

9. Nature-based solutions and mental health

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MENTAL HEALTH IN CITIES

Poor mental health is a global pandemic affecting people of all ages. For instance, more than 280 million people worldwide suffer from depression as a mental disorder (WHO, 2023). Mental disorders further include anxiety, bipolar disorder, psychotic disorders, dementia, developmental disorders and other diseases. Beyond substantial suffering of the affected individuals, friends and family members, mental illness generates enormous social and economic costs (Trautmann et al., 2016). Poor mental health stresses health-care systems and adds additional pressures as mental diseases can increase the risk for a number of physical illnesses such as cardiovascular disease (Alvarenga and Byrne, 2016).

The urgency and severity of the global mental health crisis point to the need for innovative and holistic approaches that promote mental health and prevent mental disease. Following the definition of the World Health Organization (WHO), mental health includes far more than the mere absence of disease (see Box 9.1 for an overview of the WHO definition of mental health and its determinants). Remarkably, it involves aspects of self-actualization, mental resilience and social connectedness, all of which are acknowledged in this chapter. Yet the importance of mental illness is not disregarded.

BOX 9.1 DEFINITION OF MENTAL HEALTH AND DETERMINANTS OF MENTAL HEALTH

- A 'state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work produc-

tively and fruitfully, and is able to make a contribution to his or her community’.

- Includes ‘subjective well-being, perceived self-efficacy, autonomy, competence, intergenerational dependence, and self-actualization of one’s intellectual and emotional potential, among others’.
- The ‘promotion, protection and restoration of mental health can be regarded as a vital concern of individuals, communities and societies throughout the world’.
- ‘Multiple social, psychological, and biological factors determine the level of mental health of a person at any point of time’.

Source: WHO (2018).

The aetiology of mental disorders is complex and only partly understood. It is known that interactions between internal and external factors such as genetic predisposition, social conditions, lifestyle and environmental exposures determine the risk of developing mental disease (Van Den Bosch and Meyer-Lindenberg, 2019). The interplay of these factors varies depending on population, context and setting. For example, recent research has found that depression and schizophrenia are more common in cities than in rural areas (Lederbogen et al., 2013; Reichert et al., 2020). While city living is associated with a number of benefits, urban areas can also be demanding and stressful (Tonne et al., 2021). Cities are often characterized by spatial divides and social disparities (Dye, 2008). Paradoxically, dense cities also tend to have fragmented social networks, which can be associated with a poor sense of community (Gruebner et al., 2017) and in turn may decrease mental resilience.

Other reasons for poor mental health in cities is the increased occurrence of environmental stressors (Bilotta et al., 2018). High levels of motorized traffic lead to air pollution and noise. Their negative effects on physical health have been demonstrated in the past, but recent research adds evidence for adverse influences also on mental health and well-being (Van Den Bosch and Meyer-Lindenberg, 2019). Among the many different types of pollutants, particular matter smaller than 2.5 μm ($\text{PM}_{2.5}$) seems to be especially harmful because it includes ultrafine particles that can enter the circulation and reach the brain (Rajagopalan et al., 2018). Exposure to high levels of $\text{PM}_{2.5}$ has been associated with significantly increased levels of anxiety, depression and suicide in a number of studies (Power et al., 2015). The presence of social stress may further intensify the association of air pollution and negative mental health outcomes (Olvera Alvarez et al., 2018). Noise can result in annoyance and other negative feelings which can induce psychophysiological stress reactions (Waye et al., 2002). Finally, people suffering from mental disorders may be less resilient to heat exposure and comorbidities of mental and physical

diseases are common, all of which makes those persons particularly vulnerable to environmental change (Hancock and Vasmatzidis, 2003; Kabisch et al., 2021a). It is also important to note the aspects of mental health that are related to psychological and emotional well-being, flourishing and eudaimonic happiness – as the WHO definition highlights (see Box 9.1) – and the ways in which factors in urban life may contribute to (or detrimentally impact) these outcomes as well (Bratman et al., 2021).

