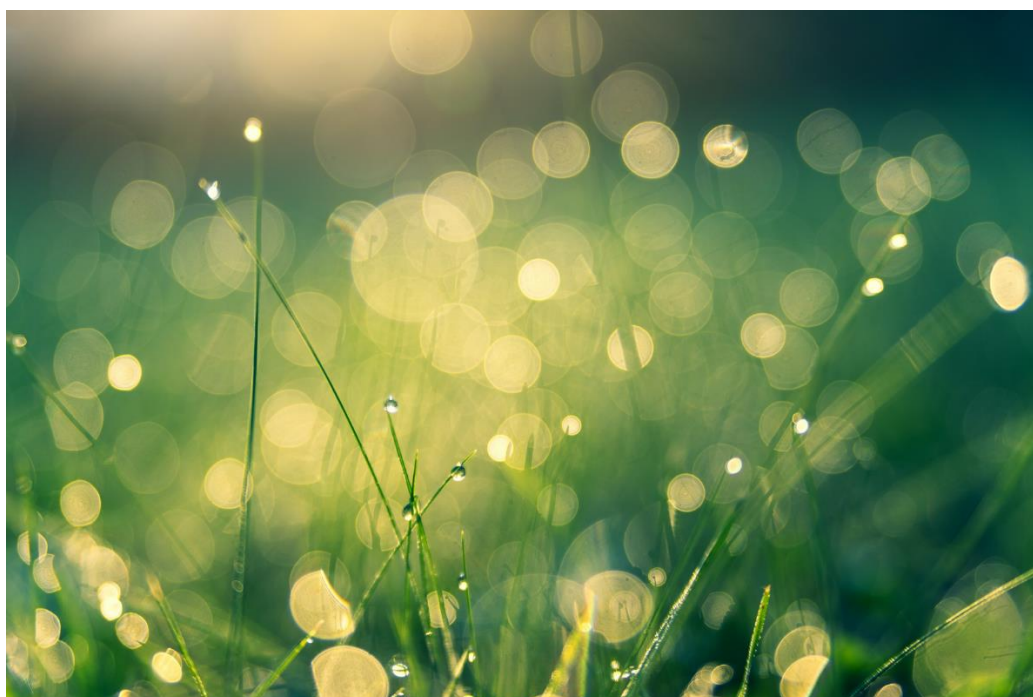


URBACT Health&Greenspace network

Health-responsive planning and management of urban green infrastructure

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Impacts of Green Spaces on Physical and Mental Health



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“Green space in cities shouldn’t be considered an optional luxury. It is a crucial part of a healthy human habitat.”

Charles Montgomery¹

General context

In 2017, WHO presented eight classes of green spaces: roadside greenery and other vegetation barriers that could be found along streets or rail tracks; small urban green spaces (such as gardens or pocket parks) and playgrounds; green roofs and facades; parks and urban meadows; greenways and corridors (such as green trails for walking/cycling); green with blue spaces (that could be found in coastal, riverside or lakeside trails); recreational and urban gardening facilities (such as community gardens, sport and play areas and school grounds); and finally the facilitated access to urban woodlands, forests and natural wildlife areas.²

A set of dimensions could characterise green spaces; their location, distance to users, size, quality and security, all aspects that could be aggregated in an “availability and accessibility” dimension. Besides, there are also aspects related with landscape quality and the user’s perception, designated as “aesthetic” dimension, that include aspects like the type of services provided by green spaces and the possibilities of management of these spaces.

Health effects of urban built environment

Urban environment directly affects the health and quality of life of the urban population. According to the estimates of the World Health Organization (WHO) 63% of global mortality, about 36 million deaths per year, is due to chronic diseases. A large proportion of these deaths are associated with risks related to the urban built environment, such as physical inactivity and obesity, cardiovascular and respiratory diseases due to transport-generated urban air pollution, and heat-related strokes and illnesses.³ Globally, household and outdoor air pollution is responsible for 7 million premature

deaths each year, out of which outdoor air pollution is causing 2.8 million deaths attributed to chronic diseases⁴. The urban heat island effect aggravates heat stress during heat waves that can lead to fatal heat stroke. As the effects of climate-change accelerate, and related heat waves become more frequent, the heat island effect will become even more pronounced. Physical inactivity, that is likely to be more common among urban populations (due to poor walkability and lack of access to recreational areas) is responsible globally for 3.2 million deaths annually⁵.

Health impacts of urban green spaces

Academic literature, the World Health Organization (WHO) and other institutional sources highlighted the importance of green spaces to improve health and well-being. WHO presented a causal model of the impacts of urban green spaces on health and well-being (*Figure 1*)⁶. Through improved air and water quality, reducing noise levels and contributing to temperature regulation, urban green spaces can effectively reduce environmental

health risks associated with urban living. In addition, they deliver health and well-being by enabling stress reduction and relaxation, physical activity, improved social interaction and community cohesion. Access to natural environments can improve overall mental health, physical fitness level, cognitive and immune function, and can lower mortality rates in general.



