authors found a difference in temperature ranging from 29-32°C where there was canopy cover or mixed vegetation compared to 39°C where there was not. As a result, the researchers modeled that *“each tree in the city mitigates the potential risk of heat*

exposure for approx. one heat-sensitive person (75 years or older) by one day” (Venter, Krog, & Barton, 2020, p. 9).

5.2.1.8 Optimized exposure to sunlight and improved sleep

By access to urban greenspaces evidence supports that more people spend time outdoors. As a result of spending more time outdoors there is a likely increase in exposure to sunlight. Though exposure to sunlight has its own risks by increased exposure to UV radiation and thus increased likelihood of diseases such as skin cancer (melanoma) it is also where humans get most of their vitamin D. To have optimum levels of vitamin D is considered to be important, especially for bone density and overall health and well-being. Thus, urban greenspaces may be an important element in providing people living in urban areas the arenas for getting enough vitamin D and the health benefits that come with it (Gillie, 2010).

5.2.1.7 Enhanced pro-environmental behavior

Research has shown that there is a link between childhood experiences in nature and adult environmentalism or pro-environmental behavior (Wells and Lekies, 2006). Pro-environmental behavior is as defined by Kollmuss & Agyeman (2002) “behaviour that consciously seeks to minimize the negative impact of one’s actions on the natural and built world”. Considered an upstream approach to deal with the challenges that climate change presents, pro-environmental behaviors are suggested to originate from, amongst other sources, by external stimuli from natural environments (Bosch & Depledge, 2015).

5.2.2 Positive Evidence Base

5.2.2.1 Improved mental health and cognitive function

Studies that have looked at the link between greenspaces and mental health have shown that there is strong evidence for positive mental health benefits and reduced stress when compared to other pathways to improved health (Gascon et al., 2015). In a study from Australia, the results

indicated that the perceived neighborhood greenness was more associated with mental health than physical health (Sugiyama et al., 2008) while a study from Spain showed that the greater exposure to greenspaces was linked to both improved physical and mental health, regardless of socioeconomic status and gender (Triguero-Mas et al., 2015). Similarly, in a study from the UK evidence showed that residents that moved from an area with less greenspaces to more greenspaces showed improved mental health (Alcock et al., 2014). From the US a study by Beyer et al. (2014) found evidence that more neighborhood greenspaces had links to lower levels of depression, anxiety and stress. In a German study the mental health of people living in urban centers were associated with blue spaces (Völker & Kistemann, 2015). In a longitudinal study from Sweden results showed that access to greenspaces resulted in significant improved mental health amongst women (van den Bosch et al., 2015). In a cross-sectional study from England researchers found links between the quality and access to greenspaces reduced psychological distress (Pope et al., 2015), and another cross-sectional study from Lithuania by Reklaitiene et al. (2014) the authors demonstrated that by those who use parks on a regular basis, and lived in closer proximity to parks, had reduced odds of self-reported symptoms of depression. Further, Berg et al. (2016) demonstrated through a study from four European cities how more time spent in greenspaces improved mental health and vitality independent of cultural and climatic contexts.

The evidence on the beneficial support from greenspaces on children is increasing, but with some inconsistencies in the findings. One example is from another Lithuanian study where Balseviciene et al. (2014) found that children living with mothers of lower education living close to greenspaces had improved mental health, while children with mothers of higher education living in greener areas were associated with worse mental health. Other studies have however shown that use of greenspaces and blue spaces have links to greater behavioral development in children and lower rates of attention deficit hyperactivity disorder (ADHD) (Amoly et al., 2014). Another study on children showed that greener environments at schools and homes were associated with improved cognitive development (working memory and attention). The results showed links to reduced exposure to air pollutants (Dadvand et al. 2015).

5.2.2.2 Reduced cardiovascular morbidity

In a UK study by Mitchell and Popham (2008) the two researchers found an association between low amounts of neighborhood greenspaces and increased risks of circulatory diseases. However,

a Lithuanian study found that the distance to greenspaces had little influence on cardiovascular risk factors, coronary heart disease and strokes. What the study did reveal however was that there was a significant association between more vigorous use of greenspaces and a lower risk of cardiovascular diseases (Tamosiunas et al., 2014). By comparison, another Lithuanian study found that walking in parks had a greater effect on lowering heart rate and blood pressure than walking in a city street. The authors suggested that walking in urban greenspaces could be an alternative form of rehabilitation from coronary artery disease (Grazuleviciene et al. 2015b).

5.2.2.3 Reduced prevalence of type 2 diabetes

Type 2 diabetes is considered a lifestyle disease which can be prevented by adjustment in lifestyles. A logical assumption is therefore to be made that access and use of greenspaces can prevent type 2 diabetes by promoting more active lifestyles (Thompson et al. 2016). This assumption has been further proved by cross-sectional studies from The Netherlands, Australia and the UK. Neighborhood greenness shows significant associations with reduced odds of getting type 2 diabetes (Astell-Burt et al., 2014a; Maas et al., 2009b; Bodicoat et al., 2014). Similarly, a German study found associations between neighborhood greenness and insulin resistance in adolescents where the authors suggested that the protective effect was a result of greenspaces reducing exposure to pollutants from traffic (Thiering et al., 2016).

5.2.2.4 Improved pregnancy outcomes

Birth weight is an indicator used to assess health in infants and low birth weight is one major prediction for neonatal and infant mortality, as well as one predictor of long-term adverse effects in childhood and later years (Thompson et al. 2016). A systematic review and meta-analysis from 2014 illustrated how access to greenspaces in proximity to where pregnant women lived was positively associated with birth weight (Dzhambov et al., 2014). Further studies from Israel, Germany and England have also found similar positive associations between greenspaces in residential neighborhoods and birth weight (Agay-Shay et al., 2014; Markevych et al., 2014; Dadvand et al., 2014b).

5.2.2.5 Reduced mortality

Studies from Japan have shown that the five-year survival rate of people aged 70 and above was positively associated with access to urban greenspaces for walking in close vicinity to where people lived (Takano et al., 2002). Further studies from England has shown that the number of greenspaces in neighborhoods influenced all-cause mortality (Mitchell and Popham, 2008), and that more greenspaces in an area was associated with better self-reported health (Mitchell & Popham, 2007). A longitudinal study from Canada of approximately 575,000 adults found evidence of reduced mortality rates in connection to more greenspaces in residential neighborhoods, where the strongest effect was shown in relation to mortality from respiratory diseases (Villeneuve et al., 2012). In a study from Spain, Xu et al. (2012) found that the perceived greenness of neighborhoods had associations with reduced mortality risks during heat waves.

In a review by Gascon et al. (2016) the authors demonstrated that reduced mortality rates from cardiovascular diseases was linked to exposure of urban greenspaces. The results did not show the same strong evidence when factoring in reduction of all-cause mortality. Similarly, in the US residential greenspaces showed associations to reduced risk of stroke mortality (Hu et al., 2008) and higher survival rates (Wilker et al., 2014). By contrast, however, Richardson et al. (2012) did not find any association between greenspace availability and overall mortality in a study of the 49 largest US states. The authors did however suggest that the nature of US cities (in comparison to European cities etc.) has a much larger dependency on cars as modes of transport and that can be one reason for the different results.

