Can nature really affect our health?

A short review of studies

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Memories from early childhood in the center of Stockholm emerge after being invited to contribute this chapter. Some blocks away from where we lived there was a park that was laid out in 1619. Many of the original trees still graced its double avenues and accompanied me in my first encounter with nature. I used the park all year round and in various ways. The skating and tobogganing in wintertime left particularly vivid memory traces, as did my earliest pictorial memory: on a warm summer day, I sit with my beloved mother on a blanket on the lawn, and she serves blueberries with milk. This haven for resting, playing, strolling, running, aesthetic contemplations, and so forth, definitely contributed to an appreciation of my childhood as being a harmonious time. And I sometimes reflect on how that time in my life would have been without the generous park silently waiting for me day after day during those important formative years.

*Humlegården, the oldest park in Stockholm, the capital of Sweden. The image is from one of its double avenues. [Vi-Skogen and MRM].*

The area alluded to is Humlegården, the largest urban park in downtown Stockholm. It is as well-known, as it is appreciated by many Stockholmers. Hence, it was the perfect setting for an unusual type of advertisement that appeared one morning in a major newspaper. All trees in the park had been sawn off and transported away, but the ground, lamps, walking paths remained, and a statue of
the Swedish botanist Carl von Linné was still standing upright. An immediate sense of un-wellbeing overwhelmed me when I saw this image. Luckily the explanation was that it had been photoshopped: “Imagine that the deforestation would occur in Humlegården” was the bold-type message of the advertisement. The aim was to gather support for a tree-planting project around the Victoria lake in Africa.

Humlegården, the oldest park in Stockholm, the capital of Sweden. This image is from the same viewpoint as the image above, but photoshopped. Part of these images were published in the daily newspaper Svenska Dagbladet on December 16, 2013, with the aim of highlighting the large-scale deforestation of eastern Africa. The text read: “Imagine that the deforestation would occur in Humlegården” and urged the reader to donate money for Vi Agroforestry’s (in Swedish: Vi-Skogen) reforestation campaign. The pictures are part of the Swedish aid organization Vi Agroforestry’s campaign Life without Trees from 2013. They are published with the permission from Vi Agroforestry and the advertising agency MRM. If you live in Sweden and want to plant trees in Vi Agroforestry to fight poverty and climate change, please swish to Vi Agroforestry: 900 50 83 or visit viskogen.se. For information in English, visit viagroforestry.org. [Vi-Skogen and MRM].

One might think that this visual experiment demonstrated the importance of the park’s trees per se for well-being. Alternatively, the effect of the trees was just that they hid stressful settings such as traffic environments and buildings. In my case, the reaction might have been provoked by the juxtaposition of that image upon my childhood memories of a much-appreciated area. It has been through posing such alternative explanatory hypotheses, and testing them, that knowledge about the effects of greenery on health has evolved.

This chapter will, in chronological order, guide you through some of the more important steps towards advancing our understanding of the relation between nature and the two most central dimensions of health, namely, well-being and lack of diseases (WHO 1946). An intriguing question is by which pathways greenery may act. This will be discussed later in the text. One way could be that it
stimulates increased levels of physical activity, an issue that will be illuminated at the end of this short review.

**Isolating effects of greenery**

The idea that there is a connection between nature and health dates back to antiquity (van den Berg et al. 2019, p. 56). The viewpoint that nature has a calming effect has given rise to embedding mental hospitals within greenery, and such practices may have emerged from empirical experiences of physicians. This idea was probably rather widespread, at least from the time of urbanization. In 1915, the Swedish Tourist Association celebrated its 30th anniversary and, in a speech by Chairman Louis Améen, a rhetorical question was posed: “The fresh winds of nature, the peacefulness of nature, and its beauty, are things that are certainly not in the pharmacopoeia. But is there a better medicine offered for our nervous generation?” (Améen 1915).

It is not an easy task to sort out the effects amongst the diversity of environmental factors and their potential individual actions per se, or in combination with one factor or the other. Still, as indicated above, this is necessary in order to move forward in our understanding of the role of greenery.

