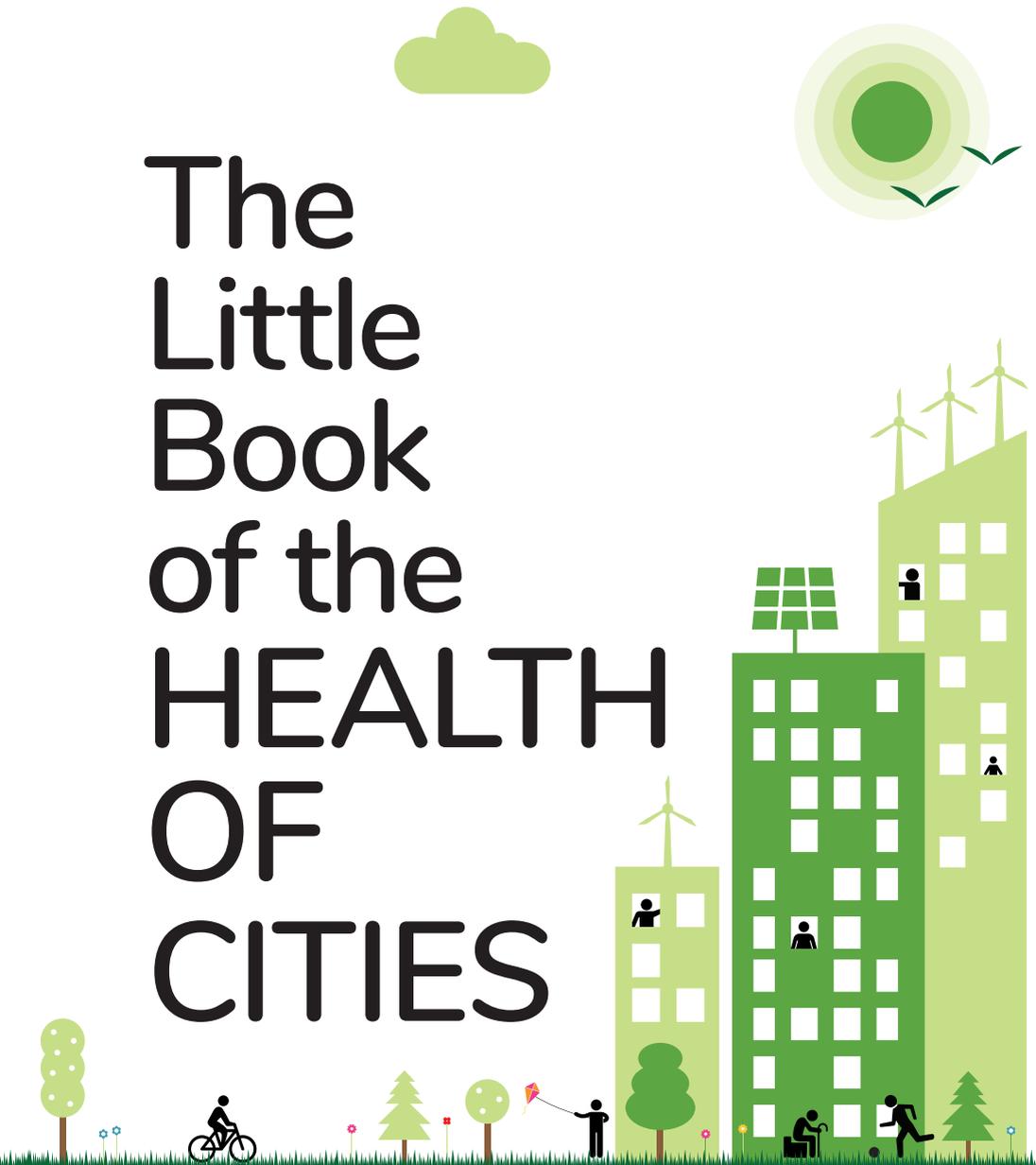


# The Little Book of the HEALTH OF CITIES



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## From the Pulse of the New Urban Agenda to the Heart of Sustainable Development

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# What this Little Book is about

Since the beginning of the history of cities after the Neolithic revolution, around 7500 BCE, cities have been centers of economic development and cultural creativity. The year 2008 marked an historical turning point. For the first time in history, more than half of the global population lived in cities. However, with the rise of cities, we note that one billion people live in slum conditions worldwide and the numbers are rising. In addition, natural ecosystems and their life-support functions are being degraded by resource use and pollution, which stems largely from cities and contributes to climate change. These changes have negative repercussions and threaten the health of people and the planet. Therefore, the entire notion of an urban advantage and urban sustainability is, therefore, being questioned and needs to be rethought.

In this Little Book we suggest that rethinking urban sustainability needs to be done by taking a systems approach. We illustrate how human beings and cities are integrated, complex living systems and that the health and wellbeing of people is compromised by degrading their functioning through various forms of pollution. We need to promote and protect health, both for the people who live in the urban environment and of the urban environment itself. According to the World Health Organization (WHO, 1998) “A healthy city is one that is continually creating and improving those physical and social environments and expanding those community resources which enable people to mutually support each other in performing all the functions of life and developing to their maximum potential”. Costanza and Mageau (1999:105) have proposed that “a healthy ecosystem is one that is sustainable – that is, it has the ability to maintain its structure (organization) and function (vigor) over time in the face of external stress (resilience).”