Figure 1. A causal model of the impacts of urban green spaces on health and well-being

Source: developed from A. Roué-Le Gall in Milvoy & Roué-Le Gall (2015), in WHO (2017). Urban green spaces: a brief for action, Copenhagen: WHO - Regional Office for Europe, p.8

Impacts on physical health

There is evidence that the provision of open and green spaces is associated with improved general physical health outcomes. According to the European Environment Agency every 10% increase in green space is associated with a reduction in diseases equivalent to an increase of five years of life expectancy⁷.

A systematic review of five online databases and over 100 studies undertaken by the University of East Anglia found that people who spend more time in green spaces have significantly reduced risks for a number of chronic illnesses. According to the research, exposure to green spaces was linked to lower heart rate, lower blood pressure, lower

cholesterol, and reduced incidence of stroke, asthma, diabetes and coronary heart disease.⁸

Some studies^{9,10} have indicated that there is a positive correlation between higher levels of green space and lower levels of obesity.

Evidence from a systematic review of studies shows that living in areas with higher residential greenness reduces the risk of cardiovascular mortality¹¹. In Florida, higher level of exposure to green space has been associated with a reduced risk of stroke mortality¹².

A study undertaken in Australia¹³ was highlighting the relevant role of the diversity of landscape features, such as trees and open spaces in improving physical health outcomes. The study has indicated that a greater variability of neighbourhood greenness was associated with reduced risk of cardiovascular disease and stroke. The likelihood of hospitalization and of self-reported heart disease or stroke was lower among people who lived in urban areas with highly variable greenness. It is suggested that heterogeneity in the distribution of greenness might contribute to better

health outcomes through promoting physical activity.

Direct exposure to green space improves the functioning of the immune system¹⁴. According to a Finnish study¹⁵, the immune systems of children can strengthen in a short time if their day-care centre yards are made more natural using forest undergrowth and grass. The findings suggest that exposure to natural environment can change the microbiome of children that result in better functioning of their immune systems.

Residential access to green space was also found to be linked to improved pregnancy outcomes¹⁶.

In the 1980s, the study of Roger Ulrich showed that merely having a view of nature can provide physical benefits. Patients with a view of trees from their hospital bed recovered more quickly, required less pain medication, and had fewer post-surgical complications than patients in rooms with urban views.¹⁷

Impacts on mental health

Access to natural environments can also improve overall mental health. There is an indication that experiencing the natural environment reduces stress levels.¹⁸ The impact of green spaces to mental health also include improved general mood, reduced depressive symptoms, enhanced cognitive functioning, improved mindfulness, short-term memory performance and enhanced creativity.^{19, 20, 21}

At individual level, the lack of contact with natural spaces is linked to an increase in the incidence of mental illnesses²². Based on a growing body of evidence suggesting that living without nature is unhealthy, Richard Louv has coined the term 'nature deficit disorder'²³.

There are several theories that attempt to explain the beneficial effects of nature exposure:

- **Ulrich's Stress Reduction Theory (SRT)** proposes that contact with unthreatening natural environments or viewing natural elements, having a restorative effect can

be effective in reducing stress creating positive emotions and feelings²⁴.

- **Kaplan's Attention Restoration Theory (ART)** suggests that continued attention and fatigue can degrade our ability to solve problems and cause various negative emotions, and that mental fatigue and concentration can be improved by time spent in, or looking at nature, showing that natural environment can resolve health problems of modern people's daily lives caused by stress and fatigue. Nature exposure allows individuals to be away from daily stressors, as natural environment attracts their attention through 'soft fascination' providing the opportunity for recovery from mental fatigue.²⁵
- **Wilson's biophilia hypothesis** claims that, as a consequence of evolution, humans have an innate tendency to interact positively with nature. When individuals engage in a non-threatening natural environment, the setting will naturally

draw out strong positive responses, observed as research evidence of benefits from nature exposure. When individuals are exposed to natural environment, the setting will naturally trigger their strong positive responses.²⁶

The biophilia concept is closely linked with the 'biophilic cities movement' Biophilic cities are cities that integrate natural features into their designs, providing close and daily contact with nature. A biophilic city is a biodiverse city, allowing people to integrate their daily lives with nature across different scales.²⁷

Factors that could influence the level of impact on health

The identification of factors that influence the relation between green spaces and health is fundamental to the planning process.

The first factor that influences the level of impact of green spaces on health is related to the scale of the intervention (Figure 2):

- individual or body scale (10-100 meters around individuals);

- neighbourhood scale (formal administrative areas, with a radial distance of 500 meters); and
- city or district scale (that corresponds to larger administrative areas, eventually resulting from the inclusion of multiple neighbourhood units).

