



## Urban green space and health related quality of life

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## Urban green spaces and health related quality of life

By Ulrika K. Stigsdotter

### Human health and city planning – history repeats itself

It should be mentioned by way of introduction that theories and research evidence discussed here should not be viewed as new discoveries. Instead, they are better understood as rediscoveries or confirmations of a notion that has been considered quite self-evident for thousands of years. Ever since early history, parks, gardens and other green spaces have been elements of the urban green network. Written records of city plans with vast parks have been traced back to 1500BC (van Zuylen, 1994). From antiquity, we even find descriptions of city plans that explicitly mention health.

Vitruvius (born c. 80–70 BC, died after c. 15 BC), was an architect who viewed architecture as an imitation of nature. In his great work on architecture, *De Architecturalibridecem* (Ten books on architecture), he proclaimed that a construction or design must display three specific qualities, often called the 'Vitruvian virtues' or the 'Vitruvian Triad', namely: *Firmitas* (solid), *Utilitas* (useful), *Venustas* (beautiful) (Vitruvius, 1999). The first of the Ten Books deals with many subjects which today come within the scope of contemporary landscape architecture, e.g. the site of a city, the city walls, the directions of streets, and the sites for public buildings. In this book, Vitruvius wrote that with regard to fortified cities the choice of a healthy site for the city is the primary and most important requirement. The work also contains a polygonal city plan in which Vitruvius, in his concern for the health of city dwellers, describes how the streets should be directed so that winds potentially dangerous to health cannot ravage the city. Ancient Rome was also the first rapidly growing large city in history – a place where land was exploited and densified to such an extent that people from all social strata complained about the noise, dirt, and lack of greenery, beauty and relaxation. Their intense demands forced the Roman Empire to lay out several public parks (Mumford, 1966).

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Later in history, during the industrial revolution (1750–1850), changes in, e.g. manufacturing, mining, transportation, and technology had a profound effect on society. The industrial revolution started in the United Kingdom and then later spread throughout Western Europe, North America, and Asia. During industrialization, the problems of increasing urbanization, poor living conditions and deteriorating public health forced the cities to change again. At the beginning of the 19th century, members of the British Parliament demanded that densification be checked, and they stressed the importance of nature in promoting human health: "...to consider the best means of securing open spaces in the immediate vicinity of populous towns, as public walks calculated to promote the health and comfort of the inhabitants." (Richard Slaney, in the House of Commons Parliamentary Debates, 1833, 21st February, col. 1056, in *Urban parks and Open Spaces*, 1983). Attempts were made to create new planning instruments based on analytical foundations. "Surgical" interventions became normative throughout Europe, such as in Vienna and Paris, where cramped old neighborhoods were demolished to make room for grids of verdant boulevards lined with monumental buildings. Underlying these great transformations of cities, however, was also an explicit health perspective (Svedberg, 1988). Laying out new verdant parks, tree-lined avenues, boulevards and promenades would create healthier cities, owing to increased sunlight, fresher air and more greenery.

Social changes and city planning during the past 200 years have entailed both positive and negative effects on human health. Thanks to vaccination as well as improved living standards and living environments – with improved hygiene, housing and access to recreational areas – several communicable diseases have been virtually eradicated. Despite this, there are still threats to public health. In Scandinavia, life spans are increasing, but fewer and fewer years are spent in a state of good health. This increasing rate of ill health costs the governments enormously and, in the long run, poses a threat to public welfare. Besides the economic gains of improved public health, Western city planning includes the notion of social responsibility for the health of the citizenry. The famous Danish Landscape architect, C. Th. Sørensen, wrote in his well-known book *Park Politics in the parish and town* from 1931: "People in the city have a fundamental need for nature – in the context of urbanity, and it is society's job to meet those needs". Still today, the overall goal of public health efforts in the Scandinavian countries is to create the societal conditions for good health on equal terms for the entire population. One Swedish example of this is the government's public health bill entitled *Public Health Objectives* (Govt. Bill 2002/03:35) which was

adopted by the Parliament in 2003. Essentially the bill aims to identify societal factors that promote good health. One of these factors concerns urban greenspaces in the cities. The need for urban green spaces and their connection to human health are articulated thus: "There is a clear relationship between people's use of urban green spaces for general recreation and their access to such spaces in their own neighborhoods. Studies show that people's everyday environments are of great importance to their stress levels and health." (Govt. Bill 2002/03:35, p. 61, translation by K. Williams).