At the beginning of the 1980s, concordant images from both North American and European research conveyed the message that most green settings, compared to urban environments without green elements, have the following effects (cf. Ulrich 1984):

- sustain interest and attention
- elicit positive emotions
- reduce fear in stressed individuals
- block or reduce stressful thoughts
- foster restoration from anxiety or stress

Of the above effects, those reducing stress are especially important for health, since a lack of recuperation from stress can, in the long run, affect both physical and mental health negatively. An alternative interpretation of these findings could, however, be that they were caused by physical activity in conjunction with nature encounters. This uncertainty led the American researcher Roger Ulrich to conduct two studies aiming at isolating the effect of nature per se.

The first study was based on an analysis of medical records from patients in a Pennsylvania hospital who had undergone standardized gall-bladder surgery (Ulrich 1984). The postoperative treatment is similar in uncomplicated cases, and normally creates a considerable degree of anxiety. Ulrich aimed to study whether the view from the patient’s hospital room affected the patient during the postoperative period. One set of rooms overlooked leafy trees, the view from the other rooms was that of a monotonous brick wall without character. To which room the patient was assigned after the surgery had been a matter of chance and the recovery rooms in which each patient had been placed after the operation were identical in other respects.

Each group consisted of 23 patients, who were matched in pairs in relation to relevant background variables. The results were that those who could see the trees had fewer negative notes recorded by nurses in the medical charts in the seven days after the surgery than those facing the brick wall. Furthermore, the amount and strength of pain-reducing medications were lower for those patients. Also, their postoperative hospitalization period was shorter. Thus, this study provides evidence that greenery can positively affect the recuperation after surgery in several ways.
How could the trees have such an effect? Many studies indicate that greenery has the potential to fascinate us more than man-made synthetic settings, and thus greenery may be the vehicle that distracts us and de-emphasizes problems, such as pain and anxiety. A well-designed psychophysical study from Stockholm University is in this respect of great interest (Ceci & Hassmén 1991). In it, healthy runners regulated their own running speeds with a scale for rating perceived exertion. They either ran horizontally outdoors on a trail in a green setting by a lake or indoors on a treadmill in a room without any windows. On each occasion, they regulated their speeds with three levels of perceived exertion. Despite these levels being identical, the participants ran on average 80 percent faster in the green-blue setting and had much higher levels of heart rate and lactic acid in the blood (both are objective measures of physical strain).

The results were interpreted in this way: stimuli reaching conscious levels depend on competition between internal cues from the body and external cues from the experience of the external environment. The maximal capacity of the consciousness to handle information is limited and, as a consequence, the influx of signals from the body may be filtered away or dampened through competition from an influx of external cues, making us experience physical work as considerably easier when running outdoors in nature (Ceci & Hassmén 1991).

*The type of outdoor setting at the shore of Lake Brunsviken in Stockholm used for the study. Photo: Peter Schantz*
In a later study by Ulrich and co-workers, physiological indicators of stress were used to evaluate how natural settings, compared to urban environments, affect stress recovery (Ulrich et al. 1991). A film showing serious injuries, leading to bloodshed, occurring in an occupational context, was viewed by 120 students. Thereafter they either saw films with (1) natural environments, (2) urban environments with people walking in a pedestrian mall or (3) urban environments with a lot of motorized traffic. The film with the occupational injury led to markedly increased stress levels in all students. Among those who viewed the natural settings afterwards, the stress levels lowered rapidly, while on the other hand, they declined more slowly and to a lesser extent in the individuals watching the two urban settings. The students’ subjective judgments coincided with the objective findings. The researchers interpreted the effect of the natural setting as being due to activation of the parasympathetic nervous system and considered that it was in line with a psycho-evolutionary theory that as humans we are created in consonance with nature, and therefore process that form of visual perception differently than we process visual perceptions of man-made synthetic environments (Ulrich et al. 1991).

Relationships between recoveries from stress, measured by an objective method, in relation to different environmental factors. The objective method measured the conductivity of the skin by electrical current, which is linked to the secretion of sweat glands. The image is based on Ulrich et al. (1991).

Greenery, morbidity and premature mortality

In order to illuminate mechanisms for the development of diseases, study models from epidemiology are often used. They stand for analyses of the distribution (who, when, and where) and determinants of health and disease conditions in defined populations. The first study of that kind, which used objective measures of greenery in the residential neighborhood and self-reported general as well as mental health, was undertaken by de Vries et al. (2003), and noted positive relations.
From 2008 and onward, a number of studies have used objective measures of both greenery and health. This is nowadays possible through geographical information systems that geocode residential addresses and map greenery in the neighborhood based on photos from satellites. The environmental data is then combined with data from socioeconomic and medical databases for statistical analyses of relations. Results from three such studies are presented below.