planning of green spaces need to be adapted to the scale of the intervention.²⁸

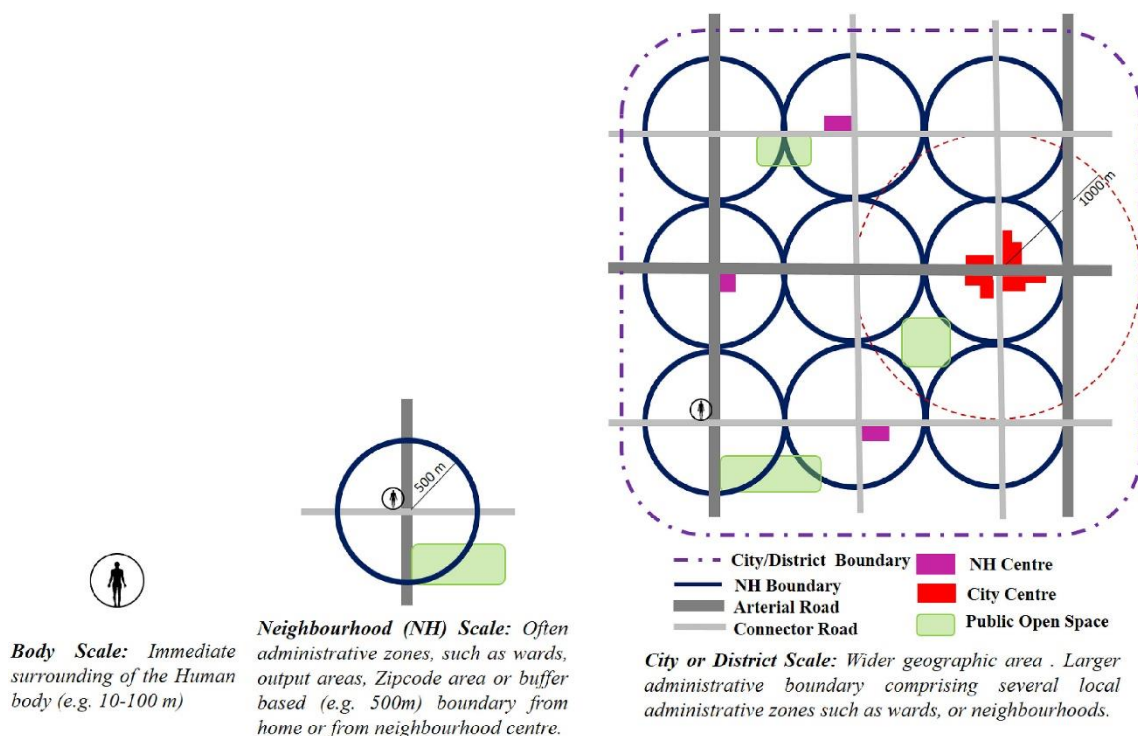


Figure 2. Conceptualising spatial scales used in urban greenspace and health research

Source: Labib, Lindley, Huck, 2020 (City scale diagram is adopted and modified from the Western Australian Planning Commission, 2015)

The second factor is related to the quality of the spaces and to their proximity to users. Proximity encourages physical activity²⁹. A Turkish study indicated that 20,7% of the users lived under a 100 meters distance to the nearest green space and 30,7% were between a 100 to 250 meters distance. Proximity improved the frequency of physical activity by the population. A study undertaken in Lisbon Metropolitan Area in Portugal with similar results, found that if the distance to the nearest green space was under 400 meters, the frequency of physical activity increased³⁰.

The third factor is complementary to the previous one: it is linked to the geographical location of the green space. The impacts of green spaces are different in central areas, suburbs or peri-urban areas of the cities and metropolises.

The fourth factor is linked to population characteristics, such as age, gender, level of disability, level of education and other socio-

economic conditions (like employment and income). Active population and children are more frequent users of green spaces than older people.

The fifth factor that determines varying level of use of green spaces is related to the mobility of population and the relation between working and non-working time of individuals. The time spent with commuting is relevant, especially in case of suburban and peri-urban residential areas. In a study undertaken in a suburban area of Lisbon Metropolitan Area³¹, only 38% of residents were found to perform physical activity. Reasons for lower level of physical activity were linked to time required for travel and the socio-economic characteristics of the families. The time spent with daily work-related activities determined a short time available for leisure activities and resulted in less aptitude to use green spaces for physical activity.

Approaches and practices to improve health outcomes linked to green space use

Urban green spaces can have a significant role in supporting or complementing various **medical treatment programs**. Examples for using urban green infrastructure for therapeutic purposes include nature-based rehabilitation for people with stress-related illnesses or mild depression; nature-based addiction treatment, designed to help patients cope with drug and alcohol addiction; or postsurgical medical treatment, such as outdoor activities in green spaces as part of rehabilitation services for cardiac patients. A pilot study undertaken in Scotland has found that using a woodland-based cardiac rehabilitation programme that is combined with regular cardiac rehabilitation activity, can boost recovery³². To complement conventional therapies a health professional can prescribe activities in green spaces to patients (see *Box 1*)

Long-term exposure to green areas through reducing stress, increasing physical activity, and stimulating social cohesion can support

preventative care, contributing to the prevention of many chronic disorders, such as cardiovascular diseases, and asthma.³³ Various prevention measures for cardiovascular diseases can be easily linked to green space use. These include regular outdoor exercise, or stress management techniques applied in natural environment, such as stress-releasing walks or mindfulness practices.