### State of the art– Research and Practice

During recent decades, the increasing amount of research, from several disciplines, confirms the general notion that nature is a resource in relation to human health (Nilsson et al., 2011). Today, research evidence from laboratory experiments and field studies indicates health benefits of either visual or physical contact with nature. The effects are seen at the cellular (e.g. Park et al. 2010), individual (e.g. Hartig, et al. 2010) and population levels (e.g. Stigsdotter, et al. 2010; Mitchell & Popham, 2008). New research proposes that natural environments have positive impacts on human health in three main ways:

1. Indirectly, through encouraging physical activity
2. Indirectly, through encouraging social contact
3. Directly, through providing psychological and physiological restoration

Evidence also suggests that there may be synergies between the three effects, e.g. physical activity in a natural environment having greater psychological and physiological benefits than in a non-natural environment such as a gym (Hug, et al. 2009). Today, one may say that there is already sufficient evidence to support the assertion that natural environments help to keep us healthy (health promotion) and can act as supportive environments for therapies used when we become unwell. Policy makers, land managers and health professionals have realized the potential of these relationships. Many recent policy documents from governments, health service providers and land managers highlight the potential for natural environments to play a role in reducing the burden of poor health and narrowing health inequality. However, the paradox is that today, in the 21st century, everyday life offers few opportunities for both physical activity and psychological and physiological restoration. This is connected, once more, to the fact that people live in an urbanized world. For the first time in history, more than 50% of the world's population lives in urban areas (Habitat, 2001). By 2050, 70% of the

world's population will be living in towns and cities. The city has become our new habitat. This rapid urbanization causes significant changes in our daily living environments, living standards, lifestyles, social behaviour and health. Urban living offers many opportunities, including potential access to improved health care, but today's urban daily living environments may also cause health risks and introduce new health hazards. A consequence of the increasing number of people who are moving into cities and of urban densification is construction on urban green spaces which reduces the natural environments available.

The health problems we face today need new solutions and action from the perspective of landscape and city planning. Generally, people in the industrial world increasingly live their lives separated from nature, spending much of their time indoors being physically inactive. The current rapid increase in obesity, diabetes II, osteoporosis and stress-related illnesses such as heart disease, depression and mental fatigue is thought to be related to these new circumstances of modern urban living (Martinez-Gonzalez, et al., 2001). As a result, the WHO (2006) has identified the lack of accessible urban green spaces for everyday recreation as a problem for people's health and well-being, and they encourage local administrators to increase the provision thereof. However, more effective landscape design, planning, management and access for all in society are needed to maximize the potential benefits and this requires a solid understanding of 'how' natural environments and health and wellbeing are, and could be, connected. In line with this idea, the Vice Director of Forest & Landscape Denmark, Dr. Kjell Nilsson, initiated and chaired the COST Action E39 'Forest, Trees and Human Health and Wellbeing'. The main objective was to increase the knowledge about the contribution that forests, trees and natural places make, and might make, to the health and wellbeing of people in Europe. The final outcome of the COST Action is the first comprehensive European textbook on the topic 'Nature and Human Health' (Nilsson, et al., 2011). The book draws together work carried out over four years by more than 100 scientists from 25 countries working in the fields of forestry, health, environment and social sciences, and captures the state of the art in terms of scientific understanding. The book pronounces the economic and clinical significance of poor health in Europe, and highlights the potential of Europe's natural environment if we can learn how, and for whom, access brings health benefits. The book presents a clear viewpoint: natural environments can play an important role in health promotion, prevention and the cure of significant health problems, which may result in Europe's natural environments increasing in value, particularly those which are accessible to populations living in urban areas.

It also follows that if these environments (or access to them) are threatened or altered by exploitation, poor city planning, poor landscape design or bad management, their *salutogenic* (health creating) potential may be seriously harmed.