A pioneering study on 41 million Britons below the age of retirement showed that the differences in health, which are related to socioeconomic status – and reveal themselves as differences in premature mortality – were lower in residential neighborhoods with more greenery. Where greenery was in abundance, the difference in premature mortality for all different causes was 43 percent between those with the greatest socioeconomic differences, whereas the difference was 93 percent in areas with little greenery. The corresponding values for premature death due to circulatory diseases were 55 percent and 120 percent, respectively (Mitchell & Popham 2008). Thus, the health differences related to socioeconomic situation were more than halved with more greenery.

A Dutch study made use of a corresponding innovative study strategy, but with morbidity as the outcome (Maas et al. 2009). It was based on about 345,000 persons and used registrations of new diagnoses by primary care physicians during one year. The results were startling. In 15 of 24 disease clusters, a lower frequency of diagnoses was noted with more greenery in the residential settings. Within these 15 disease clusters, the differences were on average 26 percent between areas with the least and those with the most greenery. In absolute numbers, these differences corresponded to 162 new diagnoses per 1,000 inhabitants per year.

Examples of diseases with a lower frequency of diagnoses with more greenery were coronary heart diseases, diabetes, upper respiratory tract infections, asthma, chronic obstructive lung disease, more severe forms of headaches, depression and angst, as well as various forms of musculoskeletal problems. The authors compared the relations between greenery and health with age and health, and noted that, in general, a one percent decrease in greenery corresponded to the increase by one year in morbidity.
A Danish study analyzed the degree of greenery in various neighborhoods where almost 1 million individuals lived from birth until the age of 10 (Engemann et al. 2019). It showed that a higher incidence of greenery during childhood is associated with a lower risk for psychiatric disorders from adolescence to adulthood. The risk of mental diseases was 55 percent higher for those with the lowest compared to those with the highest amount of greenery. The relations remained after adjustments for socioeconomic variables, age of parents and if they themselves had a history of mental illness, as well as the degree of urbanity (from rural to capital region) in which the children were raised. The relation was stronger the more years that the children had been living in these environments, pointing to the importance of the totality of the childhood period for these effects.

During the eleven years that have passed between these three studies, there have been a number of reports and reviews supporting a relation between greenery and health. However, although disclosure of relations in epidemiological studies is an important step forward along the pathway to gaining knowledge, we still need to search for the causal ways in which nature may act. How can the relations noted be understood? Given the well-controlled study of effects of greenery on stress reduction (e.g. Ulrich et al. 1991), some of the results are not entirely surprising, for example the fact that symptoms of angst and depression were inversely related to residential greenery (Maas et al. 2009). Perhaps nature can act more or less directly in some diseases. In relation to others, the causes can be secondary to the degree of greenery. Potential pathways can in such cases be to: (1) reduce harm, e.g., less air pollution, noise and heat; (2) restore capacities, e.g., physiological stress recovery and attention restoration; and (3) to build capacities, e.g., increase physical activity, facilitate social cohesion, enhance the satisfaction with the residential area and the sense of place (Markevych et al. 2017). Of all these potentially operating pathways, the clearest at this point is the one relating to stress reduction (van den Berg et al. 2019, p. 61). At the same time, a new causal pathway has been suggested recently. It relates to that rumination, which is associated with depression and other
mental illnesses, has been shown to be reduced with nature encounters, and at the same time the neural activity decreases in the corresponding areas in the brain (Bratman et al. 2015).

![Monkey Business Media/shutterstock]

**Does greenery stimulate physical activity?**

As indicated above, a fundamental question in this context is whether greenery may act indirectly by increasing levels of physical activity. There is plenty of evidence that green environments are conducive for physical activity (cf. Schantz 2003; de Vries et al. 2011). At the same time, so many variables differ when we compare an urban setting with a green one. Hence, how can it be possible to state anything about the effect of greenery *per se*? Let me illuminate this complexity with a citation from Erik Hohwü Christensen, professor in exercise physiology and hygiene at the Royal Gymnastic Central Institute (GCI, today GIH) in Stockholm, Sweden. In 1945, he wrote the following under the heading, “The physiology and hygiene of outdoor life” (Hohwü Christensen 1945; translation by Anders Schaarström):