We recognize that as different fields of science compete for attention and resources, there is a tendency to put each of those fields at the center of attention. However, for achieving the global sustainable development goals,<sup>1</sup>

<sup>1</sup> In 2015 the Sustainable Development Goals (SDGs), were adopted by the United Nations Member States as a call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030.

there are many entry points and each of the goals are connected to many others and can be put into the center as a starting point for action. Although “health” is one of the goals (SDG3), in this Little Book, we do not merely aim at stressing the importance of the health goal and that of all who are in the health and related professions. **The idea we present in “The Health of Cities” is one about cities as living urban systems, which need to be healthy to sustain healthy human lives and a healthy planet.** Today, people are in the position to create the favorable or impossible conditions for life on earth. Cities are the places where people are the most creative and productive, so it is imperative that we focus our energies on how to make our cities and their populations as healthy as possible. For that reason, former UN Secretary General, Ban Ki-Moon, on various occasions said that, “Our struggle for global sustainability will be won or lost in cities.”

As we stated earlier, we describe cities as ‘complex systems’. When Adam Smith (1776) wrote “The Wealth of Nations”, it was an investigation into a complex system: the economy. A central theme of his book was how a nation can flourish, grow and create wealth, by self-organization – a spontaneous process in which local interactions of subsystems, components and agents leads to the creation of some form of order, structure or functions.

There is a role for an authority, such as a regulatory organization, which can ensure property rights and the rule of law. Nevertheless, cities are also self-organizing, which is why people are attracted to live in them. City structures can unlock the creative capacity of people to interact and engage with one other to provide public goods and services, improve interconnectivity, enhance communication and engage people in the co-creation of urban health and well-being.

When cities are viewed as complex systems, the urban health issues we deal with appear as symptoms of deeper-lying failures in systems, such as failures to communicate, to cooperate, pass on and process information in time, and respond to available information and knowledge. The result of such failures are lost years of human lives from diseases, disasters and pollution. Those system malfunctions are “unhealthy”; they make cities unpleasant, risky and even deadly places to live in, for example, due to pollution of air, soil, water, light and sound, and they compromise people’s physical, mental and social health. Health must, therefore, be seen as a systemic concept

and as an integrator for bringing different stakeholders and representatives of different knowledge and cultures together to act collectively and intelligently and to make cities liveable for people and sustainable for the planet.

Many urban system failures occur due to barriers in communication and cooperation, for example, when public health and urban planning professionals use different languages, concepts and mental models; when knowledge does not get implemented into policies, practices and behavioral change; or when clean technologies do not get adopted due to economic rivalry or political disputes. In this Little Book, we look at cases of such urban failures, but also urban successes, when people cooperate across different organizations, at different levels of governance.

To overcome the barriers that lead to sick cities, a systems approach is not only useful but also imperative. A systems approach starts with the recognition that a city is a complex system, which provides multiple goods and services. Then, in order to understand the complex urban system, the systems approach promotes the application of a variety of different scientific methods and models to enable the composition and functioning of a complex system to be better understood and improved. The other component of a systems approach is to engage people in co-producing knowledge and co-creating solutions to prevailing urban health issues of their neighborhoods and cities. The people who live within the urban systems, who are engaged and have intimate knowledge of their environments are the ones who could help change or modify the systems and they are integral part of the whole process.

In this Little Book, we present cases, initiatives and projects which address different aspects of the systems approach and then draw lessons for all who have a stake in the health of cities: the majority of people on earth.

**That's what this Little Book is about. It explains urban health today. It explains how cities function as complex living systems, how urban, human and planetary health are connected, and what cities around the world can learn from one another. It challenges every one of us to contribute to our own health by contributing to the health of our cities.**

# How is the Health of Cities Today?



Most people on earth live in cities (Figure 1). Never before in human history, have cities been the source of wealth for so many people as they are today (Rydin et. al 2021). But now we realize that the materials and construction standards used to construct these urban buildings and the energy we use to heat and cool them feed into longer climate feedback cycles that are having significant and dramatically adverse effects on human health. For example, in rich countries, urban planning allows low housing density, which leads to high per capita carbon emissions from people using their cars to get around, a pattern of living which is generating long-term adverse health consequences for future generations. In cities that are more compact and where people live in apartment buildings, rather than sprawling stand-alone buildings, people are more likely to walk, or cycle around, or use public transport, which means they have lower average body weight and are fitter and there is less traffic pollution (Stevenson et al. 2019).

In poorer countries, where rules of land ownership are not formalized by land titles, there are large informal settlements around cities for those moving from rural areas. These informal settlements, like the Rookeries in 19<sup>th</sup> century London, or Kibera, one of the world's largest slums on the outskirts of modern-day Nairobi, are often self-organizing. Yet, Kibera has impressive examples of advanced infrastructures, such as renewable energy schemes, but generally lacks basic physical and social infrastructure, like adequate schools and health services. Moreover, the lack of enforced

building standards mean that the materials used to build houses like discarded asbestos sheets are often dangerous to health.

When migrants are confined to the outskirts of the city, they often have to trade-off cheaper rents with expensive, time-consuming travel costs, which may not leave them better off (Zhao et al. 2010) and lead to increased traffic pollution in the poorer areas. This can lead to a pattern of cumulative health problems.

Therefore, the health of cities, be they compact or sprawling, located in higher or less developed countries very much depends on how they have evolved or have been planned. The productivity, infrastructure, environmental quality, equity and quality of life can be an indicator of the health of cities, as measured, for example, by the City Prosperity Index (CPI) or the Urban Health Index (UHI).