Above all, the use of urban green spaces can contribute to **health promotion**. As defined by the Ottawa Charter signed in 1986 at the First International Conference on Health Promotion organized by the World Health Organization, health promotion is „the process of enabling people to increase control over, and to improve, their health“. It is not only the responsibility of the health care sector, but it goes beyond healthy life-styles to overall well-being.³⁴ It is also more than disease prevention that calls for action in advance, in order to make it improbable that the disease will progress subsequently.³⁵

Box 1 - Green prescriptions

A green prescription is an emerging nature-based health intervention, that is designed to improve physical and mental health and wellbeing of patients through exposure to natural environments.³⁶ It is a written advice of a health professional to a patient to be physically active.³⁷ Under the scheme the doctor can recommend the patient to go for regular jogs or walks in the park, or to participate in some other nature-based activity. Green prescriptions are typically complementing conventional therapies, and can be regarded as one part of a holistic health-promotion strategy.³⁸ It is a smart and cost-effective option to promote health creation.³⁹

Potential examples of green prescription activities include: participation in regular group walks; gardening as part of a horticultural therapy; undertaking of biodiversity conservation activities, such as habitat creation and restoration; green exercise (e.g. nature walks, biking, climbing); or wilderness arts and crafts.⁴⁰

The 'green prescription' term was first introduced in New Zealand in 1998.⁴¹ In the original initiative the general practitioner provides patients with plans for strategic physical activities and healthy diet. The term has since been broadened to include nature-based activities aimed at addressing chronic diseases, mental health issues and social isolation.⁴²

Green prescriptions are mostly used to support prevention and the complementary treatment of chronic diseases such as cardiovascular disease and diabetes.⁴³ Such schemes were shown to result in increased levels of physical activity, quality of life, a decrease of blood pressure and a change in coronary risk.⁴⁴

In the UK green prescriptions is a rapidly spreading practice. Liverpool City Council and Liverpool Clinical Commissioning has launched referral schemes that encourage activities in parks to tackle obesity and diabetes. In Devon and Somerset a three-year scheme is under way where general practitioners are encouraging patients to visit the national parks as part of their treatment. Walks, conservation work, gardening and sailing are promoted by an initiative in Dorset.⁴⁵

As a response to the COVID-19 pandemic the UK government has announced in July 2020 a £4 million investment in a two-year pilot to bring green prescribing to four urban and rural areas that have been hit the hardest by coronavirus.⁴⁶ Green prescribing became an important lever of the recently adopted Tackling Obesity strategy of the UK government.

A similar concept, '**health creation**' has also been embraced recently. The concept is about changing the focus to the role of people and communities that create health instead of just mitigating illness. In his book, Lord Crisp explores the importance of creating health in the home, the workplace, the school, the community and wider society⁴⁷, or in other words, the role of employers, teachers, community leaders, architects, and families in helping to build a healthy and health-creating society. Health creation represents a power shift from health care practitioners to people and communities.⁴⁸ It can be actively promoted by

Health-responsive planning of urban green spaces

When designing greens spaces with an overall aim to bring about health benefits, a number of factors or aspects need to be considered.

In line with the biophilia hypothesis introduced by Wilson humans have an innate tendency to seek

supporting various engaging activities, and the provision of communal spaces.⁴⁹

In line with the Ottawa Charter health promotion relies on creating supportive environments⁵⁰. Urban green spaces can function as such supporting environments. Parks and urban forests, apart from functioning as spaces enabling therapies and prevention, also have a particularly high potential for contributing to health promotion and health creation through making possible the contact with nature, social connections, and exercise.

connections with nature and other forms of life⁵¹. At the same time people are attracted to built environments (urbanophilia) because civilization offers protection from the dangers of nature⁵². People prefer the combination of natural and built environments, although in terms of relaxation

potential the more greenery versus hard surfaces, the better.

A study of Hunter, Cleary and Cleland⁵³ provides a number of recommendations for designing urban green space interventions that can potentially deliver health benefits:

- urban green space interventions should be a combination of a physical change to the green space and promotion programmes that aims at increasing park use,
- small-scale physical interventions, such as urban greenways/trails and pocket parks can be effective in bringing about health and well-being benefits,
- when designing green spaces, components that specifically focus on long-term health, social and environmental effects, as well as long-term management and maintenance need to be considered,
- the local community should be engaged in the design process to ensure that their needs are met by the intervention and to mobilise local knowledge into local solutions,
- the type and the context of green space should be considered when designing urban green space interventions.

A number of recommendations for designing green spaces into new health-promoting environments is included in a report of the United States Environmental Protection Agency (US EPA)⁵⁴:

- green spaces need to be accessible with good links (pedestrian and cycleways) to nearby neighbourhoods
- greens spaces should be designed with multifunctional uses; they should include spaces that encourage active mobility, physical activity and sports, relaxation and tranquillity, and opportunities for social interactions;
- the development of green spaces should be framed as a public health investment;
- when designing green space interventions, the needs of different age, social and cultural groups need to be considered;
- the creation of multisensory restorative environments can help mitigate the psychological stresses.