Natural environments in cities can contribute to solutions to some urban mental health challenges. A large body of evidence demonstrates the mental health benefits that exist for adults from access and exposure to urban nature, including reduced risks of depression and schizophrenia (Van Den Bosch and Meyer-Lindenberg, 2019). Interactions with nature also reduce the risk of cognitive and developmental disorders among children and adolescents, such as Attention Deficit Hyperactivity Disorder. However, the presence of natural environments in cities may be generally scarce and their accessibility is often unequally distributed, all of which may increase vulnerability in disadvantaged populations. It has been shown that low exposure to natural environments may result in disconnection from nature with negative effects on mental health (Chawla, 2015). Further, a number of studies demonstrate that without daily access to nature, children are at higher risk of cognitive and developmental disorders (Amoly et al., 2015; Chawla, 2015; Davvand et al., 2015; Zijlema et al., 2017). To improve evaluation and appreciation of the mental health benefits of nature experience, efforts are growing to incorporate them into ecosystem service assessments (Bratman et al., 2019).

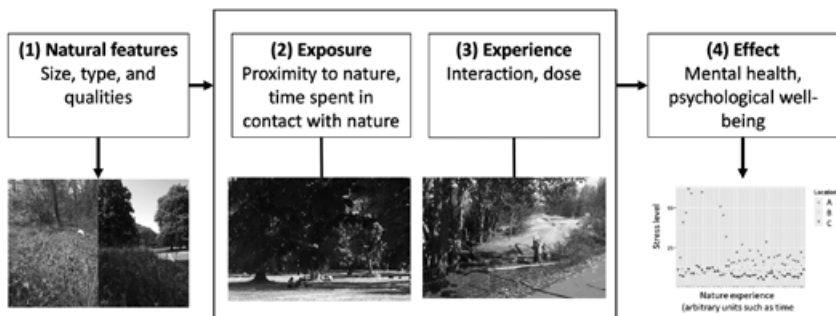
NATURE-BASED SOLUTIONS AND MENTAL HEALTH

Actions that specifically protect, manage and restore natural ecosystems, use their provided services to address societal and ecological challenges and simultaneously provide benefits for biodiversity and human well-being are called nature-based solutions (NBS) (Cohen-Chacham et al., 2016). NBS include newly planned and implemented green infrastructure elements that specifically aim at coping with challenges such as climate change, water scarcity and food insecurity. At the same time, pre-existing green spaces such as long-standing parks and cemeteries may also qualify as NBS if the criteria are being met that the provided natural elements help in protecting ecosystems and support coping with societal challenges. In the following section we introduce models that link natural elements with mental health and describe pathways through which NBS may help to resolve the urban mental health crises – which may be regarded as a societal challenge. Acknowledging the holistic definition of mental health provided by the WHO, in this chapter, NBS for mental

health are not limited to the reduction of disease, but include the support of self-actualization, mental resilience and social connectedness.

Models Linking Nature-Based Solutions and Mental Health

Potential mechanisms and pathways behind the positive mental health effects of natural environments are shown by the conceptual framework developed by Bratman et al. (2019). This provides a broad structure of a potential template with which the mental health benefits of nature contact might be considered, in support of efforts to put this science into practice (Figure 9.1) (Bratman et al., 2019). These include four main steps: the first is to characterize the nature itself, from species composition to vegetation structure and spatial configuration. These environmental attributes will affect the impacts of these elements on mental health, and will also influence the second step: opportunity for nature exposure. Here, residential proximity, accessibility (which is influenced by physical and social components of the environment), safety and quality of green space, and sociodemographic and cultural characteristics will influence the degree to which individuals are exposed to nature. With the third step comes a consideration of the experience of the nature interaction itself, which is open to a variety of perspectives and approaches, including a characterization of human–nature interaction (Kahn et al., 2010), or the use of exposure science metrics that often frame exposure in terms of ‘dose’ (Frumkin et al., 2017). Last, as more evidence is gathered regarding causal pathways and moderators (on the level of the environment and the individual), insight will grow into the ways in which steps 1–3 lead to relevant effects (step 4) that have repercussions for mental health and well-being, and the ways that these