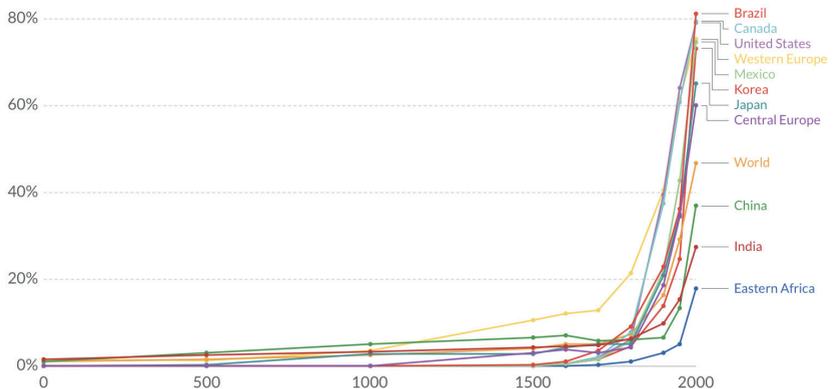


Figure 1. Share of the population living in urbanized areas (Our World in Data, 2019)

# The Health of Cities Globally and in China

In 2013, UN-Habitat introduced the City Prosperity Index (CPI), which was applied to 69 cities globally. The CPI included five dimensions to determine the quality of life in cities:

- productivity;
- infrastructure;
- environment and equity;
- quality of life;
- health (this is one of the subcomponents of the quality of life dimension, with adjustable criteria which reflect people's perception of what matters).

Classification of cities by CPI value resulted in regional brackets, with cities in the developed world populating the top two brackets (CPI of 0.900 or higher), most African cities in the bottom two brackets (CPI of 0.600 or below) and Asian and Latin American cities, which made up most of the third and fourth brackets, which have CPI values of 0.700–0.799 and 0.600–0.699, respectively).

In 2016 WHO and UN-Habitat published a global report on urban health. Different measures have been used to assess the health and wellbeing condition in which cities are, with the results being varied and not easily comparable. WHO's (2014) Urban Health Index (UHI) is a composite measure of population health adapted from the Human Development Index. The index combines nine determinants of health indicators covering the social and physical environments and health service coverage. The nine indicators include access to water and sanitation, use of solid fuels, women's education, two indicators on women's knowledge of HIV (each weighted as 1/2), and three child health service coverage indicators (each weighted as 1/3).

The UHI has a range from 0 to 1. The closer to 1, the better are the opportunities and urban environments for health. Key findings from the 2016 Global Report on Urban Health was that:

- country-level wealth is not always a good predictor of urban health. Some upper-middle-income countries had very low UHI values for their cities;
- megacities in low and middle-income countries have worse conditions for health than smaller cities;
- conditions for health vary widely within the same geographic region and within cities. In Africa, Nairobi (Kenya) has the highest UHI, followed by Mbabane (Eswatini) and Windhoek (Namibia). In the Latin America and Caribbean (LAC) region, Bogota (Columbia) had the highest UHI value;
- those cities in Africa which were effected by the 2014-2015 Ebola outbreak were among the cities with the lowest UHI.

Some of the most worrying trends in urban change today are:

- increasing urban population numbers and increasing numbers of people living in slums. The World Cities Report (2016) finds that around a quarter of the world's urban population lives in slums;
- increasing inequalities; the bigger the city the wider the income inequalities;
- increasing prevalence of non-communicable diseases; the urban environment is now one of the major causes of disease, injury and death (Sarkar and Webster 2017);
- ageing cities; the older population grows faster in cities than the overall population and faster than in rural areas (OECD 2019);
- effects of climate change on cities; health of people in cities will be affected by rising sea levels, increasing precipitation, floods, more frequent and stronger storms and extreme heat and cold (UN Habitat 2019);

- growing demands (and scarcity) for water, food and energy for cities. Two-thirds of the global population (4.0 billion people) live under conditions of severe water scarcity at least one month of the year; 14 of the world's 20 megacities are experiencing water scarcity or drought (Mekonnen and Hoekstra 2016);

What matters more than comparing cities' measures of health or prosperity is that cities engage in the exercise of collecting metrics and doing the analysis of the condition which they are in. Official information is generated from a multitude of fragmented and poorly coordinated institutions, but by gathering data cities provide accessible information to decisionmakers and citizens, that can also serve as an accountability tool for the public.

Because cities are complex systems, it is not easy to find common patterns in cities, which make them healthy or prosperous. Health in cities is influenced by multiple factors and stakeholders, including social, political, and economic forces, urban planning, environment, safety, housing, pollution and also, access to health services. Despite the variability and multiplicity of issues and factors in determining health, they are all connected and interdependent and can be managed, especially when cities recognize that they perform functions which improve liveability and thus health. Indeed, the WHO report (2016) concludes that good governance is key to achieving health in cities and achieving a nation's Sustainable Development Goals. Good governance is defined as:

- participation in decision making;
- citizen empowerment through information sharing;
- private-Public Partnership;
- intersectoral action.