Wang and Tassinary found in their study that the shape or form of green space has an impact on human health. The study revealed that irregularly

shaped parks reduce the mortality risk of residents who live near them.⁵⁵

Different subgroups (different age, social and cultural groups) use green spaces in a variety of ways. Although children and the elderly might have different needs, it is still possible to create a park or a garden that is attractive for all. While keeping the overall cohesion of the green space, it is possible to design it with 'rooms', which are distinct spaces responding to varying needs.⁵⁶

A research led by the Institute of Future Cities at the Chinese University of Hong Kong explored how to plan and design urban green spaces to facilitate the needs of older adults and to promote active aging in an urban environment⁵⁷. Their findings included the following:

- as mobility decreases with increasing age, accessibility is an essential factor to consider in planning the spatial distribution of urban green spaces; in line with the findings of the study a green space within 400 m can be considered as accessible by walking for older adults;
- there is an indication that in case of older adults, visiting of parks and other green spaces is closely related to their everyday activities, so it is worth locating urban green spaces close everyday places, such as stores, markets, service providers and public buildings;
- those with better self-reported health status preferred more stimulating, sunny and lively areas in urban green spaces, while people who perceive themselves to be in poorer health preferred less stimulating, shaded and quiet spots;
- attractive urban green spaces are considered safer and the maintenance condition of the urban green spaces as well as the colour of the plant affects perceptions of safety (in case of older adults there is an overall preference for greater number of flowers in green areas);
- Locations with design features (seating) that can encourage social interactions are typically the most popular spots in urban green spaces.

Douglas, Lennon and Scott in a study published in 2017 taking a life-course approach have provided guidance on improving green space benefits for health and well-being for different age groups⁵⁸.

Some of the recommended interventions included in the study are listed below by age group:

- *children*: engagement with nature and physical activity should be encouraged with certain designed-in elements, such as paved walkways, play equipment, fields and courts;
- *adolescents*: provision of sports facilities and other facilities supporting movement and physical activity; provision urban wilderness areas, untended vegetated areas, wildflower meadows for exploring and creative play; and zones of sheltered areas for relaxation and social interaction;
- *adulthood*: ensuring proximity of green spaces; provision of opportunities to engage with nature, spaces for walking, cycling for stress relief; development of communal seating areas in parks to encourage social interactions;
- *pregnant women*: provision of safe and accessible walkways, regular seating areas and clean public toilets;
- *elderly*: provision of accessible green spaces in close proximity to residential areas, sheltered seating areas with interesting views that encourage social interaction, spaces for games suitable for elderly abilities, such as chess and boules-type games; increasing exposure to green space through targeted greening of the streetscape.

Box 2 - Olari health nature trail in Espoo⁵⁹

In the Olari district of the city of Espoo, a new health nature trail was opened in 2019, where visitors can experience the health benefits of nature and take a break from everyday life. The trail is located in Espoo Central Park and enters various landscapes in the Kokinmetsä forest. The path with an approximately 2.4 km length has eight checkpoints with three separate exercises each. The various exercises guide the hikers to observe, learn and experience the multiple health effects of nature. These exercises have been designed with a view to target the three main target groups of the trail, children, visitors unfamiliar with the forest, and those who are seeking the health benefits provided by nature. The trail is marked with easily distinguishable blue hearts. The development of the trail was initiated by a local association, Olari-seura. Several organisations, including scout troops, day care centres, schools, a mental health association, residents' associations worked together in the planning and creation of the trail. A wide range of local stakeholders co-designed the trail and the exercises. The construction of the path was primarily undertaken by volunteers.



Source: City of Espoo

Health walk routes

The development of health walk route can help in supporting communities to connect with urban green spaces such as parks, gardens and forests to experience the various health benefits of nature. The aim of the creation of a green health route is to enable people to use their local green spaces and at the same time to improve their health condition or

Healing gardens

Hospital gardens can be used as a part of a therapy program. Patients' access to natural landscape or a garden can potentially improve well-being and health outcomes.

Healing gardens in line with the definition of the American Horticultural Therapy Association are seen as plant dominated environments including green plants, flowers, water, and other aspects of nature that are designed as a retreat for patients and visitors. They are generally associated with hospitals and other healthcare settings. A therapeutic garden is a specific type of a healing garden, that is designed for use as a component of a treatment program. This can be a physical therapy, an occupational therapy or a horticultural therapy program. Therapeutic gardens are created to meet the needs of a specific user or population.⁶²

A healing garden can function as a space for relaxation and restoration from mental and emotional fatigue⁶³, it can potentially reduce recovery time for surgery patients, reduce stress, lower blood pressure⁶⁴.

Providing patients with access to a gardening space can have additional therapeutic benefits. Letting the patients actively participate in gardening, rather

maintain a healthy lifestyle.⁶⁰ See an example of a green health route in *Box 2*. Healthcare practitioners can recommend their use through green prescribing⁶¹ (see *Box 1*). Green health routes can be used as part of rehabilitation services for cardiac patients through the organization of regular guided therapeutic walks.

than only passively enjoy the garden can have significant healing effects.⁶⁵ In horticultural therapy patients are engaged in horticultural activities led by a therapist with an aim to achieve specific treatment goals.⁶⁶ See *Box 3* on the therapeutic biogarden in Szent János Hospital.