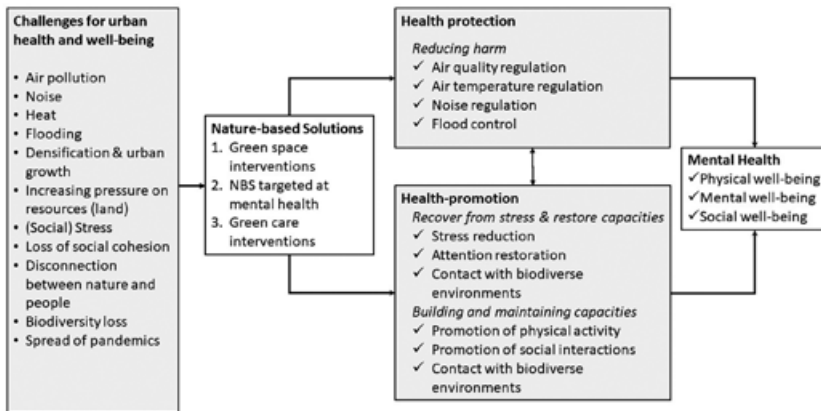
Source: Adapted from Bratman et al. (2019); photographs by Nadja Kabisch.

Figure 9.1 A conceptual model providing a template for the analysis of mental health benefits of nature contact along four main steps

effects differ across individuals and populations depending on environmental and sociocultural contexts.

In line with the considerations of the Bratman model, Markevych et al. (2017) and Marselle et al. (2021) discuss major pathways linking green spaces and biodiversity to human health in general: reducing harm, restoring capacities and building capacities. Marselle et al. (2021) expand on a dimension describing potential adverse effects of biodiversity on human health. In the following, we apply these overarching pathways to the interactions of NBS and urban mental health by discussing three main hypotheses.

First, green spaces are NBS for many urgent challenges and provide co-benefits for mental health by reducing environmental stressors. Second, NBS can directly support mental health by providing resources for human–nature interaction and mental resilience. And third, NBS that are intended to support the treatment of psychiatric disorders (also called nature-based interventions) may provide advice for urban design and unfold beneficial effects for coping with societal and environmental challenges beyond the treatment of mental disease. Based on Markevych et al. (2017), Figure 9.2 also provides an overview of pathways on NBS targeted at mental health and green care interventions in their response to global challenges to mental health outcomes.



Source: Adapted from Markevych et al. (2017).

Figure 9.2 Nature-based solutions targeted at mental health and green care interventions to respond to global challenges to mental health outcomes

Co-Benefits of Green Spaces for Mental Health

Green spaces can act as NBS as they generally address a broad range of socio-ecological challenges such as urbanization, environmental change and, in some circumstances, health inequities, through the delivery of various ecosystem services, i.e. the benefits people derive from nature (MEA, 2005). At the same time, they may contribute to reduced psychiatric morbidity. Several studies have delivered evidence for an association between access and exposure to green spaces and mental disorders: Engemann et al. (2019) examined associations between growing up surrounded by different environments and the rates of psychiatric disorders such as mood, depressive and stress-related disorders across Denmark. They found a reduced mental morbidity among people who grew up surrounded by higher shares of near-natural green spaces, particularly with high vegetation densities, compared to built-up environments. Maas et al. (2009) examined large-scale representative medical record data in the Netherlands and found reductions in the annual prevalence rates of depression and anxiety disorder related to an increasing proportion of green spaces in people's living environments. The associations were strongest among children and people of lower socioeconomic status, indicating particular benefits of green spaces for vulnerable populations. In a study from the United Kingdom, Sarkar et al. (2018) found that increases in residential greenness were associated with lower odds of major depressive disorder. The relationship was found to be particularly strong for women, participants younger than 60 years and participants residing in deprived or very dense neighbourhoods.

The reasons for these associations are not entirely elucidated, but several pathways have been suggested. The regulation of harmful exposures such as air pollution, air temperature and noise may play a role in prevalence reduction of mental disorders, following the models of Markevych et al. (2017) and Marselle et al. (2021) that we described above. If green spaces are properly planned in a NBS context, they can reduce ambient air pollution (Nowak et al., 2018), and since there is evidence that air pollution increases the risk of mental disorders (Van Den Bosch and Meyer-Lindenberg, 2019), it is plausible that green spaces hence reduce this risk. A study by Klomp maker et al. (2019) supports this hypothetical pathway.