5.2.3 Potential Negative Outcomes

Despite the promising positive potential of urban greenspaces effects on human health, it is still important to remember that there are also other possible negative consequences from introducing more urban green infrastructure. As also mentioned in the introduction of this thesis there are also complex socioeconomic factors that should be taken seriously to maximize the potential benefits and resolve the potential negative outcomes of urban green infrastructure. In this section some of these will be further explored to create a broader picture of what the outcomes might be and what one should be aware about.

5.2.3.1 Increased exposure to air pollutants

How trees and vegetation relate to airflows and with pollutants constitutes complex interactions. Trees and vegetation and other forms of urban greenspaces may be useful in inhibiting the spread of pollutants, but in some cases greenspaces might actually trap and contain air pollution, especially near heavily used roads. Think about how tree canopies can trap emissions like an umbrella. However, it is possible to optimize urban greenspaces by conscious and knowledgeable use and planning (Jin et al., 2014). Especially under certain weather conditions can physical activity be associated with increased exposure to aerosol pollutants such as particulate matter, ozone, nitrogen dioxide, Sulphur dioxide etc. when greenspaces are adjacent to heavily trafficked roads (Carlisle & Sharp, 2001). However, depending on the pollution level in a given urban area the benefits associated with physical exercise can in many cases outweigh the negative effects of exposure to air pollution. In a study from Denmark of more than 50,000 people between the age of 50-60 years showed that traffic related pollution did not alter the association between physical activity and mortality (Andersen et al., 2015).

5.2.3.2 Risk of allergies and asthma

Another potential outcome from more urban green infrastructure is the risk of allergies and asthma. It can be hypothesized that with more urban greenspaces there is the inevitable outcome of more pollen and organic microparticles that affect those who are allergic or suffer from asthma. However, evidence supporting this suggested link has been rather inconclusive (Thompson et al. 2016). In a study by Lovasi et al. (2008) the authors found that children living in areas with more street trees in NYC had lower prevalence of asthma. In a different cohort study by Lovasi et al. (2013) the authors found that there was a positive association between street trees and allergic sensitization to tree pollen and asthma. In another study in the US (Philadelphia), the results showed that pollen from urban parks and trees were listed as self-reported triggers of asthma (Keddem et al., 2015). By contrast, a study from Spain found no association between residential greenspaces and asthma, but that closer proximity to parks was linked to higher prevalence of asthma (Dadvand et al., 2014a).

5.2.3.3 Exposure to pesticides and herbicides

Depending on the type and amount of greenspace it might be that there are increased levels of pesticides and herbicides present, but mainly so if they are used in exaggerated and inappropriate ways. With risks and fears over carcinogenic compounds in these insecticides and herbicides it is necessary to deal with urban greenspaces in a way that will minimize the risks to people and animals. Guyton et al. (2015) highlights the insecticides malathion and diazinon and the herbicide glyphosate as potential harmful compounds that are used in some places to control weeds in urban parks, and they have been classified as “*probably carcinogenic*” to humans by the International Agency for Research on Cancer (IARC, 2015).

5.2.3.4 Exposure to disease vectors and zoonotic infections

As the whole world has experienced in the beginning of 2020, the potential harm for people's health and lives from zoonotic diseases is very real. Zoonotic diseases are caused by viruses, bacteria, parasites and fungi that cross over from animals or other organisms that infect humans (CDC, 2017). The one disease that is on everyone's mind in 2019 is of course what is referred to as COVID-19, but there are also other zoonotic diseases such as tick-borne encephalitis or Lyme disease. Lyme disease has increased in Europe in the 21st century. There are many causal factors behind these disease outbreaks such as warmer winters in Europe caused by climate change (Medlock and Leach, 2015).

Depending on what region of the world and the circumstances for wildlife, it is an important question to be raised that is linked to the effect of destruction of wildlife habitat on human health. With a rapid destruction of wildlife habitats, animals and humans are more often crossing paths in ways that could be problematic for the spread of zoonotic diseases and human health.

5.2.3.5 Accidental injuries

The positive impacts from physical activity in urban greenspaces are many, but there are also risks of accidents and injury, such as falls and drowning accidents (Laosee et al., 2012). Children are considered a sub-population that would be at the most risk and from a UK study it was shown

that most playground related injuries happened in urban greenspaces, but the risks of serious injuries are small and can be adjusted for by properly designed and placed playgrounds (Ball, 2004).

5.2.3.6 Excessive exposure to UV radiation

As mentioned previously, exposure to sunlight and UV rays provide important vitamin D and is a positive outcome of spending time outdoors. However, excessive exposure to UV rays is also associated with heightened risk of skin cancer. In a study from Australia by Astell-Burt et al. (2014) it was shown that people living in greener environments had higher risks of developing skin cancer. On the other side, there exists ways to design urban greenspaces to minimize the harm from UV rays. Placement and purposefully placed tree canopies is one example of how to mitigate from the harmful effects of UV radiation (Boldemann et al., 2006; Boldemann et al., 2011). There are also effective means that we can undertake as individuals to minimize harmful exposure through wearing protective clothing and sunscreen.

5.2.3.7 Vulnerability to crime

Another potential downside to urban greenspaces is that it can serve as an arena for crime. This is a complex social issue that does not necessarily reflect the inherent properties of urban greenspaces themselves and some research point towards other social circumstances and factors as being more prevalent in the perceived fear of crime in urban greenspaces. Sreetheran and van den Bosch (2014) found in a review of studies on the topic, that factors such as gender, age, and minority backgrounds were more influential than the physical factors. This was related back to vulnerability and past experiences of crime.

In a study from the US the researchers found that neighborhood parks were more associated with crime, but elements such as sport arenas and other public use installations were associated with lower levels of crime (Groff and McCord's 2012).

5.2.4 Specific Characteristics

5.2.4.1 Perceptions of green space accessibility and quality

The perceived accessibility and inherent quality of greenspaces are important in the type of use and benefits that urban greenspaces offer. Attributes of urban greenspaces such as safety, aesthetics, maintenance and proximity to home are important for the people who use them. On the opposite side perceived negative associations to urban greenspaces such as crime, graffiti, trash, noise and pollution deter people from using them (McCormack et al., 2010). A study from the Netherlands indicated that characteristics related to quality of urban greenspaces such as accessibility, maintenance, cleanliness and safety in urban greenspaces had a positive association to general health. The findings led the authors to suggest that the quality of urban greenspaces predicted health outcomes independently of the quantity of urban greenspaces (Van Dillen et al. 2012).

From Australia studies have shown that access to attractive and large open public spaces facilitates higher levels of walking among people (Giles-Corti et al., 2005). Another study from Australia found that the proximity to greenspaces within 1,6 km of a home were associated with increased levels of walking and that the attractiveness of greenspaces was associated with increased recreational walking (Sugiyama et al., 2010). Residential areas in proximity to forests and greener residential areas were found in a study from Spain to be associated with lower levels of obesity and less overweight in children (Dadvand et al. 2014a).