China leads the list of countries with the highest number of urban populations. The Tsinghua-Lancet Commission on Healthy Cities in China (Yang et al. 2018) noted that the number of cities in China increased from 193 (1978) to 656 (2015). While life expectancy has increased and poverty has decreased, the emerging urban health issues for China are:

1. migration: Between 1978 and 2015 urban populations increased from 170 million to 771 million and it is estimated that by 2020 additional 100 million people will be living in cities in China. Many of them have been migrant workers. At the end of 2015 about 177 million migrant workers and their family members lived in urban areas. By 2030, it is expected that an additional six million new migrant workers will move to cities every year;
2. ageing: 52% of people over 60 years of age live in cities;
3. pollution: Particulate matter with a diameter of less than 2.5  $\mu\text{m}$  (PM<sub>2.5</sub>) reduced the productivity of an estimated 72 million workers in 30 provinces, leading to an estimated economic loss of US\$44.4 billion, which is about 1.1% of the national gross domestic product (Xia et al. 2016);
4. urban lifestyles: The percentage of years of life lost because of non-communicable diseases (NCD) as a fraction of all-cause years of life lost increased from 50.0% in 1990 to 77.3% in 2015. Total annual premature deaths from NCDs are expected to increase from 3.11 million in 2013 to 3.52 million in 2030;
5. inequality: Between 1991 and 2006, income changes in urban areas accounted for 7.1% of rising inequality of urban health. In 2013, economic status was estimated to account for 13–14% of health inequality in urban populations. Urban poverty substantially increased between 1996 to 2010.

# Urban Health is at the Interface of Human and Planetary Health



The system we are looking at in this Little Book is ‘Urban Health’ and we understand ‘Urban Health’ as **both** the health (condition) of people living in cities, and the health (condition) of cities. According to the International Society for Urban Health, determinants of urban health are transportation, economic development, education, healthcare sector, housing, the built environment, the natural environment, the social environment, and urban planning (Figure 2).



Figure 2: The International Society for Urban Health (ISUH) defines urban health as being composed of nine determinants

The health of cities depends on human and planetary health and vice versa. Therefore, urban health is at the interface of human and planetary health (Figure 3). Urban health is about how cities function and their functioning depends on urban structures and flows (Costanza and Mageau, 1999, Elmqvist et al., 2019). Cities consist of socio-bio-physical structures, like roads, buildings and transportation infrastructure, parks and other green spaces, and also social structures like communities, neighborhoods, businesses and organization. Urban institutional infrastructures, the system of formal and informal rules and regulations, which define how flows of energy, resources and information are allocated in urban structures, also define how information is generated and allocated, goals are set, decisions are made and behavior and actions are performed, monitored and evaluated.

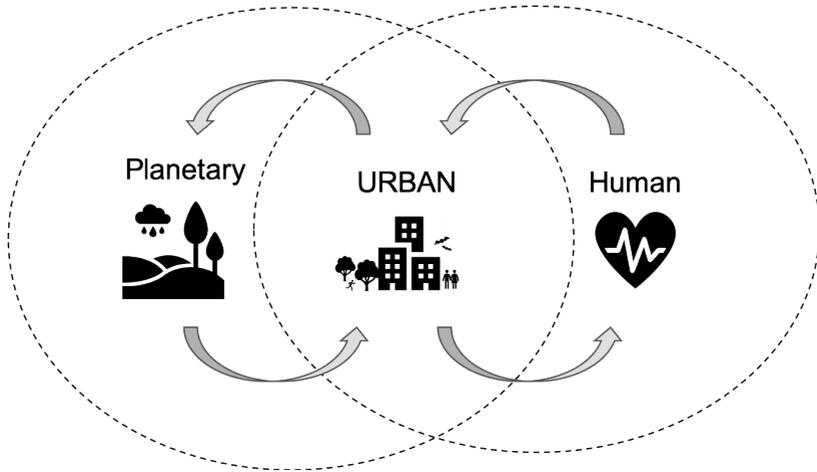


Figure 3: Urban health is at the interface of human and planetary health. Human impacts beyond planetary boundaries compromise the health of people and the planet.

The interdependence of the human and planetary systems is of course critical because urban areas have become the predominant habitat of the human species and the impact of urban living and its environment has a significant impact on the whole planet. On a planet with increasingly scarce resources, technological and engineering solutions for improving resource efficiency need to go hand in hand with institutional and behavioral change, otherwise, the efficiency gained in one area is compensated by using more of it in another, resulting in the same or an even larger ecological footprint – a situation which is referred to as the efficiency paradox or the Jevons paradox (Alcott 2008, Polimeni et al. 2008). Therefore, for cities to be healthy, their socio-bio-physical structures and ‘institutional infrastructures’ (Iskandar and Gatzweiler 2016) need to be interacting and operating together as a system.

# Urban Health is at the Heart of Sustainable Development



As has been recognized, these urban systems are critical contributors to the sustainability of the entire planet. There is a pressing need for cities to develop sustainably without causing more damage than necessary to the environment or the health of its citizens. To promote the sustainable development of cities, the United Nations has initiated various international agreements, including the Sustainable Development Goals (SDGs) of the Agenda 2030 and the New Urban Agenda (NUA). While the SDGs define the key areas and mechanism for how future development is perceived, the NUA recognizes the role of cities and provides global standards for urban planning and management at a national level in achieving sustainable development.



Figure 4: Urban health at the heart of sustainable development

World leaders have responded positively to the New Urban Agenda (NUA) to provide basic services for all citizens, and ensure all citizens have access to equal opportunities. Such commitments strengthen cities' resilience, improve connectivity and promote safe, accessible and green public spaces.

The health sector, in particular has an important role in promoting and monitoring these commitments and generally supporting the implementation of the NUA. According to the World Health Organization which has defined the health sector's unique role in its reports of "Health as a pulse of the New Urban Agenda" (WHO 2016), the health sector should be fully incorporated in urban planning, as it identifies a set of health targets that connect human health and wellbeing to urban sustainability. This integration can help to crystallize goals and galvanize public support, mobilize action from different urban stakeholders and provide tools to assess and track the costs and health impacts of urban policies and decisions.