The relationship between distance to and use of green space, physical activity and health-related quality of life

The sensory perceived dimensions of urban green spaces

The healing forest garden for stressed individuals

### 1.<sup>1</sup> Relationship between distance to and use of green space, physical activity and health-related quality of life

The Danish National Institute of Public Health, University of Southern Denmark, has carried out nationally representative health interview surveys since 1987. The purpose of these surveys has been to describe the status of and trends in health and morbidity among the Danish adult population as well as the factors that influence health status, including health behavior and habits, lifestyles, environmental and occupational health risks and health resources. The data used in this study were derived from the 2005 health interview survey and based on a region-stratified random sample of 21,832 adult Danes. Data were collected by means of face-to-face interviews in the respondents' homes. Following the interviews, the respondents were asked to complete a self-administered questionnaire. In all, 14,566 respondents (66.7% of the sample population) completed a personal interview and 11,238 respondents (77.1% of those who completed the face-to-face interview) returned the self-administered questionnaire. The difference with the 2005 version of the survey was that in collaboration with Forest & Landscape, University of Copenhagen, three additional questions regarding use of green spaces were included in the self-administered questionnaire:

The respondents were asked about the distance from their home to the nearest green space.

The possible answer categories were: <300 metres; 300 metres – 1 kilometre; 1 – 5 kilometres; >5 kilometres.

<sup>1</sup> This section consists of figures and text fragments from the following papers : Toftager, M., Ekholm, O., Schipperijn, J., Stigsdotter, UK., Bentsen, P., Grønbaek, M., Randrup, TB., Kamper-Jørgensen, F. 2011. Distance to green space and physical activity: a Danish national representative survey. *Journal of Physical Activity & Health*, issue 8, pp. 741-749.

Stigsdotter, UK., Ekholm, O., Schipperijn, J., Toftager, M., Kamper-Jørgensen, F., Randrup, TB. 2010. Health promoting outdoor environments – Associations between green space, and health, health-related quality of life and stress based on a Danish national representative survey. *Scandinavian Journal of Public Health*, volume 38, issue 4, pp. 411-417.

The respondents were asked about the distance from their home to each of the following types of green space: Beach, sea, lake; Park, green space; Forest; Other open natural area.

The respondents were also asked about the frequency of use of the different green spaces: Daily; Several times per week; Weekly; Monthly; Seldom or never.

Because the rapid increase in obesity, diabetes II, osteoporosis and stress related illnesses such as heart disease, depression, and mental fatigue is considered to be related to the new circumstances of modern urban living, the study investigated those questions from two different perspectives:

A. Physical activity and obesity – What is the relation between distance to green spaces and :

- Physical activity in green spaces
- Moderate/heavy physical activity in leisure time
- Obesity (BMI>30)

B. Health, health related quality of life and stress:

- Is there an association between health-related quality of life as measured by SF-36 and the distance from individuals' homes to the nearest green space?
- Is there an association between distance from the individuals' homes to green spaces and stress?
- Do the reasons for visiting green spaces differ depending on whether individuals suffer from stress or not?

### Results A

Distance to green spaces is negatively related to physical activity in green spaces (Figure 1). Respondents who live more than one kilometer from a green space were less likely to be physically active in green spaces compared with individuals who live closer than 300 meters to green spaces.

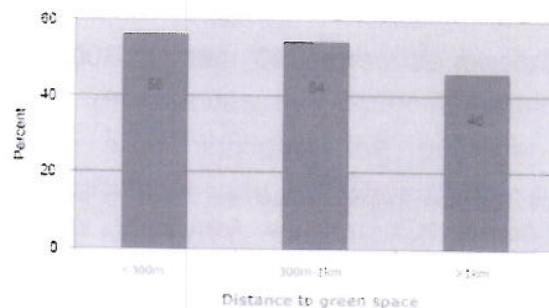


Figure 1. Distance to green space and physical activity in green space.