This study also suggested that the noise-reducing impact of green spaces may be part of the explanation. Exposure to high noise levels has consistently been associated with increased risk of mental disorders (Klomp maker et al., 2019), thus noise reduction may be an important method for preventing mental morbidity.

Another example for how green spaces can reduce harmful environmental stressors is the regulation of the ambient air temperature. For instance, Basu et al. (2018) found that warmer temperatures in California increase the risk of

emergency room visits for mental health disorders in both the warm and cold seasons.

Beyond ecosystem services that regulate the aforementioned stressors, NBS in the form of green spaces may provide safeguarding and improvement of biodiversity. This again may strengthen mental health. Marselle et al. (2019) delivered a comprehensive review of the mental health effects of biodiversity and concluded that there is evidence suggesting that biodiverse natural environments may be associated with improved mental health. Nevertheless, they emphasize that the data situation is still too insufficient to be conclusive and the evaluation of the role of biodiversity poses several methodological challenges to be dealt with in the future.

Nature-Based Solutions Targeted at Mental Health

As described above, poor mental health is strongly intertwined with several socioecological challenges. It has been associated with vulnerability to physical illnesses (such as cardiovascular diseases) that are further impacted by environmental factors such as increased heat stress and air pollution. These challenges may be directly addressed by NBS through a suite of salutogenic measures that promote mental health and well-being. This can happen through direct human–nature interaction, such as park or forest visits, by enhancing the recovery of mental resources that are strained by psychological stressors in urban areas. Kabisch et al. (2021b) found the highest restoration experience of their participants after exposure to a long-standing urban park with widespread and old trees compared to a highly artificial urban environment. They additionally found a positive correlation between restoration experience and the perceived level of naturalness in the respective environments. Another study by Gidlow et al. (2016) showed greater restoration experiences after exposure to green compared to urban environments. Furthermore, NBS such as the implementation and protection of parks and forests may improve mood and mental resilience and thus lower vulnerability to mental stress and disorders. Lee et al. (2011) demonstrated that the exposure to forest environments significantly increased positive feelings and decreased negative feelings compared with urban exposure. Chen et al. (2018) found that negative mood states and anxiety levels were significantly reduced and positive mood states were improved after visiting forests. Hartig et al. (2003) showed that positive affect increased and anger decreased after a walk in a nature reserve while walking in an urban environment resulted in the opposite pattern. Finally, Bratman et al. (2015a, 2015b) found that nature versus urban walks provided affective benefits and reduced rumination.

These restorative effects of contact with nature might be explained by the Stress Reduction Theory (see Box 9.2 for explanation). Additionally, it is plau-

sible that strong mental resources may help people to generally cope with environmental change and its adverse health effects. Altogether, including mental health promotion in the set of objectives of NBS may unfold co-benefits for coping with environmental change, urbanization and social inequality and synergistic effects could evolve.

BOX 9.2 MAIN FEATURES OF STRESS REDUCTION THEORY AND ATTENTION RESTORATION THEORY

- Stress Reduction Theory postulates that improved health and well-being is the result of contact with restorative natural environments that stimulate stress recovery from the impacts of everyday life through parasympathetic nervous system activation (Ulrich et al., 1991).
- In Attention Restoration Theory certain (green) environments support restoration from mental fatigue caused by everyday life (e.g. through directed attention at work) (Kaplan, 1995). These particular environments help to relieve the overloaded individual through experiencing a sense of being away, coherence, fascination and compatibility in a specific environment. Green, natural environments may afford experiencing these restorative qualities (Marselle, 2019).

Nature-Based Interventions and Mental Health

Nature-based interventions, also referred to as Green Care, is an umbrella term for describing specific therapies and treatments that use natural elements to improve health and well-being (Annerstedt and Währborg, 2011). These therapies address for example psychiatric diseases and apply therapeutic settings and activities close to nature in the treatment of patients, e.g. by prescribed green exercise, prescribed group walks, horticultural therapies, care farming or animal-assisted therapies (Cook et al., 2019). By treating persons with mental diseases, nature-based interventions directly address mental health crises and hence can be considered NBS. Furthermore, lessons beyond the treatment of psychiatric disease can be learned from nature-based interventions, e.g. about mentally supportive city design.