The qualities of greenspaces have been described by Pope et al. (2018) as being important factors in improving mental health by enabling relaxation and recreation. It has also been demonstrated that the quality of public open spaces where parks and gardens are included, is more relevant to mental health than the quantity of spaces (Francis et al., 2012). In another study, Grahn & Stigsdotter (2010) identified eight perceived sensory dimensions of urban greenspaces and open public spaces. The eight dimensions were: *Serene*, *Space*, *Nature*, *Rich in Species*, *Refuge*, and *Nature*. Out of these eight dimensions *Refuge* and *Nature* were strongly negatively correlated with stress. The dimension of *Nature* is interpreted as the experience of nature's inherent qualities and as something in contrast to non-nature. The dimension of *Refuge* is understood as a safe and enclosed environment where there are opportunities to play or watch people be active.

5.2.4.2 Size of green space

The size of a greenspace is likely to influence the type of activities that people may conduct in them. In the study mentioned above by Sugiyama et al. (2010) these authors suggested that attractiveness and the various options for activities within different greenspaces may be more relevant for physical activity than the sheer number of greenspaces available within an area. Dependent on the land use area available, this Australian study considered parks with sizes ranging from 1-10 ha. As proposed by the authors the planning and designing of greenspaces in encouraging physical activities might benefit more from one larger greenspace than many smaller greenspaces. This conclusion was supported by findings from a study of young people in the US where the researchers found that there was substantial increases in time spent in moderate to vigorous physical activity for those who lived closer to large parks (Epstein et al., 2006).

Size is just one dimension that is important to consider when working to understand the health benefits related to urban greenspaces. There are also what greenspaces can offer in terms of facilities, listed programs, trails and paths, everyday use for commuting, etc. that will determine its use. And not to forget the topography, shape, configuration and connectivity to broader urban infrastructure (Robertson et al., 2012).

5.2.4.3 Presence of specific facilities for certain activities

Researchers from Canada carried out a study in Ontario where they found that park facilities in the form of paved trails, water bodies and playgrounds were more important than amenities such as rest-rooms, drinking fountains and picnic areas for physical activity (Kaczynski et al., 2008). Schipperijn et al. (2013) further supports these findings and reported that increased levels of physical activity in urban greenspaces were positively associated with features such as walking and cycling routes, bike racks, wooded areas, water features, lighting, pleasant views, and parking lots.

Chastin et al. (2014) found in a study on older women that the access to resting places was important for motivating the participants to venture outside in urban greenspaces. Most of the participants also said that they would walk and be more active if they knew that they could find resting places within certain distances. This is a seemingly simple but effective measure to

increase the use of urban greenspaces by older people, supported in findings by (Aspinall et al., 2010).

5.2.4.3 Tree cover and canopy density

Tree cover and canopy density are elements that as mentioned previously, can be effective in reducing the urban heat island effect (Tan et al., 2015). Research on the topic is however in need of more clarification as results are varying. Xu et al. (2013) found that in Barcelona, on a study on all-cause mortality during heat waves, that higher percentages of tree cover was not associated with reduced mortality risk, but residents' perception of surrounding greenness was significantly associated with mortality.

During a study in a laboratory environment in the US researchers looked at the role of tree canopy density in relation to self-reported stress recovery and found that there was a positive linear association to higher levels of canopy density and self-reported stress reduction Jiang et al. (2015). When measuring physiological responses to stress reaction through salivary cortisol levels and skin conductance Jiang et al. (2014) found that men had a higher stress reduction from moderate tree density cover, in contrast from low or high tree density cover. The results were different from women whom the authors discuss as potentially having different physiological reactions.

Further studies have demonstrated the effect greenspaces have on levels of aggression and mental fatigue. Kuo and Sullivan (2001) found evidence that the presence of trees and grass outside apartment buildings had a better chance of leading to lower levels of aggression and mental fatigue than for people living in apartment buildings without any greenspace in the surroundings. By contrast, and relating to the issue of crime, Kuo et al. (1998) highlight that overgrown or neglected greenspaces may increase levels of anxiety from the fear of crime and thus has a negative impact on people's well-being.

5.2.5 Differential health benefits of greenspaces in different socio-cultural groups

5.2.5.1 Women

As mentioned briefly in some of the sections above there is evidence that gender plays a role in the experience and perception of urban greenspaces. Sreetheran & van den Bosch (2014) found through a systematic review that women were more fearful in urban greenspaces because they perceive themselves as more vulnerable. However, Krenichyn's (2006) found in a study of women's use of large greenspaces in NYC that they enjoyed exercising in parks compared to streets because of the aesthetic scenery and therapeutic and/or spiritual qualities. Another study by van den Bosch et al. (2015) found a significant relationship between the access to serene greenspaces and mental health in women, but not men.

Furthermore, there is substantial evidence that there exists beneficial effects for pregnant women with access to greenspaces. Researchers have found that blood pressure and reduced levels of depression are some benefits from having access to greenspaces and that the effect on depression was stronger for women in disadvantaged groups (McEachan et al., 2016; Grazuleviciene et al., 2014).

It is important to consider the role of gender when considering the potential health benefits of greenspaces and apply the knowledge that is emerging so that everyone benefits to the highest degree possible. Proper management and elements such as lighting can be small measures that give substantial positive returns.

5.2.5.2 Children and adolescents

The topic of the positive effects of greenspaces on pregnancy outcomes and birth weight was briefly mentioned earlier. In a study by Dadvand et al. (2015) the authors reported evidence towards a positive association between exposure to greenspaces and cognitive development in young children. Further studies have demonstrated that greenspaces are linked in some ways to reduce problematic behavior and lower risks of ADHD (Amoly et al., 2014; Taylor & Kuo, 2011; van den Berg & van den Berg, 2010; Markevych et al., 2014). Exactly how greenspaces might influence development in early childhood is hard to say, but there are potential pathways that are

interesting. In a study from Switzerland researchers show evidence of how greenspaces play an important role in the social lives of children and help in promoting social inclusion (Seeland et al., 2009).

Another potential pathway lies in how children learn about risk and how to manage it (Thompson et al. 2016). Development of the skills necessary to cope with uncertainty and risk management, which are considered important elements in adulthood, are possible to learn from activities in greenspaces. Research from the UK highlights that especially for adolescent boys' greenspaces can offer the context that satisfies this need for risk and adventurous behavior that is otherwise not easily accessible in traditional urban environments (Natural England, 2010).

5.2.5.3 Older people

In a study from 1998, researchers found that older adults living in inner-city areas benefited from urban greenspaces which seems to promote social relationships and a sense of community and belonging (Kweon et al., 1998). As social isolation is something that is more common amongst older people and carries with it an increased mortality rate (Steptoe et al., 2013), urban greenspaces can play an important role in mitigating such negative effects. Dutch researchers demonstrated in a study from 2003 that there existed a positive relationship between the amounts of greenspaces and self-reported health in senior adults (de Vries et al., 2003). Later studies have also demonstrated the many benefits from greenspaces that exist for older people. Greenspaces does for one example seem to play a role in sleep deficiency and have a stronger protective effect for people aged 65 and older in comparison to younger adults (Toussaint et al. 2015).

In a systematic review it was uncovered that when objectively measured 67% of people aged 60 and above spent more than 8,5 hours of their waking day sedentary (Harvey et al., 2013). As physical activity is considered an important element of a healthy lifestyle, it is also important that older people have access to greenspaces and facilities that help promote physical activity suitable for the older population. More evidence of the beneficial effects of greenspaces for people aged 60 and above has been summarized by Broekhuizen et al. (2013).

