Sustainable Solutions in Urban Health: Transdisciplinary Directions in Urban Planning for Global Public Health

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1 Introduction

Modern urban planning concepts, having emerged from industrial cities in the nineteenth century, are heavily linked to addressing the deterioration of public health. At the time urban reforms for public health surrounded issues of water, sanitation, and air quality. Initially, public health concerns were mostly focused on physical health aspects, but in the late twentieth century, the discourse on mental health and spatial order gained momentum, observed even today as cities have evolved into more populous and technologically-dependent spaces. At the same time, a rising concern for planetary health and global environmental justice for

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existing and future generations popularized the concept of sustainability (Stephen 2013; Verbeek 2014), which has gained widespread attention since the publication of "Our Common Future" in 1987 (Brundtland et al. 1987). Sustainability, alongside environmental and public health, in terms of both mental and physical well-being, have since been percolating in the theories and practice of urban planning.

In the last three decades, there has been an emerging interest specifically in the causal influence of urbanization on public health, which has given rise to the concept of *Urban Health* with the number of scientific publications growing exponentially since the beginning of the twentieth century (Fig. 1). More recently, Urban Health research has begun to integrate with environmental sustainability studies for evident links between human health and the environment. We are now witnessing a rise of Urban Health and sustainability studies (Fig. 2). Scientific research has defined the many links between various environmental characteristics and the mental/physical health of individuals and communities. Emerging evidence also suggests that we can counteract negative health effects through nature-based solutions. Urban Green Spaces (UGS) could potentially be one of the most powerful tools to foster Urban Health. This is an emerging transdisciplinary and policy-relevant area, with the goal to inform planning and design of greener and healthier cities, through connecting planning and design disciplines, urban/environmental studies with public health, and the biomedical and social sciences.

Over half of the world's population (54%) lives in cities, half of which is now located in Asia. This number is increasing nearly 2% annually (Gatzweiler 2020). The new urban agenda published by UN Habitat in 2020 suggested that virtually all future growth of the world's population will be absorbed by urban areas (Fig. 3, (UN 2020b)). Therefore, the value of Urban Health studies to ensure sustainable planetary and public health and to promote holistic urban planning is significant worldwide. The most rapid growth rate of urbanization is seen in the Global South, where urban primacy of the major cities compared to small and medium ones is a growing challenge. More than two billion urban dwellers are expected to be added over the next three decades, a significant proportion of whom will be living in informal or slum settlements of the Global South, which raises issues of economic development and the climate crisis. It is therefore crucial to ensure sustainable planning practices for the Urban Health of these regions.

In this chapter, we provide a comprehensive review of emerging trends in Urban Health and wellbeing connected with nature-based solutions in cities or UGS, in the context of the widely understood sustainability. Importantly, we evaluate the examples of successful strategies based on case-studies from around the globe and set them within the conceptual frame of the *Harmonious Ecosystem for Sustainable Solutions in Urban Health* (Fig. 4). We further provide directions for relevant agents to improve the health ecosystem with sustainable solutions.

Urban Health
publications (#)
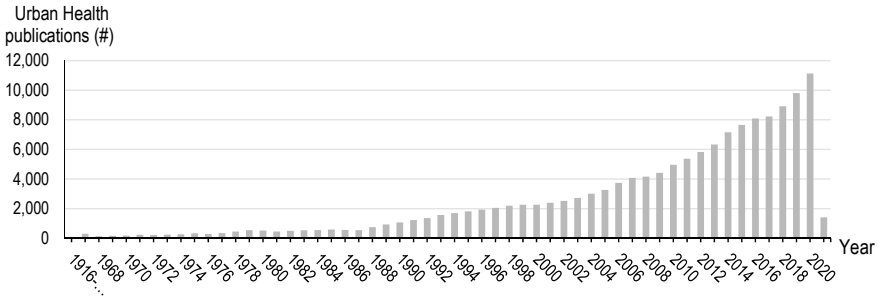
Fig. 1 Number of scientific publications on Urban Health since the first study in 1916 to January 2021 (PubMed search 01.02.2021), demonstrating an exponential annual increase over time