Vujcic et al. (2017) performed a cohort study in which randomly selected psychiatric patients completed a special programme of horticulture therapy in the botanical garden of Belgrade, Serbia. Psychological assessments were conducted before and after the intervention and the outcome was compared to a control group. The research team found a significant reduction of stress in

patients following the horticulture therapy. Pálsdóttir et al. (2018) identified qualities of natural environments that support the rehabilitation of persons with stress-related mental disorders. They examined the process of nature-based rehabilitation in a specially designed garden in Sweden and found several characteristics defining a mentally supportive environment. For example, the properties *Being away*, *Extent*, *Fascination* and *Compatibility* from Kaplan's Attention Restoration Theory were confirmed to be important aspects (see Box 9.2). Furthermore, the perceived sensory dimensions *Serene*, *Nature*, *Prospect*, *Refuge* and *Space* were identified in the therapeutic environment.

Green space characteristics such as size (therapeutic garden of 5 ha), the availability of secluded sites and escape routes and many trees were emphasized to be vital to promote restoration from fatigue and stress (Jiang et al., 2016; Pálsdóttir et al., 2018; Stoltz et al., 2016). García-Llorente et al. (2018) describe a multitude of green care interventions and discuss their potential to reconnect people with nature. They name, for example, outdoor activities including forest walks and green exercise, nature exposure, contemplation, relaxation, observing animals and plants, horticulture, gardening and agricultural activities. Those activities may be carried out by city dwellers in urban forests, parks and spaces of urban agriculture (which also plays an increasing role for urban food production and security). At the same time the authors stress that most of the existing green care studies only evaluate the direct therapeutic effects of the interventions rather than including co-benefits beyond mental health – studies assessing the relevance of green care in socioeconomic and environmental terms are identified as a future research topic.

Additionally, evidence from existing and future green care and nature-based intervention studies about mentally supportive environments may be translated into city planning to deliver urban and green space design directives that support people suffering from mental illness and prevent mental disease in general. A focus could be on the rising number of elderly people with dementia, as proposed by Andreucci et al. (2019). In addition, green care interventions may have direct beneficial ecological effects while also contributing to the promotion of sustainable lifestyles.

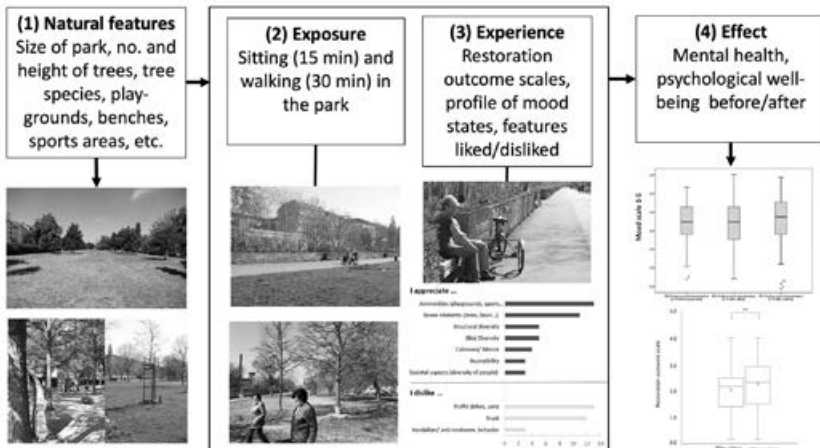
CASE STUDIES FROM THE GLOBAL NORTH AND SOUTH ON DIFFERENT SCALES

In the following section, two case studies are presented as exemplary applications of the conceptual model by Bratman et al. (2019). As a model always reduces complexity, the examples only relate to a subset of possible environmental factors and pathways that were described in the sections above. The first case study describes a newly developed park on a former brownfield site in a dense urban environment in the city of Leipzig, Germany, and the

second case study works on impacts of urban nature and particularly trees in Hyderabad, India, which is faced by rapid urbanization and loss of green space.