5.2.5.4 Deprived subpopulations and minority groups

According to Mitchell et al. (2015) there is accumulating evidence that the health benefits related to greenspaces may be strongest among people in the lower socioeconomic groups. Findings show that socioeconomic inequality when it comes to mental well-being was 40% narrower in respondents that reported good access to greenspaces, compared to those with poorer access (Mitchell et al. 2015). In support of this is also research from the US where researchers found significant associations between reported access to and quality of greenspaces and reduced psychological distress in deprived population groups (Pope et al. 2018).

The links between less well-endowed socio-economic population groups and urban greenspaces can be a good way of providing improved conditions for those who need them the most. As reported from Norway (Naess et al., 2007) and the UK (Grant et al., 2012), a common tendency amongst deprived urban communities is that they experience worse air quality which carries with again can lead to worse health conditions. However, the “quick fix” of providing more urban greenspaces for deprived communities may not be that simple. In a systematic review it was found that ethnic minorities in low income neighborhoods have different feelings and perceptions of the security in and around greenspaces (Sreetheran and van den Bosch, 2014).

5.2.5.5 Populations of various countries and geographic regions

Studies on the stress reduction value of urban greenspaces have been replicated in many countries, but most epidemiological studies have been conducted in high income countries. It will be important to conduct further research on the benefits of urban greenspaces to human health as to create a broader picture and understand how different economic conditions, climates and urban designs influence these relationships (Thompson et al. 2016).

5.3 Municipality of Oslo

Oslo has been actively occupied with questions of how to adjust and shift the municipality in a more environmentally and socially sustainable direction. The focus found in these guiding plans and programs are diverse and have a range from reducing CO2 pollution, increasing biodiversity and development of infrastructure (The Municipal Master Plan 2018; The *Urban Ecology Programme 2011 – 2026*; The Urban Development of Oslo). These measures span the entire city government, city districts and their plans for the future. In this thesis I have chosen to focus on the guiding plans and programs that have been already established. The goal has been to explore to what extent a nature and health perspective is incorporated into these plans, guidelines and programs.

5.3.1 Municipal Master Plan

The Municipal Master Plan (MMP) is the overarching guiding policy document for the municipality of Oslo. Its purpose is to point out the long-term development of Oslo, and in what direction this development should go. It consists of both a community component and a geographical component. Whereas the community part was agreed upon by the city council on the 30th of January 2019, the geographical component has been pushed out in time to be agreed upon at a later date. The three central components to this long-term strategy are described as:

1. Increase the pace of climate and environmental policy
2. Active and sustainable municipality
3. Socially sustainable city with equal opportunities

The MMP's community part is related to how Oslo can develop services related to the needs presented by societal development and how to best solve the challenges as they appear towards 2040 (Municipal Master Plan, 2019).

“A greener, warmer, and more innovative city, with room for everyone” is stated as the slogan for Oslo's Municipal Master Plan (Municipal Master Plan, 2019). Even though there are undeniable nature and vegetation connotations to the use of the word “green”, it has become a metaphor that is used at large to describe the totality of work on sustainability and climate change within the municipality. As the MMP states in chapter 3.1 - “A Greener City”, a greener city means: a car-free city, mobility, Oslo as a pedestrian and bicycle friendly city, people and nature on the same team in the blue-green city, urban greenspaces, and energy smart buildings (ibid).

A big emphasis in chapter 3.1 - "A Greener City" is placed on consumption (of natural resources), greenhouse gas (GHG) emissions and local pollution. The especially strong emphasis on GHG emissions can be seen to connect the different areas of interest and is reflected through the politically decided goal of reducing GHG emissions by 36% by 2020 and 95% by 2030 (from 1990 levels) (ibid). As traffic is the largest source of GHG emissions in the municipality of Oslo, it is logical that this sector has received a lot of attention, and that efforts are placed on reducing the source of GHG emissions from this sector by providing alternatives. These alternatives are reflected through what is described as key aspects of "A Greener City" such as a car-free city, emphasis on mobility and pedestrian and bicycle friendliness.

The closest approximation to a nature and health perspective that I was able to find through my analysis of the MMP was in relation to air pollution and the negative health consequences that it brings. But this aspect was again only related to a measure of reducing air pollution by converting the traffic fleet to zero-emission vehicles, and only indirectly mentioning urban greenspaces as an "escape" from the air pollution otherwise existing in the municipality.

When mentioning urban greenspaces in chapter 3.1 - "A Greener City" a nature and health perspective is not mentioned directly but it can be said that the emphasis on urban greenspaces as places where inhabitants can come for recreation with good air quality and reduced noise pollution does to some extent touch on the topic. However, it is not explicitly stated that there can be positive health benefits to gain from having access to these urban greenspace qualities as they have been reported in the literature. Examples being reduced air and noise pollution (Bowler et al., 2010; González-Oreja et al., 2010).

5.3.2 Political Platform (2019-2023)

The city council in Oslo is currently in its second electoral term (2019-2023). The current political platform (Byrådsplattform) can therefore be considered an extension or addition to the previous political platform (2015-2019). It is the latest policy platform that is referred to in this thesis. It consists of ten overarching policy guidelines or as they are referred to in the political platform "the Oslo promises" (Osloløfter). Especially two of these "Oslo promises" are relevant to the topic of nature and health. Policy guidelines number six and seven (Byrådsplattformen, 2019):

***Osloløfte 6:** I Oslo skal vi legge til rette for god folkehelse, gi alle rask og riktig helsehjelp, og sørge for at alle eldre får en aktiv alderdom med den omsorgen og hjelpen de trenger.*

“In Oslo we will facilitate the right circumstances for good public health, provide everyone with efficient and the right health services, and make sure all elderly has an active old age with the best care and help they need.”

Osloøfte 7: *I Oslo skal vi ha levende nabolag der alle har et trygt sted å bo, med aktiviteter og opplevelser for alle, rikere naturmangfold og kort vei til flotte friluftsopplevelser.*

“In Oslo we will have thriving neighborhoods where everyone has a safe place to live, with activities and experiences for everyone, rich biodiversity and short distances to thrilling outdoor experiences.”

For the Oslo Promise related to health and well-being (Oslo promise 6) it is stated that the municipality shall facilitate for good health and quality of life, regardless of age or preexisting health conditions, and that clean air, everyday physical activity, healthy food, less loneliness and less negative stress are essential aspects of this goal. This goal of improved healthcare is to be achieved through: (1) connected healthcare services, (2) safe early childhood, (3) health services in schools, (4) childcare services, (5) elderly care, (6) substance addiction, (7) hospitals, (8) relative/closest circle, (9) sustainable and healthy foods and (10) inclusive healthcare.

For the Oslo promise related to “green” and inclusive urban development it is stated that the city council will facilitate for an inclusive and “green” zero-emission city, facilitate for the construction of thousands of new housing units (each year), maintain and develop greenspaces and prioritize pedestrians, bicyclists, and public transport. The goal of creating a “green” and inclusive urban development is to be achieved through: (1) more and varied housing units across the city/municipality, (2) public guiding of urban development, (3) “good” neighborhoods across the city/municipality, more and improved public housing and (4) inclusive buildings and architecture.