The effects of a healing garden can be enhanced by careful design. Greenery should take up roughly 70% of the space, while hard artificial surfaces about 30%. The following features are particularly effective: tree-bordered views of water features, lush, multi-layered greenery, mature trees and flowering plants that attract birds and wildlife, private conservation areas, chairs that can be easily moved, features that engage multiple senses and easy entry.⁶⁷

There are differences in what features are sought by various age groups in the gardens. With children natural elements that enable interactive activities, such as plants, rocks, water features are particularly popular⁶⁸. Middle-aged adults tend to look for peace and quiet in the garden, while older adults are mostly seeking stimulation, and opportunities for social interaction⁶⁹.

Box 3 - Therapeutic biogarden in Szent János Hospital, Budapest

In 2017 a Mental Health Day Care centre was opened in Szent János Hospital that aimed at the psychosocial reintegration and rehabilitation of chronic psychotic patients. A couple of months later, in early 2018, as a result of a joint initiative of the patients and the therapeutic group, a small strip of soil was planted with vegetables next to the building of the day care centre. Patients and the medical team started gardening together, initially during the breaks and later already as part of the therapies. The aim was to establish a recovery-oriented psychosocial reintegration and rehabilitation practice by actively involving patients in gardening.

Building on the initial positive experiences, a year later in Spring 2019 a therapeutic biogarden was established with the involvement of a bio-gardener, a human-ecologist and a sociologist. Raised garden beds were used with differing heights to allow also older patients' activities and to enable deconstruction in case of a potential relocation. The patients were actively involved in the planning of the garden, the assembly of frames of the garden beds, and planting. In the biogarden various vegetables and herbs are cultivated.

During the breaks in between therapeutic occupation the patients together with the therapeutic team undertake smaller tasks, such as watering or weeding. During the socio-therapeutic and skill-developing teamwork the patients are engaged in harvesting, cooking, eating together with the medical team.

As a result of the initiative patients have left the closed therapeutic space and this in itself is a therapeutic factor supporting the improvement of their mental and social health. The shared gardening helps them reintegrate into society. With time, it became common that during breaks patients went out into the garden to socialize while they were routinely weeding the vegetables. The therapeutic garden can also effectively help the medical team in burnout syndrome prevention.

This easily adaptable 'green care' initiative served as a proof of concept study that can provide inspiration for other urban institutes providing health and social care services for psychiatric patients and people living with psychosocial disabilities.



Source: Gábor Kapócs (Department of Psychiatry and Psychiatric Rehabilitation, North and Central Buda Centre, New Szent János Hospital and Clinic)

References

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- ¹ https://www.nytimes.com/2014/01/05/books/review/charles-montgomerys-happy-city.html?_r=0
- ² WHO (2017) Urban green spaces: a brief for action, Copenhagen: WHO - Regional Office for Europe
- ³ <https://www.who.int/sustainable-development/cities/health-risks/about/en/>
- ⁴ WHO (2017) Preventing noncommunicable diseases (NCDs) by reducing environmental risk factors. WHO/FWC/EPE/17.01.
- ⁵ Souto Barreto, P. d. (2013) Why are we failing to promote physical activity globally? Bull World Health Organ. 2013 Jun 1; 91(6): 390–390A.
- ⁶ WHO (2017) Urban green spaces: a brief for action, Copenhagen: WHO - Regional Office for Europe
- ⁷ <https://www.eea.europa.eu/articles/forests-health-and-climate-change/key-facts/health-benefits-of-green-spaces>
- ⁸ Twohig-Bennett, C., Jones, A. (2018) The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. Environmental Research. Volume 166, October 2018, Pages 628-637.
- ⁹ Bell, J. Wilson, J. and Liu, G. (2008). Neighbourhood greenness and 2 year changes in body mass index of children and youth. American Journal of Preventative Medicine, 35(6), 547-533.
- ¹⁰ Nielsen, T. and Hansen, K. (2007). Do green areas affect health? Results from a Danish Survey on the use of green areas and health indicators. Health and Place, 13, 839-850.
- ¹¹ Gascon, M. et al. (2015) Residential green spaces and mortality: A systematic review. Environment International, Vol. 86, January 2016, Pages 60-67.
- ¹² Hu, Z., Liebens, J., Rao, K. R. (2008) Linking stroke mortality with air pollution, income, and greenness in northwest Florida: an ecological geographical study. International Journal of Health Geographics, Vol. 7, Article number: 20 (2008).
- ¹³ Pereira, G. et al. (2012) The association between neighborhood greenness and cardiovascular disease: an observational study. BMC Public Health volume 12, Article number: 466.
- ¹⁴ Braubach M., Egorov A., Mudu P., Wolf T., Ward Thompson C., Martuzzi M. (2017) Effects of Urban Green Space on Environmental Health, Equity and Resilience. In: Kabisch N., Korn H., Stadler J., Bonn A. (eds) Nature-Based Solutions to Climate Change Adaptation in Urban Areas. Theory and Practice of Urban Sustainability Transitions. Springer, Cham. https://doi.org/10.1007/978-3-319-56091-5_11
- ¹⁵ Roslund, M. I. et al. (2020) Biodiversity intervention enhances immune regulation and health-associated commensal microbiota among daycare children. Science Advances 14 Oct 2020, Vol. 6, no. 42, eaba2578. DOI: 10.1126/sciadv.aba2578.
- ¹⁶ Braubach M., Egorov A., Mudu P., Wolf T., Ward Thompson C., Martuzzi M. (2017) Effects of Urban Green Space on Environmental Health, Equity and Resilience. In: Kabisch N., Korn H., Stadler J., Bonn A. (eds) Nature-Based Solutions to Climate Change Adaptation in Urban Areas. Theory and Practice of Urban Sustainability Transitions. Springer, Cham. https://doi.org/10.1007/978-3-319-56091-5_11
- ¹⁷ Ulrich, R. S. (1981) Natural Versus Urban Scenes. Some Psychophysiological Effects. September 1981, Environment and Behavior, 13(5):523-556.
- ¹⁸ Bowen, K. J., Parry, M., the Government of Victoria. (2015) The evidence base for linkages between green infrastructure, public health and economic benefit. Paper prepared for the project Assessing the Economic Value of Green Infrastructure.
- ¹⁹ WHO, Regional Office for Europe (2016) Urban green spaces and health. A review of evidence.
- ²⁰ Bowen, K. J., Parry, M., the Government of Victoria. (2015) The evidence base for linkages between green infrastructure, public health and economic benefit. Paper prepared for the project Assessing the Economic Value of Green Infrastructure.
- ²¹ <https://www.nrpa.org/parks-recreation-magazine/2017/april/the-health-benefits-of-small-parks-and-green-spaces/>
- ²² Van den Berg, A. E. and Van den Berg, M. M. H. E. (2015). Health benefits of plants and green space: Establishing the evidence base. Acta Horticulturae, 1093, 19–30. <https://doi.org/10.17660/ActaHortic.2015.1093.1>
- ²³ Louv, Richard (2005) Last Child in the Woods. Saving Our Children from Nature-Deficit Disorder, New York: Workman Publishing Company