Urban Health and
Sustainability
publications (#)
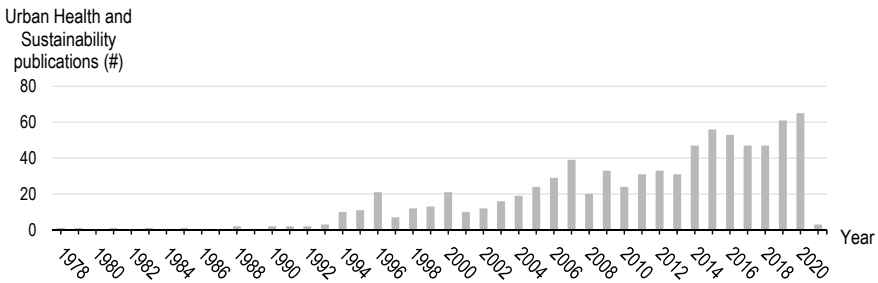
Fig. 2 Number of scientific publications on Urban Health and Sustainability since the first study in 1978 to January 2021 (PubMed search 01.02.2021), demonstrating fast growth since the first publication
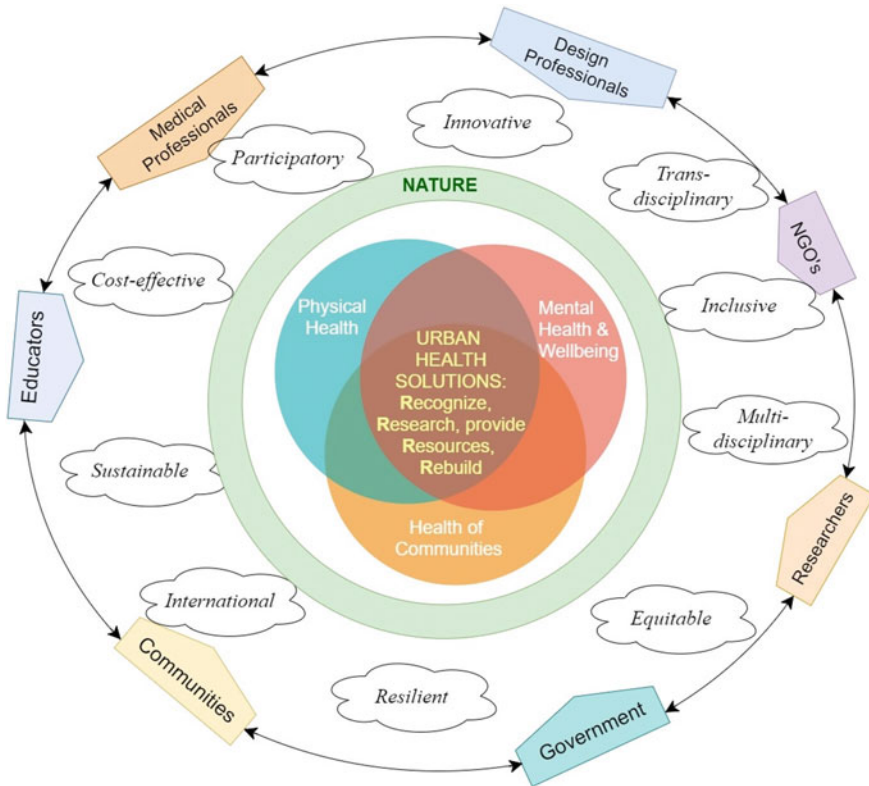
2 Urban Health

2.1 Mental Health

Broadly speaking, living in cities is bad for mental health. This is a scientific consensus, which researchers have demonstrated through multiple mixed-design studies, including meta-analyses (Gruebner et al. 2017; Peen et al. 2010). Living in cities is associated with a considerably higher risk of developing almost all mental disorders and higher disease severity compared to living in rural areas.

Considering the associations between mental health and urbanization around the globe, the results are quite consistent. Studies in Latin America and Asia have confirmed higher rates of mental health diseases, like schizophrenia or paranoias, and anxiety disorders, including post-traumatic stress disorder, in urban populations compared to their rural counterparts (Phillips et al. 2009; Prina et al. 2011). Mood disorders, such as depression, and addictive disorders, like substance addictions, were observed in cities more than rural areas in Europe (Achab et al. 2011; Jacobi et al. 2014). Further, international epidemiological studies have demonstrated the
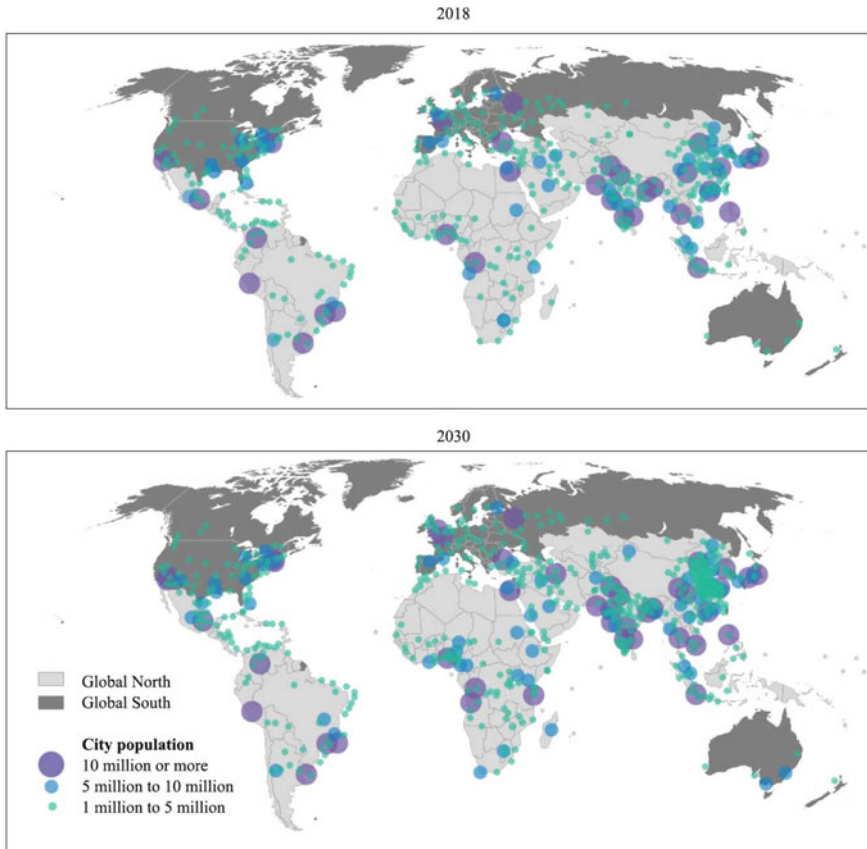
Fig. 3 Global urbanization in 2018 and projection for 2030, adapted from (UN 2018)