In regard to nature and outdoor recreation, not directly related to one promise but to the overall vision for 2030, it is stated that the city council will work towards nature and outdoor recreation becoming more available for the entire population in the municipality. All inhabitants should have close proximity to greenspaces with short distances to parks, trails and paths leading to Marka (forest surrounding Oslo). This goal is to be achieved through: (1) urban greenspaces, (2) outdoor recreation and nature in Marka, (3) the fjord and islands, (4) urban agriculture and (5) animal welfare.

5.3.3 Urban Ecology Programme 2011-2026

5.3.3.1 Introduction

The *Urban Ecology Programme 2011 – 2026* was a plan adopted by the Oslo City Council on the 23rd of March 2011. It is a detailed plan with specific targets, strategies and measures to achieve them and with outlined indicators to evaluate its performance. It is further the responsibility of all municipal bodies to formulate and develop more specific targets and terms and incorporate them into their own plans, budgets and annual reports (Urban Ecology Programme, 2011).

Vision and overall objective (Urban Ecology Programme, 2011)

Oslo will be a sustainable urban community where everyone is entitled to clean air, clean water and access to attractive outdoor recreation areas.

The City of Oslo will give priority to the following areas in seeking to achieve its vision of environmentally sound and sustainable urban development:

1. Oslo will reduce noise levels, air pollution and greenhouse gas emissions
2. Oslo will have an eco-efficient transport system
3. Urban development in Oslo will be environmentally sustainable, with an environmentally sound built environment and urban spaces
4. Waste management in Oslo will be based on a life-cycle approach
5. Oslo will maintain and strengthen its blue-green structure
6. Oslo will develop an eco-efficient city administration
7. Oslo will work together with its inhabitants, the business sector and the central government to improve the city's environment
8. Oslo will take part in regional, national and global cooperation to improve the environment.

The Urban Ecology Programme (UEP) places responsibility on all municipal bodies to incorporate and formulate relevant parts of the programme into their own areas of operation. It is possible to see the specific targets, strategies and measures, and indicators to link them with a nature and health perspective. Below are the targets and sub-targets that can be found to directly or indirectly relate to a nature and health perspective.

5.3.3.2 Targets related to nature and health

Table 5: Target 1 (Oslo will reduce noise levels, air pollution and greenhouse gas emissions)

Targets	Strategies and Measures	Indicators
<p>1.2 Oslo will improve local air quality.</p>	<p>1.2.1 Implement measures such as charging for using vehicles with studded tires, grants for the replacement of old woodburning stoves with new clean-burning models, reducing dust emissions from roads where emissions are particularly high, particle filters for diesel vehicles and promoting the use of zero-emission vehicles, in accordance with the decisions set out in the Air Quality Action Plan.</p> <p>1.2.2 Continue to promote the use of energy-efficient and climate-neutral vehicles. Continue the arrangements for free parking and passage through the toll ring for zero-emission vehicles Continue to encourage the establishment of charging stations for electric vehicles in multi-story car parks and public on-street parking, with the aim of establishing at least 100 new charging stations a year.</p>	<p>No. of days per year statutory limit values for PM10 are exceeded. Annual mean concentration of PM10. Number of hours per year statutory limit values for NO2 are exceeded. Annual mean concentration of NO2. Proportion of population exposed to noise levels exceeding L_{den} 55dB over a 24-hour period or L_{night} 45dB at night.</p>
<p>1.3 Oslo will reduce noise levels to which inhabitants are exposed.</p>	<p>1.3.1 Carry out the measures set out in the Noise Action Plan in cooperation with owners responsible for key noise sources. Revise noise maps (2012) and the Noise Action Plan (2013) in accordance with Chapter 5 of the Pollution Regulations.</p> <p>1.3.2 Complete mapping of noise bands for Oslo in accordance with the government guidelines for incorporating noise into land use planning.</p>	<p>Proportion of population exposed to noise levels exceeding L_{den} 55dB over a 24-hour period or L_{night} 45dB at night</p>

	<p>1.3.3 Obtain good statistics on road traffic for use in mapping and monitoring noise and air quality.</p> <p>1.3.4 Continue the establishment of quiet areas in Oslo (see the Noise Action Plan).</p>	
<p>1.5 Oslo will adapt to climate change.</p>	<p>1.5.1 Draw up a climate change adaptation strategy for the City, including:</p> <ul style="list-style-type: none"> • a strategy for dealing with storm water, including opening up culverted rivers; • the establishment of more green spaces and green roofs; • climate change assessments as part of planning for new infrastructure; • mapping of areas where there is a risk of landslides; • mapping of areas where there is a risk of flooding; • a strategy for the protection of large trees; • sectoral action plans for climate change adaptation. 	

As presented in the review by Bowler et al. 2010a, urban greenspaces in the form of vegetation such as trees, shrubs, herbs and grass can lessen the impacts of urban pollution sources such as traffic and industry and in turn provide benefits for public health. One way this could be achieved, not stated in the Urban Ecology Programme under the strategies and measures, could be consciously implemented green infrastructure that would decrease air pollution.

As noted in the literature, consciously and well-designed green infrastructure can buffer non-natural sources of noise and provide relief for urban dwellers (González-Oreja et al., 2010; Irvine et al., 2009). However, this is not mentioned under strategies and measures in the Urban Ecology Programme. Establishing more greenspaces, as a measure for adapting to climate change, is under strategies and measures mostly interpreted as being stormwater management.

Table 6: Target 3 (Urban development in Oslo will be environmentally sustainable, with an environmentally sound built environment and urban spaces)

Targets	Strategies and Measures	Indicators
<p>3.1 Oslo will promote eco-efficient urban development in accordance with the principles of urban ecology.</p>	<p>3.1.1 In accordance with the municipal master plan, commercial and residential developments are to be based on densification within the built-up area and near public transport nodes. Densification should not take place at the expense of the green structure. Environmental requirements are to be integrated into zoning plans to ensure the environmental quality of land development. Oslo will encourage developers to calculate carbon footprints when planning major urban development projects.</p> <p>3.1.2 Improve environmental conditions in the districts, residential areas and local communities where this is most necessary. The Groruddalen area (covering the eastern districts of Oslo) will be given priority under an agreement between the City of Oslo and the Norwegian Government, which focuses on sustainable development, better quality of life, and improved living conditions through four programmes of action:</p> <ul style="list-style-type: none"> • sustainable transport in the Groruddalen area; • green structure, sports and the cultural environment along the Alna river; • local community development; • children and young people, education, living conditions, culture and social inclusion. 	<p>Proportion of new developments on brownfield sites. Population density in new residential areas. Area acquired for development of green structure in m2.</p> <p>Proportion of population living within 300 m of local services.</p>