'Heavy exercise and competitive sports regularly and several times a week' and 'exercise or heavy gardening at least 4 hours a week' were combined to create an overall measure of moderate/vigorous activity in leisure time. Respondents who live between 300 meters–1 kilometer from the nearest green space were less likely to be moderately/vigorously physically active in leisure time compared to those who live less than 300 meters away from a green space (figure 2).

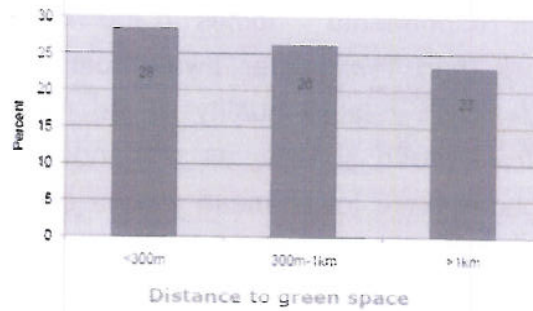


Figure 2. Distance to green space and moderate/vigorous activity.

Self-reported height and weight in the face-to-face interview were used to calculate Body Mass Index (BMI) (weight in kg/height in m<sup>2</sup>). A BMI index of 25 or more is the threshold for being overweight and 30 is the threshold for being obese.

Individuals who live more than one kilometer from the nearest green space were more likely to be obese (BMI ≥ 30) than those who live less than 300 meters from a green space (figure 3) (adjusted for gender, age, education, accommodation, size of municipality, and long-standing disease).

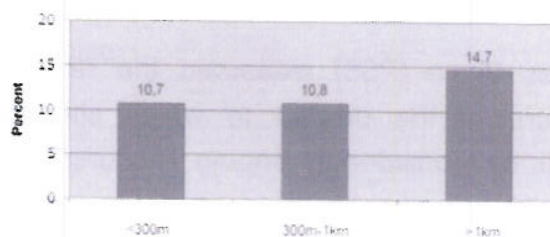


Figure 3. Distance to green space and BMI.



## Result B

The SF-36 is a 36-item instrument that measures eight dimensions of health (bodily pain; general health; mental health; physical functioning; role limitations due to emotional problems; role limitations due to physical health; social functioning; and vitality) and it was included in the self-administered questionnaire. Higher scores on the SF-36 (range 0-100) indicate better health and health-related quality of life. The gender and age-adjusted mean scores for the eight SF-36 subscales (the different dimensions of health) are shown as a function of distance from respondents' homes to the nearest green space (figure 4). Danes who live more than 1 kilometer away from the nearest green space have poorer health and health-related quality of life than respondents who live closer than 1 kilometer from green spaces, as respondents who live more than 1 kilometer from green spaces have lower mean scores on all eight subscales than respondents who live closer.

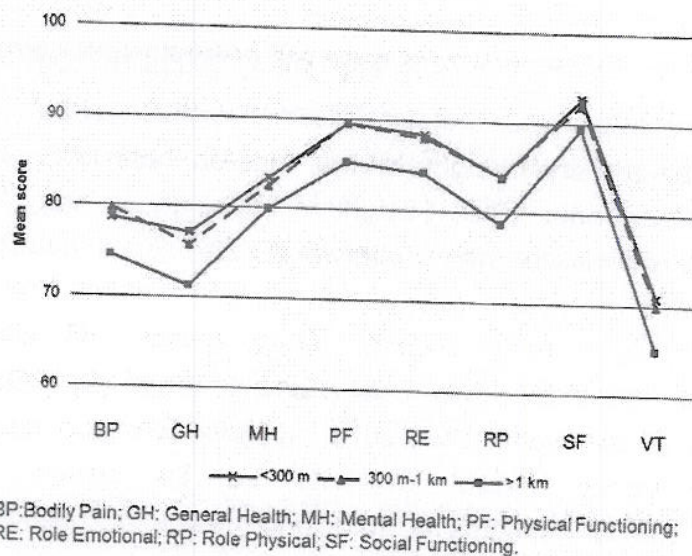


Figure 4. Gender and age-adjusted SF-36 mean scores by distance to nearest green space and each health measure.