Good urban planning should not only take into account the health sector itself, but also be able to reduce the health risks from all aspects of life in cities, such as environmental pollution, diseases, social inequality, and work and employment, for example. The implementation of both the SDGs and the NUA require integrated and coordinated actions including collaborations among and responses from different stakeholders and sectors. Urban sectors, including housing, transportation, natural environment, built environment, transportation, urban planning, education, health and community cohesion, are all determinants of “urban health” (Figure 4), directly and indirectly as co-benefits affecting human health (Shaw et al. 2017). Thus, success in “health” depends on functioning cities and is the key for achieving sustainable development.

In the Sustainable Development Goals (SDG) discourse, “Urban Health” is described as a cross-cutting theme to achieving sustainable city development as it closely links to various factors affecting the SDGs. For example, ensuring access to adequate, safe and affordable housing will help achieve SDG 3 of reducing both physical and mental human ill-health, and SDG 8 of attracting local economic investments and develop diverse workforces, which are vital for addressing social inequality and exclusion. Improving the built environment by ensuring adequate sanitation infrastructures and public facilities, transport systems and building density are important for achieving SDG 11 which aims to make cities inclusive, safe, resilient and sustainable. More examples of how urban health determinants are linked to SDGs are shown in Table 1. Some examples listed in the table are relevant to the social and environmental aspects of cities. The list does not imply any prioritization of the SDGs as every SDG is connected to urban health determinants, directly and indirectly. SDG 3 (Health) and SDG 11 (Cities) have been left out to avoid redundancy as they are by definition determinants of urban health. Howden-Chapman et al. (2017) provide a list of interconnections between the “Health” SDG and other SDGs.

Table 1: Urban health determinants and connections to SDGs

Urban Health determinants	SDGs	Explanation
<b>Housing</b>	8 Decent work and economic growth	Ensuring access to adequate, safe and affordable housing reduces both physical and mental human health, attracts local economic investments and creates employment, which is vital for reducing social inequality and exclusion.
	10 Reduced inequalities	
<b>Economic Development</b>	1 No poverty	Urban-based economic activities account for more than half of the global Gross National Product (GDP). Developing national economies create employment opportunities for all women and men, which increases household incomes, reduces poverty and inequalities.
	10 Reduced inequalities	
<b>Natural Environment</b>	8 Decent work and economic growth	Protecting the natural environment, such as protecting forests and reducing anthropic pollution helps to mitigate environmental impacts such as global warming and stimulates local economies (e.g. preserving biodiversity improves the economic potentials of ecotourism).
	13 Climate action	
<b>Built Environment</b>	6 Clean water and sanitation	Sustainably built environments are relevant for the use of clean energy technologies, adequate clean water and sanitation infrastructures, green design and sustainable transport systems that could improve the living environment where citizens are able to have a good quality of life (e.g. access to clean water and energy).
	7 Affordable and clean energy	
<b>Urban Planning</b>	4 Quality education	Effective and integrated urban planning incorporates different sectors of cities including transportation, infrastructure, environment, human health, education, social cohesion and gender equality, which is important for creating equitable, peaceful and sustainable cities.
	5 Gender equality	
	10 Reduced inequalities	
	16 Peace, justice and strong institutions	
<b>Education</b>	1 No poverty	Improving access to education increases the number of young people gaining skills for getting decent jobs which decreases the unemployment rate and poverty.
	8 Decent work and economic growth	

<b>Transportation</b>	8 Decent work and economic growth  10 Reduced inequalities	Improving urban mobility, particularly in the least developing countries, not only improves local transport safety but assists local people to better access and benefit from jobs and market opportunities. This reduces social inequality by better serving the needs of vulnerable groups and creates more inclusive communities.
<b>Community Cohesion</b>	5 Gender equality  16 Peace, justice and strong institutions	Improving community cohesion increases the ability of all communities to function which creates harmony and peace rather than conflict. Diversity of communities in terms of culture, nationality, gender and religion is important for establishing better governance and sustainable cities.
<b>Health Sector</b>	1 No poverty  16 Peace, justice and strong institutions	The health sector provides a set of targets that connect human health to the living and natural environment, economies and social issues that are important for making healthy urban policies of reducing urban poverty and inequality.

# Cities: Multi-level Complex Systems



As well as being described as complex systems, cities are, in fact, multi-level complex systems. Self-organizing interactions and processes, such as community-level interactions, are compartmentalized by level organization that is decomposed into “structures, processes and functions” (Lane et al., 2009). The structure of the organization describes the parts, and the interactions inside and outside these parts; processes describe the organization transformations or the transformations to which it participates. The function describes its actions. These three elements evolve over a range of spatial and temporal levels (Figure.5).

At the *micro-level*, individuals develop their social and economic life, with their own capabilities and those of their collaborations with others in social networks, and with the material goods and services they can access. Combining personal and inter-personal means and energy, people try to optimize their health and well-being in their specific environment (in a bounded rationality way: Simon, 1972) and according to their individual history and values. But often, individuals do not completely manage their environment because of numerous natural and social constraints.

A person gains more or less from his or her belonging to the *meso-level of a city*, which permits numerous actions with some groups of other inhabitants. By this way, the meso-level is not only the sum of interactions

between couples or individuals, but represents, as economists say, indivisible returns (we cannot divide the property of a community). Proximity allows intensifying local interactions to socialize, produce and consume, allowing to reach a satisfying level and way of life for each individual, due to economies of scale.