<p>3.2</p> <p>Properties owned by Oslo will be managed eco-efficiently, and the city's construction projects will be energy- and eco-efficient.</p> <p>Both regulatory and economic instruments will be used to achieve permanent reductions in stationary energy use, including phasing out all oil- fired heating by 2020.</p> <p>Cultural heritage management in Oslo will maintain the city's historical qualities.</p>	<p>3.2.1.</p> <p>Draw up environmental management plans to ensure that important environmental considerations are taken into account in all major urban development projects, for example the Fjord City projects and developments in areas such as Ensjø, Økern and Gjersrud/Stensrud.</p> <p>The city administration will implement the environmental management plans so that environmental qualities are maintained and a life-cycle approach to new projects results in reductions in energy use, greenhouse gas emissions, pollution and costs.</p> <p>3.2.2.</p> <p>Improve, manage and maintain the city's properties, buildings, streets, green spaces, facilities and infrastructure eco- effectively. Oslo will follow a cost-effective maintenance policy. Repair and maintenance of protected and historically important buildings, structures and cultural environments will to be based on restoration principles. Take steps to ensure that all existing municipal buildings that are reasonably close to the district heating system are connected to the system. Energy certification of municipal buildings will be required on sale. The solutions chosen for properties, buildings, etc. must be user-friendly and encourage environmentally sound use.</p> <p>3.2.3</p> <p>Draw up environmental programmes for all municipal building projects and major renovation</p>	<p>Proportion of municipal construction projects with environmental programmes.</p> <p>Energy use per m2 in municipal buildings.</p> <p>Energy use per m2 in a life- cycle perspective (construction, operation, demolition) in municipal buildings.</p> <p>Greenhouse gas emissions per m2 in a life-cycle perspective (construction, operation, demolition) in municipal buildings.</p>
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	<p>projects. The solutions chosen must be user-friendly and encourage environmentally sound use. New municipal buildings, including renovation projects exceeding 250 m² in size, will be provided with water-based heating systems and connected to the district heating network where possible.</p>	
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For target 3 there is placed a lot of emphasis on the maintenance of existing green infrastructure and development of new urban greenspaces. This can be seen in sub-point 3.1: “Oslo will promote eco-efficient urban development in accordance with the principles of urban ecology.” and sub-point 3.3: “Urban spaces will be maintained, developed and made greener, and kept free of graffiti and litter”, sub-point (Urban Ecology Programme, 2011, p. 8 & 11). The strategies and measures for sub-point 3.1 mentions accordingly that densification will not be at the expense of green infrastructure, that environmental conditions will be prioritized (especially in the Grorud Valley), municipal activity will promote sustainable urban ecology and that outdoor recreation areas will be prioritized (ibid, p. 8-9). However, the justification for the emphasis on green infrastructure seems to be related back to a general strategy of environmental and social sustainability. Any specific mentioning of the potential public health benefits to gain from these efforts are not mentioned.

Table 7: Target 5 (Oslo will maintain and strengthen its blue-green structure)

Targets	Strategies and Measures	Indicators
<p>5.2 Oslo will maintain and further develop its green structure, focusing on continuity and quality.</p>	<p>5.2.1 Oslo's forests will be maintained and the current boundary of the built-up area retained. The forest zone nearest the built-up area is a recreation area, and provision will be made for a combination of nature and human activity. Management of the forest closest to the built-up area will be adapted</p>	<p>Proportion of population who live within 300 m of the nearest green space.</p> <p>Area of designated outdoor recreation areas and green spaces with public access, m².</p>

	<p>to the high intensity of use and the resulting wear and tear on the environment.</p> <p>5.2.2 Make arrangements for public access to and use of designated outdoor recreation areas by purchasing them or through agreement with landowners, in addition to improvements. Valuable unregulated areas of natural environment will be safeguarded by zoning. Designated outdoor recreation areas and other important areas of natural environment and green spaces in the built-up areas are to be retained. The quality and accessibility of green spaces and any barriers to access will be analysed. Any new outdoor recreation areas must be of high quality.</p> <p>5.2.3 Develop an indicator to monitor green spaces as regards accessibility, universal design, size and quality. This indicator should be considered in conjunction with the indicator for designated outdoor recreation areas.</p> <p>5.2.4 Implement the plans and investment projects that have been adopted for the green structure in the built-up area. Complete the construction of the planned network of footpaths/cycle tracks, and further develop plans for this network in connection with revision of the Urban Green Spaces Plan. Ensure public access to the shoreline and establish a continuous coastal path where this is possible. Unauthorised barriers and other obstacles to free access along the fjord will be removed.</p>	<p>Area of school gardens and allotments in m2.</p> <p>Number of children and adults who use school gardens and allotments.</p>
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	<p>5.2.5 Establish routes across the Groruddalen valley between the forest areas Østmarka and Lillomarka for pedestrians and cyclists.</p> <p>5.2.6 The city districts have taken over the responsibility for managing local green spaces, and the results of this will be evaluated.</p> <p>5.2.7 Retain and acquire new areas for school gardens and allotments.</p>	
<p>5.5</p> <p>Oslo will provide opportunities for and access to varied outdoor recreation and outdoor learning and environmental teaching.</p>	<p>5.5.1</p> <p>Green spaces, the islands in the fjord and the forest areas closest to the city will be set aside and maintained in accordance with the Plan for Sports and Outdoor Recreation. Outdoor recreation areas will be acquired and improved through the project for public outdoor recreation areas. The goals and guidelines for forest areas owned by the City of Oslo will be used as a basis for use of all the forests surrounding Oslo. Rezoning of the lakes Alunsjøen and Breisjøen, which have been part of the city's drinking water supplies, will be considered to permit outdoor recreation and bathing.</p> <p>5.5.2</p> <p>Schools and day care centres will arrange to visit buildings, structures and sites of environmental and historical interest in their neighbourhood as part of their teaching. Each school is encouraged</p>	<p>Proportion of the total built-up area zoned as outdoor recreation areas. Proportion of schools and day care centres that run regular outdoor learning activities.</p> <p>Proportion of the population who use green spaces, split by user group.</p> <p>Proportion of green spaces, the islands and the forest zone nearest the built-up area where arrangements have been made for universal access.</p>

	<p>to “adopt” a stretch of a river or stream in cooperation with the organisation Oslo Elveforum.</p> <p>5.5.3</p> <p>Protect wooded areas near homes, schools, etc., to provide local opportunities for physical activity and enjoying natural surroundings. An overview of the relevant areas will be drawn up when the Urban Green Spaces Plan is updated.</p> <p>5.5.4</p> <p>Establish a database of buildings, objects and sites of environmental and historical interest that can be used in educational activities. Activities related to the natural environment that the city can offer schools should be incorporated into their teaching.</p> <p>5.5.5</p> <p>Encourage more groups of the population to become active users of Oslo’s forests through cooperation with minority organisations and the city districts.</p>	
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Under target 5, sub-point 5.2 more emphasis is placed on the maintenance and development of green infrastructure and with a focus on continuity and quality. The indicators for sub-point 5.2 gives insight to how the municipality is indirectly acknowledging the health benefits that can come from exposure to greenspaces. Indicators are: (1) Proportion of population who live within 300 m of the nearest green space. (2) Area of designated outdoor recreation areas and green spaces with public access, m2. (3) Area of school gardens and allotments in m2. (4) Number of children and adults who use school gardens and allotments (Urban Ecology Programme, 2011, p. 16). Even though these indicators are well enough on their own in assessing the use of urban greenspaces they do not mention any indicators on how this might affect the health of inhabitants in these areas. If this had been included into the indicators it should further provide support and

bring importance to further maintenance and development of the green infrastructure. On neighborhood and city district scales.

5.3.4 Grorud Valley Community Program

In Oslo there exists a political focus on lifting certain city districts and neighborhoods, so they are perceived and felt safe to live and grow up in. This is referred to as *Residential Area Politics* (Områdepolitikk) (Områdepolitikk i Oslo, N/A). The policies refer to challenged neighborhoods as areas that experience a combination of physical and social circumstances that make the average population living in that city district or neighborhood score lower on certain living standard parameters. Experiences have shown that these parameters are a combination of unemployment, child poverty and living density (ibid).