The Perceived Stress Scale (PSS) measured the respondents' self-estimated stress. It is a measure of the degree to which situations in one's life are appraised as stressful by considering coping recourses and feelings of control. The scale consists of 10 items, each rated on a five-point Likert scale. The PSS scores range from 0 to 40, where higher scores show more perceived stress.

The overall mean PSS score was 11.0 (figure 5). The mean score is somewhat higher for women than for men (11.7 vs. 10.2;  $p < 0.05$ ). The more often the respondents visit green spaces, the less stress they report. Furthermore, we see

that the longer the distance is from respondents' homes to the nearest green space, the more stress they report. The association between stress and distance to green spaces remains even after adjusting for potential confounders.

	Mean (SD)	n
Total	11.0 (5.93)	10,250
Gender*		
Men	10.2 (5.68)	4802
Women	11.7 (6.05)	5448
Age*		
16-24y	12.0 (6.11)	886
25-44y	11.1 (5.93)	3520
45-64y	10.8 (5.81)	4058
65+y	10.9 (6.06)	1786
Combined school and vocational education*		
<10y	12.7 (6.20)	1218
10-12y	11.5 (6.03)	2756
≥13y	10.5 (5.74)	5999
Distance to green space or natural areas*		
<300m	10.8 (5.84)	6931
300m-1km	11.1 (6.00)	2630
>1km	12.3 (6.26)	602
Frequency of visits to green spaces or natural areas*		
Daily	10.5 (5.70)	4446
Several times a week	10.7 (5.84)	3023
Weekly	11.7 (6.02)	1850
Monthly/seldom or never	12.8 (6.65)	810

n = number of respondents.

\*p < 0.05.

Figure 5. Mean scores (standard deviations) of the Perceived Stress Scale.

An analysis of the association between stress and visits to green spaces showed that respondents who do not report stress are 1.57 more likely to visit a green space at least a few days a week than those reporting stress. As can be seen in Figure 6, the reasons for visiting green spaces differ significantly depending on whether the respondents are stressed or not. A higher percentage of stressed respondents than not stressed reported that the most important reasons for visiting green spaces were to 'reduce stress/relax' and to 'obtain peace and quiet without noise'

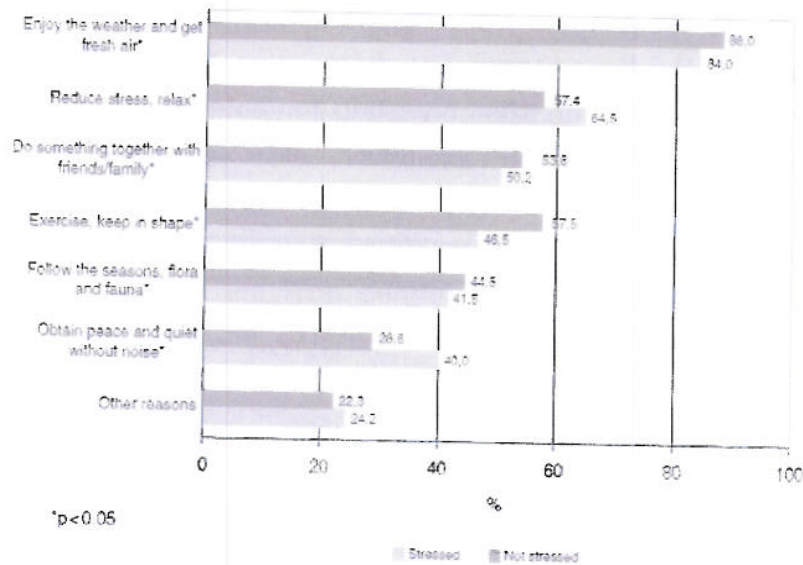


Figure 6. Gender- and age-adjusted prevalence of reasons for visiting green space according to stress status.

## 2.<sup>2</sup> The sensory perceived dimensions of urban green spaces

Everything that is green is not good for human health *per se*. This second research project aimed at providing research that can be used as the basis for inspiration and argumentation to influence the work of local administrators and city planners so that their planning and design of recreational urban green spaces responds to the preferences and demands of stressed individuals. The overarching hypothesis was that people perceive green spaces in terms of certain dimensions, where some dimensions are more important and preferred than others with respect to restoring people from stress. The aims were to: identify and describe the perceived dimensions in nature; identify which dimensions people in general prefer; identify the dimensions people who report stress prefer; and identify a combination of the dimensions people who report stress prefer.