-
- ²⁴ Ulrich, R.S., Simons, R.F., et al. Stress recovery during exposure to natural and urban environments *Journal of Environmental Psychology*, 11 (1991), pp. 201-230
- ²⁵ Kaplan, R.; Kaplan, S. (1989) *The Experience of Nature: A Psychological Perspective*. Cambridge University Press. ISBN 978-0-521-34139-4
- ²⁶ Kellert, S. R., and Wilson E. O., eds. *The biophilia hypothesis*. Island Press, 1993.
- ²⁷ Beatley, T. (2014) *Biophilic cities, The sustainable urban development*, ed. Wheeler and Beatley, Routledge.
- ²⁸ Labib, S.M., Lindley, S., Huck, J. (2020) Spatial dimensions of the influence of urban green-blue spaces on human health: A systematic review, *Environmental Research*, Volume 180, January 2020.
<https://doi.org/10.1016/j.envres.2019.108869>
- ²⁹ de Vries, S., van Dillen, S.M., Groenewegen, P.P., Spreeuwenberg, P. (2013) Streetscape greenery and health: stress, social cohesion and physical activity as mediators, *Social Science & Medicine*, Volume 94, October 2013, Pages 26-33. <https://doi.org/10.1016/j.socscimed.2013.06.030>
- ³⁰ da Costa, E.M., Fumega, J., Louro, A. (2013) Defining sustainable communities: The development of a toolkit for urban policy. *Journal of Urban Regeneration and Renewal*. Volume 6, Issue 3, 2013, Pages 278-292
- ³¹ Franco, P., Marques da Costa, E., Simões, J. M. (2019) Physical Activity in families daily-life of suburban areas – the case of Rio de Mouro, Lisbon Metropolitan Area, Conference: 2019 AESOP Congress, Venice, IT.
- ³² <https://www.nursingtimes.net/clinical-archive/cardiovascular-clinical-archive/using-outdoor-activities-in-cardiac-recovery-06-05-2014/>
- ³³ <https://www.spph.ubc.ca/parks-big-and-small-needed-for-public-health/>
- ³⁴ <https://www.who.int/healthpromotion/conferences/previous/ottawa/en/>
- ³⁵ <http://www.emro.who.int/emhj-volume-14-2008/volume-14-supplement/editorial-health-protection-and-promotion.html>
- ³⁶ Robinson, J. M. and Breed, M. (2019). Green Prescriptions and Their Co-Benefits: Integrative Strategies for Public and Environmental Health. *Challenges*. 10. 9. 10.3390/challe10010009.
- ³⁷ <https://www.health.govt.nz/our-work/preventative-health-wellness/physical-activity/green-prescriptions>
- ³⁸ <https://theconversation.com/green-prescriptions-should-your-doctor-send-you-for-a-walk-in-the-park-143231>
- ³⁹ <https://www.health.govt.nz/our-work/preventative-health-wellness/physical-activity/green-prescriptions>
- ⁴⁰ Robinson, J. M. and Breed, M. (2019). Green Prescriptions and Their Co-Benefits: Integrative Strategies for Public and Environmental Health. *Challenges*. 10. 9. 10.3390/challe10010009.
- ⁴¹ <https://www.health.govt.nz/our-work/preventative-health-wellness/physical-activity/green-prescriptions/how-green-prescription-works>
- ⁴² Robinson, J. M. and Breed, M. (2019). Green Prescriptions and Their Co-Benefits: Integrative Strategies for Public and Environmental Health. *Challenges*. 10. 9. 10.3390/challe10010009.
- ⁴³ <https://www.health.govt.nz/our-work/preventative-health-wellness/physical-activity/green-prescriptions/how-green-prescription-works>
- ⁴⁴ Elley, C. R. (2003) The effectiveness and cost-effectiveness of the Green Prescription physical activity intervention: a cluster randomised controlled trial in primary health care. Thesis, PhD--General Practice, University of Auckland, 2003.
- ⁴⁵ <https://www.emersonsgreentreatmentcentre.nhs.uk/news/could-gps-soon-be-writing-a-prescription-for-a-walk/>
- ⁴⁶ <https://www.gov.uk/government/speeches/george-eustice-speech-on-environmental-recovery-20-july-2020>
- ⁴⁷ Crisp, N. (2020) Health is made at home, hospitals are for repairs. Building a healthy and health-creating society. SALUS Global Knowledge Exchange, June 2020.
- ⁴⁸ NNHSA (2017) *A Manifesto for Health Creation*. The New NHS Alliance
- ⁴⁹ <https://www.youngfoundation.org/publications/transforming-health-shifting-health-systems-illness-treatment-prevention-health-creation/>
- ⁵⁰ <http://www.emro.who.int/emhj-volume-14-2008/volume-14-supplement/editorial-health-protection-and-promotion.html>
- ⁵¹ Kellert, S. R., and Wilson E. O., eds. *The biophilia hypothesis*. Island Press, 1993.
- ⁵² Felonneau, M. (2004) Love and loathing of the city: Urbanophilia and urbanophobia, topological identity and perceived incivilities. *Journal of Environmental Psychology - J ENVIRON PSYCHOL*. 24. 43-52. 10.1016/S0272-4944(03)00049-5.
- ⁵³ WHO (2017) *Urban Green Space Interventions and Health. A review of impacts and effectiveness*. the WHO Regional Office for Europe. UN City, Marmorvej 51, DK-2100 Copenhagen Ø, Denmark.
- ⁵⁴ Scott, M., Lennon, M., Douglas O., Bullock, C. (2020) *Eco-Health: Ecosystem Benefits of Green Space for Health*. EPA Research Report, Report No.328, 2015-HW-MS-6.