Mental Health Impacts of a Park Regeneration Project in Leipzig

The Lene-Voigt-Park is a new park that has been developed on a former railway brownfield site and was opened for public use in 2004. It is part of the urban regeneration strategy ‘Park-Bogen-Ost’ in the city of Leipzig that is located in the eastern part of Germany (Figure 9.3). The aim of the regeneration strategy is to revitalize the local districts and neighbourhoods characterized by high population and building density and low green infrastructure, to create a green ‘fresh air’ corridor with several bicycle lanes connected to the city’s cycling network, pedestrian routes, creative playgrounds, sports areas and urban gardening spaces along the former railway line. The redevelopment of the Lene-Voigt-Park can be regarded as a NBS, because it was meant to improve the environmental conditions (low air quality, intensive urban heat island effect due to a high percentage of built-up space) in the eastern part of Leipzig (Kabisch, 2019). At the same time, there are multiple benefits for human health and well-being.



Source: Adapted from Bratman et al. (2019); photographs by Nadja Kabisch.

Figure 9.3 Application example of the conceptual model by Bratman et al.: mental health impacts of visitation patterns to an inner-city built-up park on a former brownfield site in Leipzig, Germany

A recent research project by Kabisch et al. (2021b) aimed to determine the mental and physical health effects of different urban green environments. One of the examined parks was the Lene-Voigt-Park in Leipzig. Applying the conceptual model by Bratman et al. (2019), in *Step 1 (natural features)*, information on park vegetation and infrastructure characteristics was collected and spatially mapped. This included the size of the park, number and height of trees, tree species, playgrounds, sports activity areas, urban gardening sites, benches, waste bins, etc. A multifunctional park was identified that mainly consists of lawns, a number of newly planted trees, paved trails, several playgrounds and sports facilities such as a table tennis area, a basketball court and four beach-volleyball fields. For *Step 2 (quantifying exposure)*, a sample of 33 older people was exposed to different urban green environments including the Lene-Voigt-Park. Participants were asked to sit and to walk for a specified amount of time in the park. They were asked to choose their seating location and walking route for themselves to simulate a realistic park visit. For *Step 3 (experience)*, the restoration experience was measured using the restoration outcome scale as an instrument. The values provided through the restoration outcome scale significantly increased with longer exposure time (Figure 9.3). When the participants were asked to describe which aspects they appreciated in the Lene-Voigt-Park, they mentioned the different built amenities such as the playgrounds and sports areas, but also referred to the different green elements and the overall high diversity of structures in the park. Some of the participants, however, also complained about the high traffic of bikes and the cars around the park as well as trash and vandalism on the site. These could be regarded as usage barriers for some residents. In terms of recommendations for urban planning and decision making, potential usage barriers may be considered in future park planning and maintenance (Hunter et al., 2019). This would also include adapting to local contexts and demands, e.g. the installation of sufficient lighting, sanitary infrastructure and drinking fountains which are particularly demanded by older people, women and families with children (Kabisch et al., 2021a). Finally, for *Step 4 (effects)*, mental and cardiovascular health effects were examined through well-being assessment scales and measuring physiological stress parameters such as blood pressure and heart rate variability (see Kabisch et al., 2021b for a full description of the study).

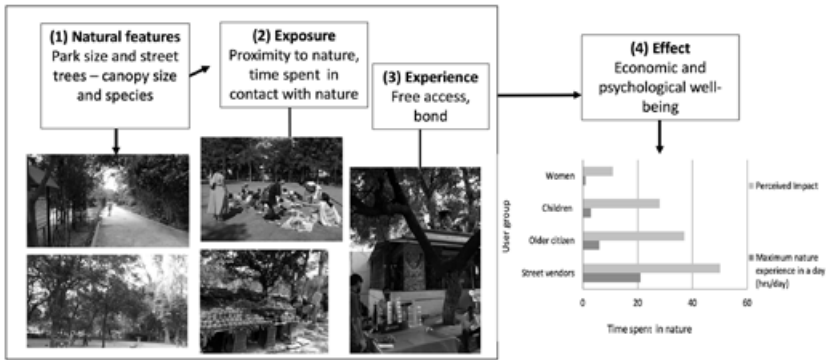
Urban Nature as Stress-Reducing Space: the Case of Hyderabad, India