dose-response relationship between risk of mental illness and exposure to urban environments: the more time spent in an urban environment as a child—the higher risk of schizophrenia as an adult (Pedersen and Mortensen 2001; Van Os et al. 2010). An extensive, recent study comprising of over 900,000 participants pointed specifically to the degree of proximity to green spaces in the urban areas and development of psychiatric disorders from adolescence to adulthood (Engemann et al. 2019). The findings showed that the association between relative risk of developing *any* psychiatric disorder (borderline type, personality disorders, anorexia nervosa, other eating disorders, obsessive-compulsive disorder, neurotic and stress-related disorders, depressive disorders, bipolar disorders, mood disorders, schizophrenia and schizoaffective disorders, substance abuse) was higher among those who grew up further away from green spaces. Furthermore, rural living was found to be protective against the development of many psychiatric disorders.

Fig. 4 Harmonious Ecosystem for Sustainable Solutions in Urban Health – a Conceptual Framework

The most commonly identified potential causes are attributed to social isolation, inequality, as well as poverty and ethnical segregation in certain neighborhoods. Therefore, the higher risk of mental illness is broadly correlated with lower socio-economic status (SES), which has a cascade effect on many environmental exposures. However, correlation is not causation, so it was problematic to prove that these issues were caused specifically by poverty. Clearly, mental health disorders in cities are not reserved only to the lower SES groups—depression and anxiety, substance abuse, schizophrenia, eating disorders and dementias are observed across all income brackets (contributing to a wide group of diseases of affluence or so called *affluenza*). This suggests that more complex mechanisms are driving these negative phenomena and a bulk of them point at the quality and specificity of the urban built environment.

There are several hypotheses and theories, but the exact mechanisms and their links with the built environment remain largely unexplored. Nevertheless, it seems plausible that the environmental factors may be effect modifiers between inborn predispositions and disease outcomes. This indicates that if suboptimal

environmental factors can speed up disease progression among those predisposed, they may also, if amended, protect against disease development. One of the potential mechanisms explaining the impact of city environments on mental health has to do with increased stress caused by pollutants and noise. For example, living close to road traffic can disturb sleeping patterns and cause more irritability and aggression, which fuel mood and anxiety disorders. Another sensory mechanism processing can be linked with the visual stimulation. A typical contemporary urban environment is filled with static and dynamic, mostly abstract built-up elements tied up with a complex web of infrastructure. Maximizing the density of information through a variety of forms, colors, textures can then lead to overload of sensory stimulation. Processing all of this information by the brain, for example in the process of wayfinding, may be challenging and in effect lead to depleted cognitive resources and mental fatigue, which can further promote mood and anxiety disorders. One key characteristic of urban space is the large-scale, high density of elements (e.g. buildings, pieces of infrastructure) all fitted onto limited plots of land. Smaller individual space, as well as shortened visual outreach, can create a sort of psychological strain. This is why landscape architects and environmental psychologists value long-distance views for giving a sense of comfort, relaxation for strained eyes, reorientation from the urban life and even contributing to a sense of personal freedom (Skalski 2007).

Another complementary hypothesis links the increased prevalence of mental diseases in the cities to a disconnection from nature. Contemporary urban spaces are comprised of forms based on Euclidean geometry, but these forms do not come from nature. In fact, it is very difficult, if not impossible, to find a perfect circle or a straight line in nature. Nature, on the other hand, is plentiful with amorphic and asymmetrical forms, with its own geometry (fractals, Fibonacci sequence). Some researchers and philosophers argue that the heavy exposure to abstract forms, multiplied in cities by modern architecture, may cause an additional strain on our nervous system (Skolimowski 1988). At the same time, the exposure to natural elements does not cause such a strain and can even mitigate the strain caused by the city structures.

For thousands of years, humans have been living and evolving in rural communities with a very close proximity to nature, and only for a few hundred years have we been adapting to urban spaces. Evolutionarily speaking, we are not used to the compact environments of big cities or crowds exceeding tribal dimensions of 150–200 people and, arguably, we may be still living through a phase of adaptation. Mental health is the likely cost of this adaptation to a relatively rapid environmental change. The idea behind Urban Health planning is that while properties of urban environments can cause mental health problems, they can also be used for the mental health promotion of well-being, or the prevention of psychological illness. Quite recently, scientists and professionals from various disciplines have started joining forces and expertise to uncover the mechanisms to mitigate the psychological strain or mental health promotion through urban space planning and design. In effect, many new disciplines have emerged such as *Neuroarchitecture, Environmental Neuroscience,* and *Evidence-based design*.