Sunday after Sunday there is a flow of people from the greater cities by train or bus, by bicycle or by foot, away from the built-up areas out to forests, and open land, or to the coasts. During summer, the roads in the countryside are overflowing with walking and cycling groups of children, youth and elderly, striving with a spirited tempo to the goal of the day: a beautiful camping place, a tourist cabin, a weekend cottage or a room at a hotel. During wintertime, the bicycle is changed to skis, and the ski trails are densely located around the cities, as long as there is any snow left. What is it that drives urban residents out into the open air [...]? [...] The question is not easy to answer, but in the following, an attempt will be made to analyse some factors that may be considered to be decisive for this urge away from the cities, while at the same time some of the benefits will be touched upon, such as that a healthy outdoor life undoubtedly brings with it [...] There is such a close relationship between the bodily and mental functions, that bodily well-being usually also causes mental equilibrium. For this reason in itself, outdoor life is a mental health factor of paramount importance. But also in many other respects, it means a psychic stimulus for urbanites. The greatest significance lies perhaps in the environmental change and in the relaxation from daily life, and the work, troubles and concerns that this entails.
In suggesting that “environmental change” might be a driving force for the move out from the cities to the countryside, Erik Hohwü Christensen brought to light the difficulty of assessing the possible effects of the greenery in itself. This is since “environmental change” in this context includes a number of different opposites that may act: noise/silence, exhaust fumes/fresh air, crowdedness/solitude, everyday life/leisure time life, flows of vehicles/vehicle-free zones, synthetic elements/natural elements, etc.

Given that complexity, a way forward could be to illuminate whether perceived greenery in a normal everyday cycle-commuting context stimulates cycling in itself. For that purpose, a study was conducted in which cyclists were asked to rate their own cycling routes in Stockholm’s inner city during September-October, i.e., when nature is green. They were well acquainted with these environments, having made about 250 commuting trips a year. The cyclists also rated a number of other environmental variables, such as flows of motorized vehicles, exhaust fumes and noise, that they were exposed to along their different cycling routes. The intention was to take into account variations in ratings of other different environmental variables. The figure below shows the connection between how much greenery the cyclists perceived along their individual cycling routes and how they considered that these routes, as a whole, inhibited or stimulated their cycling (Wahlgren & Schantz, 2012).

The relationship between commuting cyclists’ perceived levels of greenery along their own routes and appraised levels of whether the route’s environment as a whole inhibits or stimulates this cycling (n=805, mean and 95% confidence interval). The number 8 stands for a neutral position in both variables studied. All estimates apply to the urban part of Stockholm’s inner city. The figure is based on data from Wahlgren & Schantz (2012).
The analyses showed that even when taking into account estimates of a large number of other environmental factors along the routes, including ugliness/beauty, exhaust fumes, noise, flows and velocities of motorized vehicles, the relationship still remained. Similar results were noted when cyclists (n=1056) rated route environments in the Greater Stockholm suburban/rural landscape (Wahlgren & Schantz 2014).

These two studies strengthen the conclusion that greenery seems to stimulate physical activity, and those findings have later been supported in large scale studies in Germany, with a broad representation of sociocultural backgrounds, and using standardized photo collages showing street scenes with different levels of greening (Nawrath et al. 2019).

![Greenery stimulates cycling; here through the Royal National Urban Park on the way to work in the inner city. Photo: Peter Schantz](image)

**Concluding remarks**

The new knowledge about health and greenery is, as stated above, in many ways enigmatic in terms of causal pathways. The findings are, however, so strong that WHO (2016, p. 41) has recently stated that, apart from the value of direct contact with greenery in our housing environments, there is evidence for “a need for small, local green spaces very close to where people live and spend their day, as well as large green spaces, offering formal provisions such as playing fields, and opportunities to experience contact with nature and relative solitude”. Another recommendation from WHO is that each child should have access to green spaces for play and physical activity (WHO 2016).
Returning to my childhood park memories: having the park close to where I grew up provided me with experiences that have influenced my current values. They were, and are still, reasons enough for advocating for green elements of various kinds in our living environments. Be that as it may, I am pleased in this short review to have presented a landscape of various studies leading up to the fact that today we have a new and strong body of complementary types of evidence supporting the value of nature from the perspectives of well-being and health (van den Bosch & Bird, 2018). It illustrates that a new chapter is being written in the history of health sciences.


**References**


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