Under the overarching *Residential Area Politics* there are two other terms that refer to the efforts put in place. First, *Prioritized Area* (Områdesatsing) refers to the general description of a time limited and totality of extra efforts put in place in a geographic area. Secondly, under *Prioritized Area* we find *Community Programs* (Områdeløft). There can be multiple *Community Programs* in one *Prioritized Area*. *Community Programs* refers to the specific plans and programs that are put in place under a geographically limited area such as a city district or neighborhood. Examples of measures under *Community Programs* can be to keep young adults in school or to employ citizens of immigrant backgrounds (ibid).



Figure 4: Overview of Residential Area Politics (Områdepolitikk).

In this thesis I have chosen to focus on the district of Grorud (one of four districts in the Groruddalen Valley) and the specific plans under the *Community Programs* for this district related to the topic of nature and health. The *Community Programs* are divided into three sub-parts; community, adolescence and education & employment. In the “Plan for Community Programs: District Grorud” (Programplan for områdeløft Bydel Grorud) we can find the overarching goal for the *Community Programs* in Grorud that stipulates: “*The programme shall contribute to lasting improvements of services and community qualities in areas where the needs are greatest, so that more inhabitants in these areas become financially independent and active in the local and larger community*” (Programplan for Områdeløft Bydel Grorud, 2020., p. 2).

As mentioned, *Community Programs* Grorud is a specific targeted plan for the Grorud district under the municipal strategy under the *Prioritized Area* of the Grorud Valley, under the policy of “*Residential Area Politics*”. The district of Grorud has an overarching goal that shall guide all work within the district. The overarching goal is stipulated as “In Grorud we shall work together to create good living conditions and increased overall well-being for the inhabitants” (Programplan for Områdeløft Bydel Grorud, 2020, p. 3). District Grorud is directly aiming for work on public health in all of its services and one of the long-term goals that the district wishes to achieve through its strategic planning is lively neighborhoods that increase health and well-being. The community sub-part of *Community Programs* is one central component of the district’s work in achieving the aforementioned goal (ibid).

As stated by the district of Grorud there are certain main challenges that are focused on and from where strategic priorities are made. Especially two of these main challenges can be seen as being relevant for this thesis. First, the district reports that too many people suffer from some form of physical or mental health issue. Secondly, perceived exclusion and loneliness is a challenge in parts of the population and that again leads to reduced quality of life (ibid). As some of the research literature included in this thesis has mentioned, it seems to be good opportunity for the Grorud Valley Community Program to utilize green infrastructure in their program. However, without the awareness and knowledge about these links between nature and health the distance between problem and potential solutions seem far.

5.4 Results

The biggest takeaway from exploring the municipal policies, plans and programs related to a nature and health perspective was that there is no explicit mentioning of associations between nature and health. This was also the conclusion after interviewing 3 employees within the municipality, specifically the Agency for Urban Environment (Bymiljøetaten), holding relevant positions towards the topic of nature and health. However, that does not mean that there is a lack of understanding or effort to utilize the green infrastructure in a way that prioritizes health. One of the interview participants mentioned a 36% increase of greenspaces in the Grorud Valley. Many examples show how efforts are placed on utilizing urban greenspaces for physical activity and the health benefits that come with it. For the most part there seem to be a lack of knowledge and thus formulation of a nature and health perspective.

One learning point from the interviews was that all interview participants were positive to the idea of a nature and health perspective. When discussing the Grorud Valley Community Program it was mentioned that greenspaces were a valuable resource that would be emphasized further in the program. Considering how the Grorud Valley Community Program lists some of their main challenges as: physical and psychological health issues, perceived exclusion and loneliness, there is evidence in the literature that point towards how urban greenspaces can help in promoting social interactions and promote a sense of community and belonging (Kim and Kaplan, 2004). However, similarly to the UEP and MMP there is no explicit mentioning of the potential benefits of nature for its health benefits. The empirical understanding that there are health benefits, perhaps especially physical health benefits, are seemingly so imbedded in us that they are overlooked when it comes to actually integrating this knowledge into plans and programs. This is also mentioned in the literature where Markevych et al. (2017) mentions how the idea of “common sense” creates a false understanding of the benefits and how to achieve them.

As there is both a need for awareness and increased knowledge about a nature and health perspective SRT provides a theoretical foundation that can be relatable. Stress is no something that is foreign to the most of us and how we can passively use green infrastructure to combat this should be made more accessible. “...restorative influences of unspectacular natural scenes, compared to urban views, may be most pronounced when the observer's initial state is one of stress and excessive arousal” (Ulrich, 1983, p. 116). It can often be that we miss something that is right in front of us simply because we are not aware of it. But after we become aware of it we

ask ourselves how we could have ever missed it. Numbers presented by the municipality places the percentage of the population living within 300 meters of an urban greenspace to be 98% (Municipality of Oslo, 2019). It is safe to assume that there are many potential greenspaces that can serve various purposes.

6. Discussion

As mentioned on multiple occasions at this point the field of nature and health research spans many fields and scientific disciplines. This makes it quite challenging to summarize the totality of existing literature. Not only because of the sheer volume of literature published but also from the specific knowledge required to fully comprehend the results and what this can imply for a broader context. One example can be that there is not necessarily a direct link between the evidence presented by Tamosiunas et al. (2014) on vigorous use of urban greenspaces and lower risk of cardiovascular disease and the findings of Beyer et al. (2014) that points towards associations between greenspaces and lower levels of depression, anxiety and stress. However, if we look outside of specific disciplines it is possible to explore the pathways in which improved physical health (as a result of more use of greenspaces) inadvertently leads to less psychological health.

Even though one could extrapolate certain links from the literature it can be hard to establish the relevance and how it can be implemented by developers, city planners and policy makers. The question that should be asked then is how literature and knowledge on the links between nature and health should be understood and acted upon. It could be argued that it would be better if developers, city planners and policy makers had the necessary knowledge about the topic of nature and health to fully utilize the benefits it can bring. However, understanding in depth the underlying mechanisms at play could also be considered redundant if one is looking to develop an urban property or park. It could therefore be argued that it would be sufficient to provide qualities such as size and density or specific plant species and their associated attributes.

In the following paragraphs I will present the findings and analysis from research I have collected from the literature, analysis of municipal documents, interviews with municipal employees and how my research into the topic of nature and health under the context of Oslo has resulted in three recommendations.

Research on the topic of nature and health has provided associations that can be valuable for urban developers and city governments to include in their work. This includes but are not limited to positive evidence on how examples of exposure to greenspaces can lead to reduced levels of cardiovascular disease (Mitchell and Popham, 2008; Tamosiunas et al., 2014; Grazuleviciene et al. 2015), lower levels of depression (Beyer et al. 2014; Reklaitiene et al. 2014), increased birth

weight of newborn children (Dzhambov et al., 2014;), reduced exposure to air pollution (Bowler et al., 2010; Calfapietra et al., 2016) and overall reduced mortality (Villeneuve et al., 2012; Xu et al., 2012; Gascon et al., 2016). The volume of literature that promotes positive findings as well as the breadth of the literature should be considered to provide validation of the topic.