After years of eradicating the city greenery to allow for infrastructure development, it became clear that introducing nature into the city life is one of the most powerful tools to mitigate the negative mental health outcomes we experience from living in the cities, not only through the reduction of noise, pollution and urban heat, but also through the provision of contact with nature linked to sensory and attention restoration. Urban parks, forests and gardens, green roofs, pocket parks and restored riverbanks form the green infrastructure of the city, as opposed to the *grey* infrastructure of the built environment. Their contribution to humans was initially summarized within the ecosystem services approach, according to which, all green spaces directly or indirectly serve us through providing resources, supporting natural cycles, regulating the damage caused by human activity and providing aesthetic, educational and recreational values. For example, an important *Provisioning* ecosystem service is generating fresh produce for communities that can be grown in allotment gardens. An example of a *Supporting* service is allowing rainwater to infiltrate to the ground (instead of the sewage) and join the natural water cycling. An example of a *Regulating* ecosystem service is sequestration of carbon dioxide from polluted air, and an example of a *Cultural* ecosystem service is recreation—allowing people to bike in the urban forest. Nonetheless, in the light of recent developments, the provision of mental health and well-being by urban natural ecosystems has become a key aspect of health promotion in urban spaces.

UGS, with their specific types and forms, can be the main and most importantly sustainable tool for mental health and well-being promotion in urban areas. Promoting universal access to UGS, especially for persons with physical or mental disabilities, or non-clinical populations with high stress exposure is also strictly aligned with the Sustainable Development Goal 11.7 and 11.3.[1] Moreover, the newly emerging research and practice of investigation and incorporation of ecosystem and biodiversity values into the urban fabric acts as a medium to connect all stakeholders participating in urban planning and development processes. This transdisciplinary approach can balance the economic and social inequality (Sustainable Development Goal 15.9[2]) with the provision of high-quality salutogenic UGS.

2.2 Physical Health

The impact of urbanization on physical health is complex. On the one hand, the positive influence that rapid urbanization has had on the increase and ease of access

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[1] SDG 11.7—Provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities; SDG 11.3—enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

[2] SDG 15.9—Integrate ecosystems and biodiversity values into national and local planning, development processes and poverty reduction strategies, and accounts.

to healthcare, running water, better sanitation, and nutrition cannot be denied. Unfortunately, at the same time, we have observed a dramatic increase in the prevalence and severity of diseases attributable to urbanization, which disproportionately affect the lower SES groups and are predicted to further increase over the next decades in the absence of bold and dramatic urban planning changes.

Urbanization has most profoundly impacted the rise in chronic respiratory diseases, such as chronic obstructive pulmonary disease, asthma and pulmonary hypertension, which are responsible for three million deaths annually (6% of all deaths) and significantly reduce quality of life (Godfrey and Julien 2005). Urbanization has also caused an increase in other non-communicable diseases (i.e. diseases that are not transmittable from person to person) such as metabolic and cardio-vascular diseases (e.g. obesity, hypertension and type 2 diabetes (Cyril et al. 2013)), which are the most common causes of premature mortality worldwide, certain types of cancer (e.g. lung cancer, colorectal cancer (Monroe et al. 1992)), auto-immune and allergic diseases (e.g. eczema, asthma (Schram et al. 2010)), and the speed of spread and prevalence of infectious diseases (SARS, MERS or most recently Covid-19 (Alirol et al. 2011)). Importantly, urbanization has brought diseases typically associated with the Global North to the Global South. For example, the speed of progression of non-communicable diseases like obesity or diabetes in the Global South is currently very alarming (Goryakin et al. 2017) and is larger than in the Global North. This is thought to be mediated by the stages of economic development (Angkurawaranon et al. 2014). Similarly, while the Global North eradicated infectious diseases as one of the leading causes of death, infectious diseases, like respiratory infections and diarrheal diseases, are still a leading cause of death in the Global South (Neiderud 2015). Rapid urbanization in the Global South is considered to further increase this problem and is a serious cause for concern.

While we can clearly establish the negative effects that urbanization has had on health, it is more difficult to identify *why* that is. There are a few potential explanations of why urbanization contributes to the development of ill health, but most of them have a common root cause, which is the reduction of green spaces in the human living environment. Both in the Global North and the Global South, as our cities grew larger, the natural ecosystems in the cities were shrinking. This reduction had a cascade effect on the range of disease-promoting factors. UGS reduce temperature and noise, increase exposure to diverse vegetation, improve air quality, and promote mild and moderate-to-vigorous physical activity. Consequently, the loss of the UGS and biodiversity in cities leads to increased concentrations of air pollutant levels and allergens, and decreased exposure to diverse environmental microbiomes, causing the so-called 'dysbiotic drift' (Prescott et al. 2018). With higher concentrations of allergens and pollutants, we have observed the rise in the prevalence and severity of respiratory diseases and lung cancer (Hemminki and Pershagen 1994). This is more predominant in the Global South than the Global North, and developing Asia accounts for two-thirds of the global burden (Cohen et al. 2005). At the same time, lower exposure to diverse vegetation in the UGS is considered a strong risk factor for auto-immune disorders

and allergic disease, which are particularly prevalent in urban populations compared to rural ones. These disorders can be observed as early as in the first 12 months of life and track to adulthood (Botha et al. 2019).