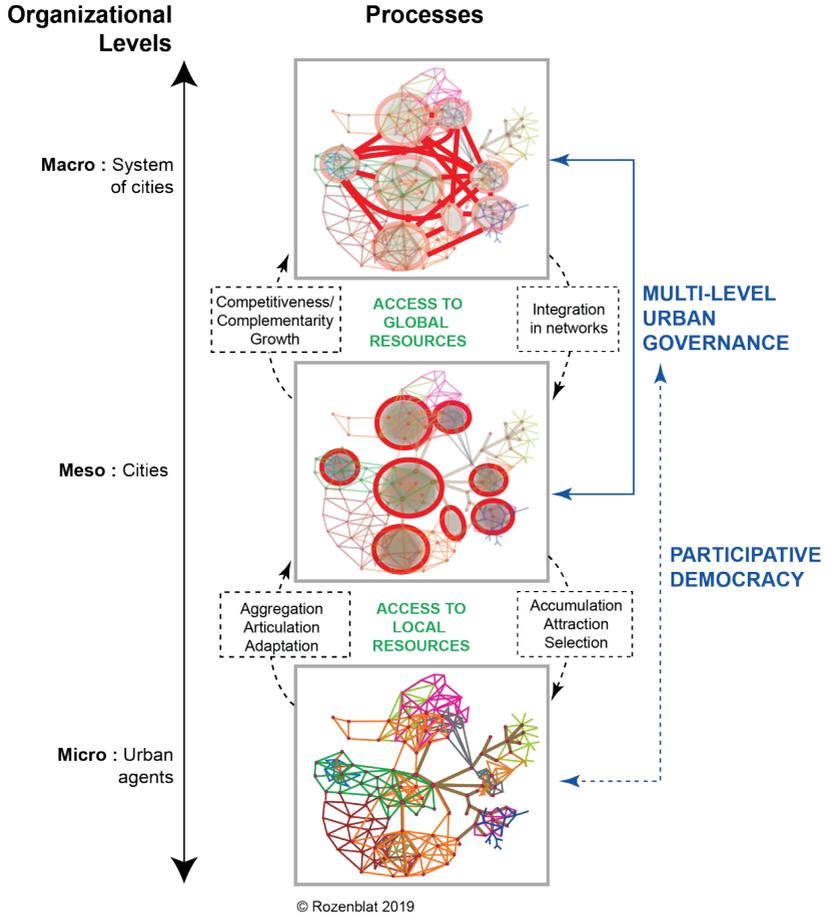


Figure 5: The Multi-level System of cities

The access to local resources is in large part possible through group organization: places to meet, real estate markets to find a house, food markets to eat, job markets to work and similarly for access to all facilities, social and medical services and leisure. Inhabitants have access to resources, but also constitute a resource themselves, e.g., human capital for enterprises and customers for market. Thus, there is a feed-back loop when somebody integrates into the city: this person participates in the whole city system while at the opposite end the system nourishes and supplies the person. Thus, this person is at the same time constrained by the rules of the city, but also an actor of the system, participating in the perpetuation of these rules or their evolution.

As a whole, the material and immaterial city organization is widely dependent on inherited structures that contain many cultural and historic roots that shape a path dependence where ancient city planning influences the current pattern and does not always correspond to our present needs. For example, narrow streets are not the best environment in which to drive cars and this has a knock-on effect that impedes the walkability of cities.

This does not prevent us from trying to change things despite the numerous strong structures and individual behaviors that have been adapted to these positive or negative constraints (Giddens, 1984). Local governance is responsible for these restructurations leading to regulatory arbitrages between the desires of individuals and those of the “common interest”. This tension is treated both by engineers and policies, sometimes in a participatory democratic process. However, most of the time, local governance has limited power on economic and social forces.

It is also worth considering beyond this level. **The macro-level of systems of cities**, or clusters, is composed of far cities or regions where the social, ethnic or economic groups of the city can access (or can offer), resources of goods, information or ideas. This would not be possible without the common interests of other urban agents within the city at the meso-level. From an economic perspective, the wealth of enterprises and of their employees comes from “sharing, matching and learning” (Duranton & Puga, 2004) processes inside cities positioning them in the context of regional, national or global exchanges. The evolution of the way of life of people is also based on these kinds of processes. The social and economic place of

each individual depends both on his or her place in the city and on the place of the group to which they belong, inside the more global system of cities. In fact, networks of interactions are particularly dense and overlapping in cities, but they connect worldwide when one speaks about the economy, trade, migration and communication (Castells, 1996). If a person was born in a mining specialized city, they will not have much other choice than to work in the mine or to a service connected to it, because it is what makes the economic existence of the city where they live. Thus, the global market acts indirectly on each individual, by forging the structure of each city participating in the whole system of cities. It is the same for numerous aspects of life diffusing from one place to another.

The global system is in a constant evolutionary change process: activities evolve thanks to new innovations, making some activities delocalize or disappear while others emerge. While cities' governance can try to restructure local activities, these trends are global and thus necessitate action at the regional, national or even continental or global levels. In particular, national policies are relevant for many demographic or social aspects, because of a certain homogeneity in the culture and in the support for health and well-being comprising different systems of insurance and all medical services. According to the country, its history and its political structure, different regional or provincial administrative levels have great powers to change rules, which the local administrative governance rarely has.

The highest levels of these complex multi-level urban systems are inherent of the coordination of multi-level governance and policies. This is a sophisticated and complex situation which requires a deep understanding of the interacting processes between the three levels in order to intervene for long term urban health, i.e. high levels of systems thinking.