A total of 953 randomly selected informants from nine Swedish cities

<sup>2</sup> This section refers to and consists of fragments and figures from the following documents : Grahn, P. & Stigsdotter, UK, 2010. The relation between perceived sensory dimensions of urban green space and stress restoration, *Landscape and Urban Planning*, volume 94, issues 3-4, pp. 264-275.

Stigsdotter, UK, & Grahn, P. 2011. Stressed individuals' preferences for activities and environmental characteristics in green spaces, *Urban Forestry & Urban greening*, volume 10, issue 4, pp. 295-304.

Randrup, BT., Schipperijn, J. Ipsen Hansen, B. Søndergaard Jensen, F. & Stigsdotter, UK, 2008. *Natur og sundhed. Sammenhæng mellem grønne områders udtryk og brug set i forhold til befolkningens sundhed.* (Nature and Health) Park- og Landskabsserien, 40/2008. (in Danish)

(representative of the Swedish population) answered a postal questionnaire with pre-coded questions. The questionnaire consisted of three parts: personal data, preferences for natural qualities and self-estimations of health status. Using SAS factor analysis, the association between preferences for the different qualities perceived in urban green spaces were examined. The results identified and described eight perceived sensory dimensions (figure 7). People in general prefer the dimension Serene, followed by Space, Nature, Rich in Species, Refuge, Culture, Prospect and Social. The dimensions Refuge and Nature are most strongly correlated with stress, indicating a need to find the most restorative environments. A combination of Refuge, Nature and Rich in Species, and a low or no presence of Social, could be interpreted as the most restorative environment for stressed individuals.