As the cities grew bigger and the UGS reduced in size, we removed natural walking paths and increased reliance on public transportation systems, which inherently discourage walking and promote more sedentary lifestyles. The growth of road networks without walkable paths and lack of the UGS with recreational areas, as well as the long distances to reach the UGS, which are often un-walkable, are both a physical and psychological barrier to physical activity. On the one hand, we have little physical access to the UGS. On the other hand, the motivation to overcome those physical barriers decreases, not only because of the effort required, but also because of time limitations, particularly among the lower SES groups, who are more likely to have physically demanding jobs and less motivation for leisure physical exercise. Furthermore, due to lower pedestrian access to grocery shops, we have seen a rise in the so called 'food deserts', which are areas within city centers with poor access to healthy foods and fresh produce. Food deserts are predominantly present in the areas inhabited by low-income earners and are a causal factor contributing to both malnutrition and obesity. Historically, food deserts have mainly been associated with urban areas in the Global North and less is known about them in the Global South.

Low levels of everyday physical activity and reduced access to fresh produce are a major factor in the development of cardio-vascular and metabolic diseases like obesity and heart disease, sarcopenia and colorectal cancer, which were once considered diseases of advanced age, but in the modern world already demonstrate in early childhood. Loss of the natural environmental protection from heat and noise provided by the UGS is a further discouraging factor for spending time outdoors, particularly during the hot seasons in moderate climates, and throughout the year in tropical and subtropical climates. This is particularly prevalent in the so-called "heat islands", urban areas significantly warmer compared to their surroundings as a direct result of human activity, which impact the health of all animals including humans and have an active influence on meteorological conditions like rainfall, wind, and even season duration.

Furthermore, high noise pollution in urbanized areas has obvious detrimental effects on hearing and mental health, and some less obvious secondary effects on disease promoting factors. For example, excessive urban noise can lead to sleep problems, migraines, and physiological effects resulting from stress and hormonal changes that promote cardio-vascular disease. These problems may be worse in the Urban South, where there are often no laws and regulations on noise pollution that most, if not all, countries in the Global North have introduced.

Finally, urbanization increases rates of contact and the mobility of dwellers, both within and outside the cities, thus promoting the speed of the spread of pathogens. For this reason, infections have the potential to spread rapidly, which poses epidemiological risks. This has been particularly evident during the recent Covid-19 pandemic, where 90% of all infections were in urban areas (UN 2020a), or earlier examples of SARS and MERS in Asia, or frequent Ebola outbreaks in Africa,

which are quickly contained in rural areas and difficult to control in urban areas (Okware et al. 2015).

There are two important questions in the field of Urban Health that remain unanswered. First, *can* cities be made more healthy places? And second, *how* to sustainably improve Urban Health in both the resource-rich Urban North and the resource-poor Urban South countries? In recent years we have seen multiple longitudinal and epidemiological studies highlighting the positive impact of proximity to UGS on mental and physical health. For example, higher proximity to UGS predicts lower rates of cardio-vascular diseases (Seo et al. 2019), lower odds of occurrence and remission, better prognosis for the prevention of cancer (bladder, breast and lung (Porcherie et al. 2021)), and lower rates of respiratory diseases and allergies (Tischer et al. 2017). One of reasons for the lower prevalence of diseases close to UGS is increased physical activity that promotes better health and increased microbial colonization of one's microbiome, which improves immunity and hence mobilizes the body's fighting mechanisms against pathogens and mutations. Intuitively, we might therefore expect that creating more UGS, even if they are small, will improve the health of urban populations. Surprisingly, research evidence from clinical trials demonstrating this causal mechanism is still scarce (a PubMed search of the term "urban green spaces randomized clinical trial" returned 12 results), highlighting the need for methodologically-sound, randomized clinical trials showing clear evidence that creating more UGS will improve the health of urban populations. This direction is necessary to address the Sustainable Development Goals 3, 9, 11,[3] and importantly, it would also reduce health disparities between the rich and the poor, thus addressing goal 10. It is nevertheless encouraging that in recent years it has been recognized that cities *should* in fact be healthier, and there has been a concentrated effort to improve the healthfulness of cities. While we have evidence for sustainable solutions for Urban Health, their effectiveness is yet to be determined.

2.3   Health of Communities

While mental and physical health consider the individual, the idea of the health of communities considers inclusion and active contribution of the least advantaged populations in the formulation and design of the urban space. A collective vision of health and wellbeing promotes accessible UGS, which can be shaped and shared by all citizens and introduces a harmonious relationship between humans, the urban space, and nature. This relationship is forged through the exchange of ideas and actions of the communities to build and modify their own local urban environment.

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[3] SGD 3—Ensure healthy lives and promote well-being for all at all ages; SDG 9—Industrial, innovation and infrastructure; SDG 11—Make cities and human settlements inclusive, safe, resilient, and sustainable.

In the process, the community structures are strengthened creating subjective feelings of territorial belonging, sense of place, social cohesion, and sense of community (Christens 2012b). In fact, these feelings of mutual support have been found to foster collective actions on a larger scale demonstrated in self-organizing social movements and manifestations through place-based strategies in their local UGS (Escobar 2004). In this case, communities begin to transform the UGS, introducing opportunities for bottom-up community gardening and farming.