# Urban Health: A Systemic Problem



As we have said earlier, cities are multilevel complex systems. In addition, urban health is a systemic problem because it is defined by multiple determinants, which interact in complex ways within the city. At each level, these complex urban systems function in ways that produce and provide a wide range of goods and services (Elmqvist et al. 2019: 411). These functions and services are described in more detail in Table 2.

By identifying the functions of urban systems at each level, we create a better understanding of the ways in which the determinants of urban health interact and bring forth urban health problems, such as diseases or pollution. It has, therefore, been suggested that urban health problems can be seen as emergent properties of urban systems (Jayasinghe 2015). Urban systems can be composed of any type of chain of interrelated agents, effects, flows or structures which serve a common purpose. For example, transport infrastructure is an urban sub-system composed of physical road infrastructure, people using that infrastructure with their vehicles and the regulating infrastructure of traffic rules. Another example of an urban sub-system is one that is composed of dynamic relationships between variables for food security and the proportion of obese people in urban communities (Figure 6).

Table 2: Functions of urban systems (Gatzweiler et al. 2017)

Function	Description
Supporting	Benefits provided by physical space (habitat) and infrastructure for basic life support functions, e.g., waste management, water treatment and sanitation, and energy provision (electricity). Enabling flows of energy (captured in form of low entropy goods) and information. They are necessary for all other functions to be produced. Markets sometimes require physical space for exchange but market exchange can also take place in virtual spaces.
Provisioning	Benefits derived from the provision of manufactured goods and knowledge and the access to infrastructure for water, energy, food, transportation, social interaction, market exchange to maintain its population's health, internal structure, procedures and processes: e.g. (processed) food, (purified) drinking water, construction materials, machines, artifacts (e.g. furniture, bicycles), ICT devices, education and knowledge infrastructure (universities), hospitals.*
Regulating	Benefits derived from providing rules and regulation (institutional infrastructure) to keep the (bio-physical) infrastructure running: e.g., regulating access to social space, legal systems, education systems, markets. Means are laws, norms, cooperatives, law enforcement, disease and disaster management and emergency response systems, health service systems, environmental protection agencies.
Cultural	Benefits provided for humans in cities which are created in socio-cultural spaces. Social space and liberties for economic and political exchange, exchange of ideas, social exchange, recreation and leisure, space for spiritual enrichment, art and cognitive development. E.g. cultural events, "Heimat" (sense of belonging), exhibitions, libraries, cultural heritage values (e.g., historical places), cultural diversity.

Note: \* In the provisioning category of urban system functions, universities and hospitals, for example, are listed as provisioning functions, providing the facilities for regulation functions to be provided, e.g. education and disease treatment. Knowledge institutions regulate the quality and quantity of knowledge provided to particular segments of society. The boundaries between providing and regulating functions are not always straightforward.

Apart from the multiple interactions of factors which determine urban health, urban health is a systemic kind of problem from yet another viewpoint: The history of cities starts with the transition from hunter-gatherers to sedentary forms of life, early settlements and eventually cities (Christian 2008). Agriculture enabled people to capture the energy from the sun in cultivating grains, producing and storing surplus and thereby improving

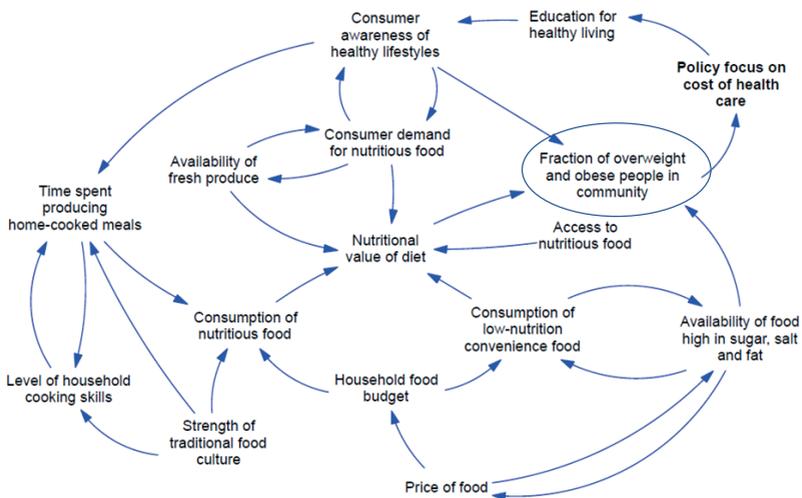


Figure 6: Dynamic relationships between variables for food security and the proportion of obese people in urban communities (Newell et al. 2007)

chances of survival. A warming climate allowed for making new lands cultivatable and habitable. Eventually, increasing population numbers in cities caused environmental degradation in the urban hinterlands and eroded the ecological support functions which are required for a healthy urban life. As cities grow, their structure and functioning needs to adapt to the surrounding environment in order to maintain the health of their citizens. Medieval cities were confronted with essentially the same challenge as we are today. Previously, medieval cities had suffered diseases in epidemic proportions (Ciecieszki 2013). Some of those medieval diseases, such as the plague, are returning today. The World Health Organization recorded 320 cases including 77 deaths in 2015 (Bichell 2017).

Gowdy and Wilson (2015) explain that social systems, like markets, which were originally built on the basis of informal rules of exchange, have evolved into a sophisticated system of global capitalism and now seem to dictate and manipulate human behavior. Neoliberal ideas led to a situation in which a market system “tell(s) people how to live rather than people setting up markets to help them live the way (they) want to live.” (Norgaard, 2017).