⁵⁵ Wang, H., Tassinari, L. G. (2019) Effects of greenspace morphology on mortality at the neighbourhood level: a cross-sectional ecological study. *The Lancet Planetary Health*, Volume 3, Issue 11, November 2019, Pages e460-e468. [https://doi.org/10.1016/S2542-5196\(19\)30217-7](https://doi.org/10.1016/S2542-5196(19)30217-7)

⁵⁶ <https://www.brightview.com/resources/article/tips-successful-healing-garden-design>

⁵⁷ Tan, Z., Lau, K. K., Roberts, et al. (2019) Designing Urban Green Spaces for Older Adults in Asian Cities. *Int J Environ Res Public Health*. 2019 Nov; 16(22): 4423. PMID: PMC6888534. doi: 10.3390/ijerph16224423.

⁵⁸ Scott, M., Lennon, M., Douglas O., Bullock, C. (2020) Eco-Health: Ecosystem Benefits of Green Space for Health. EPA Research Report, Report No.328, 2015-HW-MS-6.

⁵⁹ [https://www.espoo.fi/en-](https://www.espoo.fi/en-US/Social%20and%20health%20services/Take%20Care%20of%20Yourself/Finding%20wellbeing%20in%20the%20forest%20the%20new(168203))

[US/Social and health services/Take Care of Yourself/Finding wellbeing in the forest the new\(168203\)](https://www.espoo.fi/en-US/Social%20and%20health%20services/Take%20Care%20of%20Yourself/Finding%20wellbeing%20in%20the%20forest%20the%20new(168203))

⁶⁰

https://sustainablehealthcare.org.uk/sites/default/files/green_health_route_programme_by_the_nhs_forest_1_0.pdf

⁶¹ <https://sustainablehealthcare.org.uk/what-we-do/green-space/green-health-routes>

⁶² <https://web.archive.org/web/20130908221648/http://ahta.org/sites/default/files/DefinitionsandPositions.pdf>

⁶³ <https://www.scientificamerican.com/article/nature-that-nurtures/>

⁶⁴ <https://horttherapywithhankbruce.weebly.com/healing-in-the-garden.html>

⁶⁵ <https://www.healthcarefacilitiestoday.com/posts/Patient-participation-in-gardening-at-hospitals-can-improve-health-outcomes--1105>

⁶⁶ <https://web.archive.org/web/20130908221648/http://ahta.org/sites/default/files/DefinitionsandPositions.pdf>

⁶⁷ <https://www.scientificamerican.com/article/nature-that-nurtures/>

⁶⁸ Sherman, S., Varni, J., Ulrich, R., Malcarne, V. (2005). Post-occupancy evaluation of healing gardens in a pediatric cancer center. *Landscape and Urban Planning*. 73. 167-183. 10.1016/j.landurbplan.2004.11.013.

⁶⁹ <https://www.scientificamerican.com/article/nature-that-nurtures/>