The participation of communities in the making of cities is not a new concept (Jacobs 2016). In fact, important advances have been made to introduce new sustainable agendas, such as the SDG, which aim to tackle inequality and poverty through participatory governance and inclusive urban spaces (SDGs 1, 10, 11[4]). Nevertheless, a major threat to these initiatives in both the Global North and South, are the confounding political agendas introduced by neoliberal urbanism, which is an urbanism subordinated by capital that seeks for higher positions in the global urban network through the development of mega infrastructures (Vives Miró 2011). The problem with these developments is that communities are not included in the process and are often displaced as they settled in the areas destined for (re)development. In developing countries, there are extreme cases in which low-income communities are neglected participation and are dispossessed from their settlements to give place to urban development. One example can be found in the slums in Bangladesh, settlements that for the last decades have been consolidating due to rural to urban migration. It is estimated that nearly 90% of the slums are in government lands and 70% of them are tenants (Razzaque et al. 2019). Although the life conditions in the slums are scarce and extreme, they are often settled illegally in prime areas of the city, making them vulnerable to evictions as the occupied land is planned for new constructions (Fig. 5).

This phenomenon, also known as urban gentrification, has gained importance in the last decades among scholars and non-governmental organizations. For instance, in developed countries, disadvantaged or lower income communities are often exposed to urban gentrification when urban mega projects take place in their neighborhoods. In this case, the area(s) are destined for (re)development to attract higher income populations, which cause a form of exodus of the communities to remote areas in the cities. The place-connection, community ties, and local business are lost during this process. Additional negative impacts of neoliberal urbanization manifest in social problems such as social isolation, polarization, intolerance, and exclusion towards different sectors of society (i.e., religion, race) as commonly seen in developed countries. While these problems are intrinsically linked to the driving forces of development (i.e., globalization) and its political and financial structures, the most affected are urban residents caught in a continuum of rapid changes in their social patterns and cultural rhythms (Friedmann 2007). The frenetic lifestyles and

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[4] SDG 1—End poverty in all its forms everywhere; SDG 10—Reduce inequality within and among countries; SDG 11- Make cities and human settlements inclusive, safe, resilient, and sustainable.

Fig. 5 Tjagon slum **a** before and **b** after eviction. Dhaka, December 2019 and March 2021 (Photos by Nazwa Tahsin, private archives)

lack of familiarity causes the detachment of people from the process of creating place, meaning, sense of belonging, and community bonding in the urban space, hence less tolerance, reciprocity, and social capital. This, according to scholars has created a sense of 'placelessness' altering the urban realm into a 'network of power and disempowerment' (Friedmann 2010), in which the participation of the collective in the transformations of the urban environment is negligible.

In the Global South, land dispossession is owed to gentrification and/or climate change. Thousands of low-income, land-dispossessed communities unable to secure land settle in high-risk areas prone to geological and anthropogenic disasters. The lack of adequate infrastructure, water, sanitation, overcrowding, environmental pollution, financial instability, and lack of access to UGS severely compromises the mental health and well-being of these populations, giving rise to dysfunctional social behaviors such as extreme violence. Under these extreme social and environmental conditions, the ill health and poor wellbeing of low-income communities is exacerbated. Nevertheless, although the physical and psychological burden that low-income communities face has been recognized, there has been little improvement in policy making that integrate mental health programs in low-income communities in the Global South (Patel et al. 2016).

Recent studies have reported the collective efforts taken by communities to prevent the negative impacts of neoliberal urbanization. These social movements have diversified from integrating discourses of social justice to expose cases of environmental injustices in both Global North and South countries. There are three types of environmental injustices as discussed by Schlosberg (2009): distributive (how goods are unevenly distributed), procedural (groups have equal access to decision-making), and lack of recognition (discrimination of groups due to race or identity). Clearly these typologies reveal the complexity of the multi-scalar relationships that create the venues for environmental injustice in a specific location (Debbané and Keil 2004). In the Global South, several cases have exposed the inequitable and unfair actions of the state that prioritize the interest of the higher socio-economic classes over vulnerable low-income communities. One example is the flood-control infrastructure (i.e., flood walls, dikes) built to increase infrastructural resilience in Thailand—the control systems were carefully developed to

protect urban centers and industrial states. Nevertheless, the location of these floodwalls created uneven exposure to floods imperiling the low-income communities located on the peripheries (Marks 2016). Interestingly, these injustices, also promoted civic mobilizations of low-income communities. In a way it can be said that when few sectors perpetrate injustices over the most vulnerable, in turn, these injustices create platforms of civic contestation against inequality. These contestations have been supported by international policies and regulations, especially in European countries dedicated to fund projects that help reduce the inequalities caused by industrial environmental degradation. Although, it is possible that the positive tangible effects of these policies will only be visible in several generations, as years of injustice cannot be wiped out in a single decade.