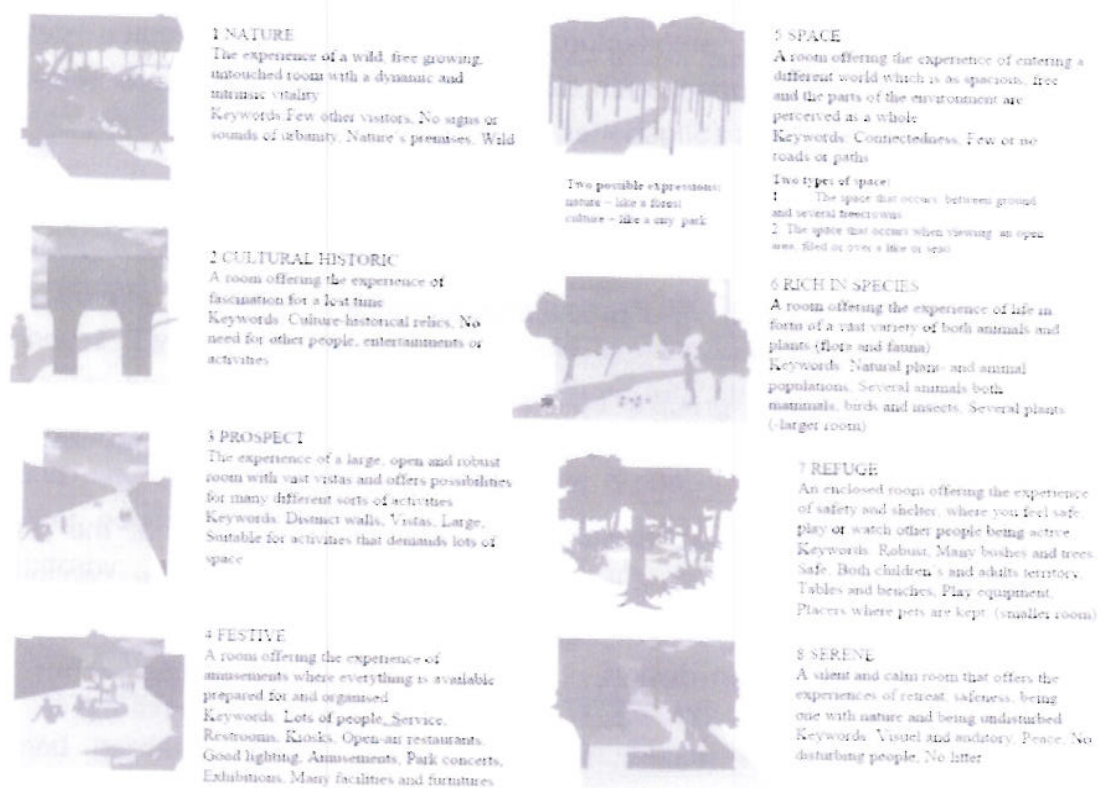


Figure 7. The eight Perceived Sensory Dimensions of green spaces.

Further, the results identified seventeen different outdoor activity types. The most preferred activity type among the most stressed informants was 'rest activities' followed by 'animal activities' and 'walking activities'. All pairs of these three activity types and PSDs which showed a significant association were transformed into 'activity-sensory dimension types'. A regression analysis

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showed that the most preferred activity–sensorydimension types for informants who reported a high Level of Stress were ‘animal activities’ (feeding or petting small animals) in the PSD ‘rich in species’ , ‘animal activities’ in the PSD ‘refuge’ , and ‘rest activities’ in the PSD ‘nature’ .

### 3.<sup>3</sup> The healing forest garden for stressed individuals

The demand for different types of natural environments that promote health and treatment is increasing globally. However, all natural environments are not good for health and examples of natural environments that have had negative health effects exist (Ulrich, 1999). Therefore, evidence–based landscape architecture emerged into a branch called ‘health design’. An example of this is the healing forest garden Nacadia which is designed after ten superior evidence–based health design criteria (E–BHD) (Stigsdotter, in press). E–BHD is a rather new process within landscape architecture, and no generally accepted definition exists. The University of Copenhagen has identified a transparent E–BHD process, which has three main parts (Stigsdotter, in press):

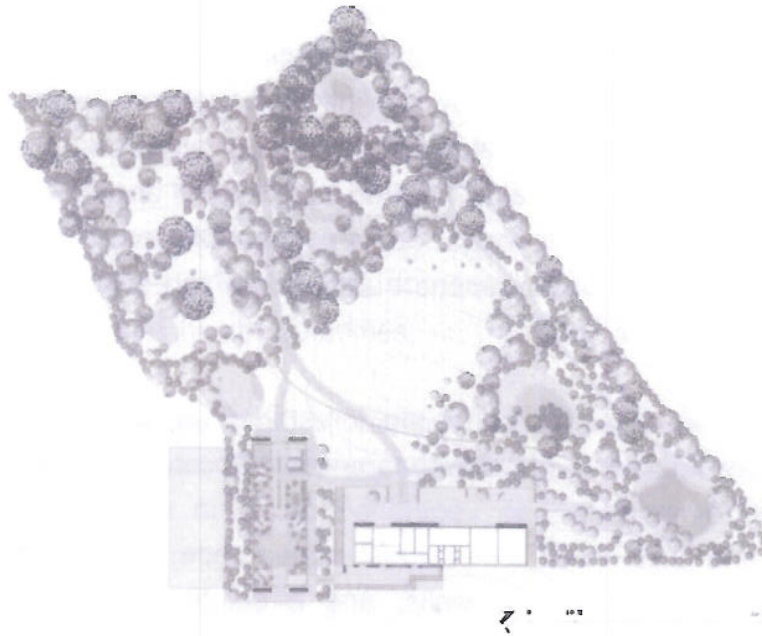
1. Aesthetic and practical landscape architectural skills and experiences.
2. Research Evidence and valid practical experience.
3. The specific patient group's special needs, wishes and preferences, the planned treatment program and the patient's expected rehabilitation process.

One important aspect in this explanatory model of E–BHD is that the process does not stop when the design is laid out. The garden must be continuously evaluated so that the new documented experiences and research results can be incorporated into the garden design.