Despite a lot of positive outcomes from the research included in this thesis it is also necessary to mention that the some research findings are still presented as vague or inconclusive in some scenarios. One example is the findings by Richardson et al. (2012) which did not find any association between greenspace availability and overall mortality in the US. This research finding is argued by the authors to be different from the EU, because of the way cities in the US are more dependent on cars, and thus potentially mitigate the potential effects of urban greenspaces. This example of contrasting evidence should highlight how context is important to consider when moving from theory to actual implementation of green infrastructure.

Another important element that becomes apparent is what role perception has to play in the context of nature and health. As presented by Xu et al. (2012) the perceived greenness of neighborhoods influenced the mortality risk during heat waves in Spain. Similarly, Vries et al. (2013) found evidence suggesting that quantity and quality of greenspaces play a role in the perceived social cohesion of a neighborhood. What this indicates is that awareness about greenspaces could be an important factor in manifesting the potential benefits.

To what extent the municipality of Oslo incorporates a nature and health perspective is not a black and white question. The municipality of Oslo pursues and prioritizes sustainability and climate change through policy platforms, resource allocation and thus prioritizing the green and blue infrastructure in the municipality. However, there is not any specific mentioning of or directed attention brought to the ways in which nature in the form of green infrastructure can be a valuable asset in lifting public health within the municipality. That is, other than the anecdotal and empirical subjective knowledge that exists about the value of nature for human health.

Ways in which Oslo is arguably indirectly incorporating a nature and health perspective is for one example seen in the Urban Ecology Programme's point 5 (Oslo will maintain and strengthen its blue-green structure). Under the *strategies and measures* sub-point 5.5.3 it is stated that "Protect wooded areas near homes, schools, etc., to provide local opportunities for physical activity and enjoying natural surroundings" (Urban Ecology Programme, 2011). Another example can be seen

in how Oslo is focusing on developing pedestrian/cycle path networks to increase these forms of transport to further reduce the use of cars within the municipality. Under the Urban Ecology Programme's strategies and measures sub-point 5.2.4 it is stated that "Complete the construction of the planned network of footpaths/cycle tracks, and further develop plans for this network in connection with revision of the Urban Green Spaces Plan" (ibid).

Understanding how the municipality of Oslo indirectly incorporates a nature and health perspective as seen above it becomes possible to look at potential ways that this perspective can be further integrated. Because of many existing plans and programs, it should be considered to be an effective approach to further build upon the existing frameworks. From the research into how the municipality is already working on sustainability and specifically the role of greenspaces I have concluded that there is an especially strong case to be made for increasing awareness of the public to the potential health benefits that can be gained from exposure to nature. In the urban context of Oslo, nature in the form of greenspaces should be looked at as an underused resource in relation to public health.

By exploring existing research on the topic of nature and health and applying it to the context of the municipality of Oslo it has become clear that there is not enough effort put in place to utilize the benefits that can be brought to both inhabitants of Oslo and the municipality as an organization. The value of introducing such a perspective would be that it provides public health benefits and at the same time strengthening the green infrastructure for its sustainability benefits and climate change adaptation and mitigation effects. Because of Oslo already being a municipality with a lot of green infrastructure there would be less need for big infrastructure spending that would not otherwise be planned. What the municipality of Oslo can focus on instead is spreading awareness to influence behavior and perception so that the inhabitants of Oslo can utilize the green infrastructure and benefit from it with the knowledge that it is probably better than one would previously think it is.

Conclusion

Oslo is a green municipality with a “green” agenda. Oslo has more parks and urban greenspaces than many other cities around the world. From my exploration of the research literature and Oslo as a context it seems that Oslo is on a good path to integrate a nature and health perspective that would serve the municipality and its citizens in a good way. The findings on how urban greenspaces can serve public health benefits should therefore be further highlighted and integrated into municipal policy, plans and programs. The Grorud Valley Community Program has shown to be a good example of how municipal goals to improve local conditions can also be valuable experiments in how to further improve public health in urban environments. Apart from the lack of explicit recognition of a nature and health perspective there are certain urban development and social improvement efforts that could be put in place to further capitalize on the existing research. Politics, measures and instruments are in place that indirectly present a nature and health perspective but without an actual formulation and recognition of this perspective and phenomena it becomes hard to fully integrate into practical policies.

As a result of an explicitly formulated policy on nature and health it would be possible to deliberately build and develop green infrastructure that contain the qualities that have been mentioned in the literature. One example is how quality seem to be more important than quantity, which is also supported by the theoretical formulation of ART. That *Being Away and/or Extent* (physical or mental distance) can be important in getting the experience which in turn has restorative effects. Another example is more knowledge about what type of vegetation that is more effective in removing air pollution, or what type of vegetation that blocks out noise pollution most effectively.

Positive outcomes of integrating a nature and health perspective does not necessarily have to only be about pure health related either but can be a combination consciously developed areas that facilitate for greater social interaction. Allow elderly to enjoy more time outdoors, children to experience nature closer to home, and overall foster appreciation for nature in urban environments.

My recommendations are about awareness and perspective. It is clear that Oslo is making a significant effort in adapting to more ecological practices in all its undertakings. However, I would

recommend a stronger emphasis on the substantial public health benefits that can come from more consciously developed green infrastructure. Continuing the development of urban greenspaces with a specific focus on how each greenspace or natural element can serve a public health benefit. Furthermore, the municipality of Oslo should emphasize awareness and explicit perspectives as a strategy to spread knowledge to its inhabitants so that the knowledge that exists in theory can be practiced by everyone that feels it is something they would benefit from.

I see the topic of nature and health as being an integral part of sustainability and environmental awareness. The resilience of our urban ecosystems is closely connected to how we design and develop our societies. Reductions of GHG emissions is one important element of sustainability but is not the essence of what environmentally friendly agendas should be about. The prospering and elevation of human lives and societies is in the end the desired outcome.

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Appendices

Appendix I: Interview Questionnaire

Semi-structured interview guide

M/F

Title (if not anonymous):

1. Qualitative interview introduction

Urban greenspaces and mental health: Semi-structured interview

Length: 20-30 minutes

Primary goal: To see things the way you see them... more like a conversation with a focus on your experience, your opinions and what you think or feel about the topics covered

2. Verbal consent

Would you like to participate in this interview?

Verbal Consent was obtained from the study participant/Verbal Consent was NOT obtained from the study participant

3. Background Information

Overview:

Invite interviewee to briefly tell me about him/herself: General information about background... mostly about experiences and perspectives on issues surrounding city planning/urban development, urban greenspaces, mental health well-being.

4. Experience working with green infrastructure

Can you tell me about your experience working with green infrastructure?

- In Oslo
- Have you had any experience working on a “nature & health” perspective?

- Do you know about any specific “nature & health” measures that have been put in place in Oslo?
 - Examples: Parks? Projects? Other?
 - If yes, do you know if these examples have had any:
 - Scientific base?
 - Anecdotal base?

5. Responses from the public

Overall Oslo has a good reputation for its green infrastructure, in short, how do you perceive the overall feedback when it comes to the parks and other green infrastructure?

- What are the positives?
- What are the less positive?

6. Nature and Health

Do you believe that it is worth exploring how to introduce a nature and “health perspective” in further development of green infrastructure?

- Why?
- Why not?



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