In the first type of environmental injustice (distributive) is also found the inequitable access to UGS and ecosystem services of marginalized social groups. This issue has been widely discussed by scholars, who have concluded that access to UGS is often stratified based on income, ethno-racial characteristic, gender, and age (Wolch et al. 2014). Similarly, it has been highly discussed how this form of environmental injustice can increase health disparities of low-income neighborhoods (Jennings et al. 2019). Although the clearest solution is to increase access to UGS in marginalized or low-income neighborhoods, the interventions should be carefully planned and designed to avoid introducing green or ecological gentrification when new UGS are built. Recent studies have found that UGS projects that have a political agenda of sustainability have a potential to be inequitable, as the land price speculation increases, as well as the property value and communities become dispossessed of their assets (Anguelovski 2016). One example is the representative mega green-infrastructure plan (Green Belt) developed in low-income neighborhoods in the city of Medellin, Colombia. The beautification of these neighborhoods through green infrastructure has resulted in the seizure of part of these territories to transform into touristic hubs for the more affluent (Anguelovski et al. 2019). This could affect the sense of ownership towards the green place, as well as the residents' social capital and activism (Fig. 6). Similar cases have been found in cities in developed countries (i.e., Portland, United States) (Anguelovski 2016).

Although increasing access to urban greening can have a significant positive effect on the individual's health and well-being as discussed previously, the questions of how, with who, and when to do it should be considered if green or ecological gentrification is to be avoided. To envision new forms of community health that promote agendas of inclusion, the communities should be collectively conscious and find the means for community organization and action to participate in the transformation of their local UGS. An example is found in the bottom-up nature community-based solutions created in existing UGS that integrate sustainable urban farming and gardening (Fig. 7). The participative character of these solutions fosters active engagement and direct contact with nature, which can directly benefit the mental health and well-being of the communities by preventing social isolation of the most vulnerable populations (i.e., elderly, disabled) and could provide social interaction and networks for migrants. Interestingly, after the outbreak of the Covid-19 pandemic, several of these community interventions were

Fig. 6 Jardin Circumvalar Campo Santo Park after the intervention of the government, Villatina Comuna 8, September 2017 (Photo by Diana Benjumea, private archives)

developed in existing UGS by communities in the Global North and South. Some scholars have argued that these interventions could become secondary support networks for the cities' UGS (Benjumea and Olszewska-Guizzo 2021; Krasny and Tidball 2012). However, the impact of community nature-based solutions expands beyond the physical improvement of the urban space. In fact, the biggest benefits have been recorded in the subjective psychological sense of wellbeing of the communities (Jennings and Bamkole 2019). These benefits are explained by the feelings of stewardship and control over their lives and proactive functions (Krasny and Tidball 2012) reinforced by community ties, economic opportunities (Hwang and Feng 2020; Michalski et al. 2020), generosity (Weinstein et al. 2009), community empowerment (Christens 2012a), and increased social capital (Jennings and Bamkole 2019). In short, community-based nature solutions provide evidence that mental health and equitable access to UGS is best achieved when the communities play an active role in the making and/or transformation of UGS.

3   Directions in Sustainable Urban Health

The issues of mental and physical health at the individual level, as well as the level of communities in the context of urbanicity, are being gradually recognized by institutions. Funders like the Rockefeller Foundation and the Wellcome Trust have oriented their programs towards systemic thinking, inherent in the idea of global health. The International Council for Science Programs, Future Earth, United Nations University's International Institute for Global Health have also embarked on the journey to establish systemic solutions to Urban Health issues (Siri 2016). Simultaneously, the European Commission with its *Green New Deal* agenda voices out the powerful message: "The solution is in nature" in its *Future Brief—Science for Environment* (EU 2021).

Fig. 7 Nature community-based solutions. Left: Ground-up Initiative, Singapore; Right: Medellin Comuna 4 Moravia (Photos by Diana Benjumea & Maleza, private archives)

Our *Harmonious Ecosystem for Sustainable Solutions in Urban Health* (Fig. 4) goes beyond conceptualization and provides directions for four specific actions to be taken in regards to the living environment to develop these solutions. We propose the directions for action to be focused on the 4Rs: Recognize, Research, provide Resources, and Rebuild. As long as all actors included in the conceptual frame can be involved in the process, we argue that the leaders of the positive change should be the researchers and policy makers. They shall be the mediums to convey the complex processes, building on the powerful driving forces of scientific curiosity and public service, or both. Below, we discuss the specific directions for researchers and policy-makers.

3.1 Researcher

The scientific community needs to formally recognize the impact of cities on physical, mental, and community health delivery as a new ecosystem service. This concept needs to be then addressed in **multidisciplinary** research initiatives (including epidemiologists, data scientists, bioinformaticians, architects, human geographers, among other specializations), which may well be a starting point for creating novel research areas. One of the potential causes of the slow adaptation of the Urban Health discipline to mainstream research could be methodological issues surrounding some of the earlier work in this field, and a lack of studies demonstrating causality. Namely, the majority of evidence is based on short-term observational studies. There is a profound lack of experimental evidence that would demonstrate causality, too few longitudinal population-based cohort studies that assess long-term impact, and too few translational randomized-control intervention trials in this field. Without such research, it is difficult to firstly convince policy-makers of the causal links between environmental factors and ecosystem health, and secondly, demonstrate with a strong probability that modifying certain environmental factors will have a measurable and clinically significant impact on

ecosystem health in the short and long term. It is also difficult to convince policy makers to direct, the often-limited, funds to (re)build the cities following the recommended advice.