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3 This section refers to and consist of fragments and figures from the following documents : Corazon, S.S., Stigsdotter, UK.,Claudi, A.G., Kjell Nilsson. 2010.Development of a Nature–Based Therapy Concept for Stress Patients at the Danish Healing Forest Garden Nacadia. *Journal of Therapeutic Horticulture*, volume 20, pp. 34–51’

Stigsdotter, UK. In press. Terapiträdgårdar – Evidens baserad hälsodesign (Therapy gardens – Evidence–based Health Design). *Socialmedicinsk tidsskrift (SMT)*. Pp. 44–54. (in Swedish with English abstract).



*Figure 8. The Healing Forest Garden Nacardia.*

The healing forest garden Nacardia is the first therapy garden that is connected to research and education at a Danish University. It is located in the Hoersholm arboretum which is Denmark's largest collection of trees and shrubs. The garden covers 1,1 hectares and two buildings, a gardener's cottage and a large greenhouse. Overall the garden can be said to have four main objectives :

1. Provide nature-based treatment for patients with stress-related illnesses.
2. Obtain evidence-based knowledge about the effect of healing garden design and nature-based therapy for this client group.
3. Offer education within the field of healing garden design and nature-based therapy.
4. Serve as a knowledge and demonstration center

The University of Copenhagen defines a therapy garden as a deliberately designed garden, with the intention of contributing actively and positively to treatment and the patient's well-being (Stigsdotter, in press). This means that the therapy garden must both support and challenge/stimulate the patient during the treatment process. The therapy garden must also provide the framework for meaningful and practical activities, such as fruit picking or chopping wood, but also offer activities on a symbolic level, so that conversation with the horticultural therapist can be based in nature. The therapy garden is a prerequisite for Nature-Based Therapy. Nature-Based Therapy is defined by the University of Copenhagen as a generic term for a heterogeneous field of therapeutic practices,

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which take place in natural environments and which use activities and experiences from the environment as therapeutic means (Corazon, et al. 2010). Both the garden design and therapy are intimately related. In the therapy garden, two trained horticultural therapists perform the treatment. Nature-Based Therapy consists of a ten week program and the clients meet the horticultural therapists three days a week, for three hours. The treatment started in September this year and will be part of two larger research projects which will follow the clients and the garden over several years.

Nacadia is characterized as a healing forest garden, which could be described as a garden with a natural forest appearance. A forest garden is often described as being three dimensional, as vegetation grows in several layers (Hart, 2001). These layers and their three dimensional appearance are intended to create the feeling of a room with a floor, walls, and a ceiling made up of living natural materials that are thought to enhance the feeling of being totally submerged in nature, thereby supporting the healing process. The layers also provide diverse harvest opportunities, which change during the season. Once the forest garden is established as a functional ecosystem, it requires very little maintenance.

#### Concluding words

The ancient belief that city nature can be a positive resource in relation to citizens' health and their health related quality of life is confirmed by modern research; green spaces in cities can promote human health and therapy gardens can support healing processes and general well-being.

However, we need to improve the understanding of how to design, manage and promote these green spaces. Thorough descriptions of what these environments can achieve are also necessary. It is recommended that the future planning of health promoting urban green spaces and therapy gardens has its foundation in an evidence-based health design/planning (E-BHD) process, which calls for practitioners (landscape architects/ city planners) to make practical decisions based on an integration of the best available research evidence and proven experience with their practical expertise and their knowledge of clients' attributes (such as variation in perception, preferences, circumstances, values, needs and health status). It is fundamental that the planner or designer is aware that a mentally weak, stressed or ill person understands and interprets the surroundings in different ways than an individual who is not ill. Therapy gardens for different patient groups need different designs. Examples of green environments

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that have had negative health effects exist, caused by poor understanding of the user group' s perception and health situation

Finally, urban green spaces must not be viewed in isolation, but instead they need to be understood as interrelated parts of a larger green urban network. The distance from individuals' homes to green spaces is important, but also that different sizes and shapes of urban green spaces can offer users different uses, activities, experiences and health outcomes.

**Notification :** This text consists of parts and figures from earlier published material and is therefore not allowed to be published or interpreted as original research.



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