Hyderabad is the sixth largest metropolis located in Telangana, a southern state in India. The city is situated in a part of the Krishna river basin, the Musi sub-basin. Hyderabad falls in a tropical savannah zone with an annual mean temperature of 26.6°C and low rainfall. The city has faced a rapid decline in green cover in the last 20 years from 2.71 to 1.66 per cent (Ramachandra et

al., 2015), hence various initiatives and policies are considered to increase it. In the age of accelerated urbanization and drastic reduction of greenery, proximity to green space or wooded area is considered an important value for the people living in the city. The interaction with natural elements is a crucial influence factor on spiritual well-being (Irvine et al., 2019). In the following, exemplary results from interviews with adult park users, children park users and street vendors in Hyderabad are presented that highlight the value of experiencing nature in the city as a stress-releasing space (Basu and Nagendra, 2021). In this example, the particular importance of trees as NBS for mental health is demonstrated.

By applying the conceptual model by Bratman et al. (2019; see Figure 9.4), in *Step 1 (natural features)*, information on characteristics of four major parks and street trees was mapped and collected. This included size of the parks, species present (native versus introduced) as well as height, girth and canopy sizes of street trees in various neighbourhoods and biodiversity present within. In *Step 2 (understanding exposure)*, park visitors and street vendors formed the sample of the study. Long-term park visitors, frequent visitors, irregular visitors and vendors with and without access to tree shade were interviewed. For *Step 3 (experience)*, activities like walking barefoot on the grass and listening to birds chirping may stimulate good feelings (Ratcliffe et al., 2013; Ritters, 2011). People in the parks of Hyderabad were found to express their state of feeling as a sense of ‘calmness’, ‘meditative’, ‘solitude’ and ‘blissful’. Particularly information technology employees consider that the time spent in the park for a tea break is the best time of their day, because the fresh air and tree shade fade away their stress, leaving a sense of calmness which boosts their energy to work again. Street vendors with tree shade are found to be much happier than vendors without. After spending long working hours outdoors, trees become a sense of ‘home’ and ‘sukoon’ which holds a very deep emotional connection and sense of belongingness. Strollers in the parks find walking in green spaces therapeutic and anxiety-reducing. A middle-aged couple feels reluctant to wake up and spend time in an air-conditioned gym: ‘We spend 9 am–8 pm in an air-conditioned closed office environment, we never felt like adding 2 more hours in a gym which is the similar environment.’ But a park motivated them to exercise daily and spend some time in an open environment. While trees have direct impacts on the majority of the wealthy residents, the cultural beliefs and traditional uses of trees also indirectly influence the psychological well-being of socioeconomically disadvantaged city dwellers. Historically, the livelihoods of these people are intertwined with trees. Basu and Nagendra (2021) found that centuries-old trees that are present in the streets and parks of the old city of Hyderabad act as keystone species with a high population of urban wildlife. And they are also considered to be sacred. Many fruit vendors start their day by offering fruit to the tree under which they spend their whole

day, which is also shared by many birds, ants and even monkeys on some days. This offering is locally called *bohoni*.



Source: Adapted from Bratman et al. (2019); photographs by Sukanya Basu.

Figure 9.4 Application example of conceptual model by Bratman et al.: stress-releasing impacts of urban nature in Hyderabad, India

Finally, for *Step 4 (effects)*, the time spent in nature has various economic and psychological well-being benefits and has stress-releasing impacts on various user groups. Trees were found to stimulate nostalgia as a common feeling among city dwellers, especially in the older group, as interview results show. A huge mango tree in Indira Park in Hyderabad triggered childhood memories in many older citizens. A group of seven retired men became friends by reminiscing over the old days. Now their 5 pm–8 pm time spent together under this tree is their ‘time of escape’. Therefore, trees not only stimulate memories but also promote socializing which may have a significantly positive impact on their mental well-being.