Furthermore, the research needs to use sound methodologies with ample sample sizes and multi-disciplinary committees to ensure the highest scientific value and minimize the sources of bias to allow for replication in various contexts and across different climatic and social realms. At the same time, while widely replicable, the studies should also aim to establish the context and population-specific environmental determinants of health and well-being, for example, community gardens with specific features adapted to the local climates and area-specific populations. This may be challenging to achieve in resource-poor countries in the Global South, so to address this issue, research initiatives should foster **international** consortia to promote such context-specific adaptations for Urban Health solutions and should also provide funding for research and translational efforts in developing countries of the Global South, which have fewer resources for research efforts.

International, multi- and **transdisciplinary** collaboration is paramount to introducing Urban Health research as a mainstream solution for public health. Furthermore, improving the methodological quality and testing the efficacy of Urban Health solutions in intervention studies based in clinical settings will bring us closer to lobbying for Urban Health and self-care solutions to become complementary forms of treatment to classical and traditional pharmacological and lifestyle change solutions, recommended and prescribed by general practitioners. Based on the research to date, some of the most promising nature-based Urban Health solutions that require validation through intervention studies include passive and active exposure to certain types of landscapes (e.g. contemplative scenery, regular nature exposure for urban kids, park prescription programs, horticulture therapy sessions, among others). To this end, it is important for them to be **cost-effective** in the long term. To achieve this, we need to develop models to estimate the monetary public health value of these solutions to justify the return of investment and economical gains of protecting the natural environments in cities. While we might expect that the long-term public health value of sustainable Urban Health solutions will greatly outweigh the initial costs associated with (re)building our cities, there needs to be sufficient evidence from sources such as computational simulation studies to demonstrate feasibility. More financial support from the Global North and financial assistance from the international corporate structures, particularly those with prominent presence in the Global South (e.g. food and beverage companies, coffee traders) might be necessary to develop these solutions in the Global South.

3.2   Policy Makers

Policy making will mainly be informed by research efforts and approaching various SDGs in a synergistic manner, rather than each of the SDGs separately. Actions for

policy makers should focus on re-greening cities and promoting the **equitable** access to safe, green spaces in cities. This should focus on improving the proximity and walkability to UGS (e.g. less than 300 m walk to a green space from every household), as well as safety of the experience, such as lighting and maintenance, which are extremely important in poorer areas of the Global North and in the Global South. UGS should provide spaces for active and passive recreation (playgrounds, exercise areas, contemplative spaces (Olszewska et al. 2016)), additionally testing various **innovative** ideas, such as solutions to promote working in the UGS. These can include providing WiFi in the UGS, provisioning seating arrangements with tables and shelter from the atmospheric conditions. Importantly, we need policy makers to recognize the social inequalities in the delivery of ecosystem services and begin more rapid and dramatic transformation in the most vulnerable areas.

Inclusive and **participatory** approaches, such as engaging all age groups in the design and construction of the community garden, should be prioritized in order to enhance local community bonds and boost the sense of place stewardship. To this end, the idea of urban farming is by far the most promising through the provision of fresh produce (especially important when linked to food security issues), and the strengthening of community bonds and mental/physical health.

Besides working on the quality of the UGS, policy makers need to foster multi-stakeholder collaborations and invite experts and professionals, as well as communities, to the table. This **transdisciplinary** approach (e.g. consultations, social campaigns) may bring beneficial results in terms of more health awareness. Introducing Urban Health and sustainability concepts as integral components in basic school curriculum will additionally promote awareness from a young age. Again, the important caveat here is the need for stronger research evidence in order to introduce these concepts to the communities.

4   Conclusions

Environmental factors affect both mental and physical health and as such play an important role in the health of communities. On the one hand, poor access to the UGS in the cities has been linked to depression, anxiety, and a range of other psychiatric diseases, as well as poor respiratory, metabolic, and cardio-vascular outcomes. On the other hand, an emerging body of evidence suggests that we can use the built environment to build resilience against these diseases and potentially reverse them, thus improving the health of communities. Providing easy access to the UGS, especially designed to promote health and treat diseases across different contexts, may be a safe, cost-effective and, most importantly, sustainable solution to improve individual and community outcomes, while at the same time restoring the functional natural ecosystems in cities.

The goal is to design and implement innovative and sustainable Urban Health solutions to support the growth of resilient communities. In order to achieve this, there is a need for a concentrated and harmonious effort from multiple agents,

including researchers, NGOs, clinicians, educators, and, most importantly, policy makers. High quality, impactful translational intervention studies funded by local, national, and international institutions with involvement of private corporations will be required to develop and convince policy makers of the most optimal solutions for public health in both the Global North and South. This has to take into consideration the disparity between the Global North and South with the latter requiring greater initial funding.

The overarching directions that we propose for all the agents concerned with individual and community mental and physical health are summarized in Fig. 4, and center around the **4R**s:

- **R**ecognize that individual and community health is impacted by, and could potentially be improved by, the Sustainable Solutions in Urban Health
- Design methodologically sound translational **R**esearch studies that show evidence that individual and community health can be improved by the appropriate Sustainable Solutions in Urban Health
- Provide the **R**esources to implement Sustainable Solutions in Urban Health
- (**R**e)build the cities prioritizing the Sustainable Solutions in Urban Health, starting in the most vulnerable communities.

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