In terms of safety, interview results showed that lack of safety is a major reason for stress, especially among women. Parks may enhance social interactions, provide a ‘sense of safety’ and reduce anxiety. Park workers and street vendors with access to the wooded area find their work very satisfying, peaceful and physically secure. Female labourers often have to take their children to work and as they find their work in the construction sites life threatening, they rather choose to work in the parks for the safety and health of both themselves and their children: ‘If we know our children are safe, we can work peacefully.’ According to many street vendors, trees are the determining factor for selecting their work location to have a better workspace.

Many parents in the parks indicated the need to have green spaces for the overall development of their children. They find spending time outdoors in green spaces decreases their children's time spent on electronic gadgets: 'Our child has developed its interest in painting after we started coming to the park every evening. Nature helps to enhance her imaginations.' Through the interaction with children during the research process, the research team found that they tend to develop a fondness for gardening as well as birds and animals. They expressed their engagement with gardening or animals as 'exciting', 'interesting', 'makes me happy' and 'fun'.

The street vendors sitting under a tree for several years symbolize trees as their protector and parental figure. Responses like 'My father used to sell fruits sitting under this same tree, I can strongly feel his presence even today' (58-year-old man) provide critical insights on the intricate bond in human–tree relationships. *Ficus religiosa*, also known as sacred fig, are canopy trees vital for hot climatic conditions and have the highest religious significance among most city dwellers. Earlier in history, forests provided a venue for several traditional events and as the forests shrunk in size, old trees in the streets and parks became highly valued. These trees facilitate many cultural events, are associated as sacred areas and also promote cultural values and morals that are passed on to newer generations in many communities.

Also, low-income groups depend on various parts of trees for treating common diseases, which reduces the stress of paying for medical treatment. For example, *Azadirachta indica*, commonly known as Neem tree, is widely used for medical purposes: twigs, barks, leaves, fruits – all parts of the trees are utilized for various purposes. Worship is an important feature for many vendors and park workers. From interactions with park workers and street vendors, we found that certain trees in the parks are perceived as providers, often called *annam-daata*. They believe that the well-being of their livelihood is linked to the blessings provided by certain trees. The findings of the study in Hyderabad emphasize the importance of non-material benefits or cultural ecosystem services obtained from nature for human well-being. Overall, these services have gained scientific attention in recent years (Ament et al., 2017; Kosanic and Petzold, 2020; Plieninger et al., 2015; Schaich et al., 2010).

CONCLUDING REMARKS AND TAKE-HOME MESSAGES

The two case studies from Germany and India impressively illustrate how NBS can improve mental health in quantitative and qualitative ways, including the prevention and treatment of mental disease, but also far beyond this. In this chapter we demonstrated that green spaces can be considered NBS for many urgent societal challenges and provide co-benefits for mental health

by reducing environmental stressors. Additionally, NBS may target directly supporting mental health by providing resources for human–nature interaction and spiritual identification, enhancing social interaction and connectedness and strengthening mental resilience. Last but not least, lessons learned from nature-based interventions that are originally intended to support persons with psychiatric illness may provide counsel for the design of mentally supportive cities, parks and landscapes.

Access to nature provides important benefits for mental health, via multiple pathways, and with critical repercussions for many individual and social outcomes (Sangha et al., 2018). On the global scale, as an ever-increasing proportion of humanity moves to cities, with an associated decrease in contact with nature, it is important to account for what the effects of this changed experience entail for mental health. These impacts include a growing deprivation of the benefits that nature contact provides, as well as the independent pathway of increased risk for the onset of disease to which certain urban factors contribute. These impacts should be taken into account in urban planning efforts and decision-making contexts and in critical efforts to address health inequities (Jennings and Gaither, 2015). This includes working to rectify the effects of prior practices and planning decisions that have resulted in inequitable distribution of nature access within urban environments (Nardone et al., 2021) and directly addressing discrimination that can occur in natural spaces as well (Hoover and Lim, 2020; Silva et al., 2018). NBS have great potential to support urban mental health, and future interdisciplinary research and city planning may further support science on the topic and contribute to putting science into practice.

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