# What does it mean to take a Systems Approach?



A systems approach is a way of thinking about complex systems by connecting data to knowledge, knowledge to action and involving people for the co-production of data and co-creation of knowledge (Figure 7). A systems approach starts with the understanding of a city as a complex system; as overlapping social, technological, physical, ecological networks in nested systems. Recognizing a city as a complex system means that we need to deal with its plannable, designable, manageable and controllable features but also with its unplannable and uncertain features which result from it being complex, rather than only being complicated. Then, in order to understand that complex urban system, the systems approach promotes the application of a variety of different scientific methods and models by means of which system structure and behavior can be better understood and simulated. Based on a better analysis of systems, their malfunctioning and inefficiencies, suitable interventions can be identified. The last component of a systems approach is to engage people in producing knowledge, finding solutions and being engaged in local action which address urban health issues. This part of the systems approach, in particular, addresses

the unplannable and radically uncertain nature of cities. Local actions are taken in response to larger-scale problems, like climate change and urban heat islands. Those actions or projects are experiments and, if fit, have a chance to be upscaled and make decisive system changes.

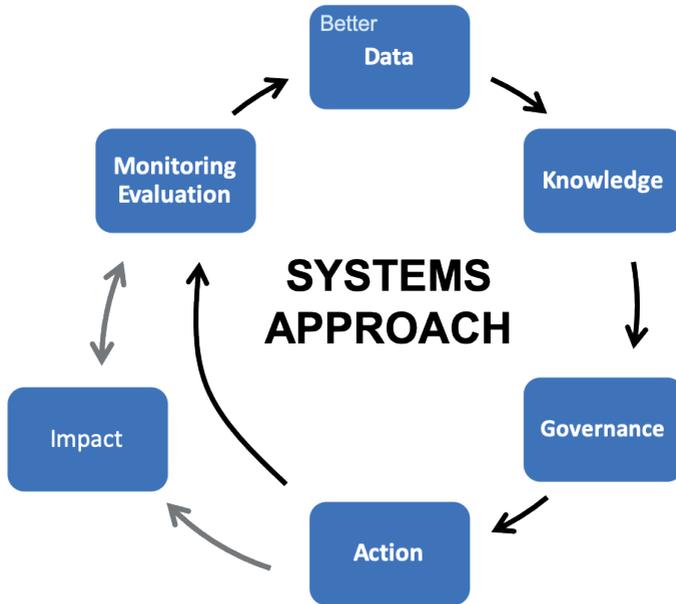


Figure 7: A systems approach is a way of thinking about complex systems by connecting data to knowledge, knowledge to action and involving people for the co-production of data and co-creation of knowledge.

The “systems approach” is an integrative concept. In science, the systems approach combines different cultures of knowledge and integrates the analytic with the syntegrative approach. Rational and heuristic knowledge are brought together. With regards to data, a systems approach aims at integrating quantitative and qualitative data. A systems approach is not only interdisciplinary in that it involves different knowledge domains in the

co-creation of new knowledge, but it is also transdisciplinary by aiming at informing people and policy-makers about scientific knowledge but also making them part of the scientific process of co-creating knowledge.

By conceptualizing the city as a complex system, the systems approach to urban health and wellbeing eventually aims at improving urban system functioning by allowing resource, energy, data and information to flow along with the different types of urban infrastructures (buildings, green/public space, waste and sanitation, food, water, energy, transport (Ramaswami et al. 2016)). The vision is that such healthy functioning urban systems make best use of the resources and collective intelligence co-created by people and technology in order to detect and respond to emerging health risks in cities, in time to prevent the loss of human lifetime and to prevent unsustainable impacts on planetary health.

# Urban Health Equity: A Systems View



Urban health equity is fundamental to the Sustainable Development Goals (SDGs), the New Urban Agenda, and any national or local strategy to improve population wellbeing. Yet, how we define and act to promote health equity in urban contexts is not well articulated or understood. In this short section, we offer some suggestions for how researchers and practitioners ought to understand the causes or mechanisms, including biologic, for how inequality gets ‘under our skin’ to produce health inequities and some strategies for promoting health equity.

Let’s start with health inequities and equality. Health inequities are avoidable differences in the social, environmental and political conditions that shape morbidity and mortality, and disproportionately burden the poor, racial, ethnic and religious minorities and migrants. Health inequities are distinct from health disparities since the latter are defined as differences in health status and/or access to health care services between differently situated groups. These groups of people might be stratified by age, income level, gender, disability, education level, migrant status, religion, ethnicity, geography and other population or place-based characteristics. Health disparities often just measure differences.

Health inequities are differences that are deemed to be unfair and unjust because, in part, they are avoidable. Early death rates for urban factory

workers during the industrial revolution or migrants today are from dangerous work and living conditions, discrimination, exposure to environmental hazards and a host of other avoidable and unfair conditions.

Health equality suggests actions to ensure that all groups have the same opportunities and access to the resources that can promote health. On the surface, this seems fair; everyone should have access to the same quality medical care, education and clean air, for example. What is problematic about health equality is that it ignores that not all urban populations or communities are starting from the same position, often because of historic injustices or circumstances we are born into. Health equality can fail to recognize that historically discriminated against groups – ethnic minorities, the poor, migrants, etc., – continue to experience greater exposure to air pollution and other toxic pollutants and suffer greater morbidity and mortality burdens. Redesigning cities to promote physical activity for all may ignore the specific needs of people with disabilities. City strategies of ‘universal access’ to water and sanitation, can often ignore the unique safety needs of women who have experienced sexual violence when accessing a hygienic toilet.

**Urban Health Equity** is explicitly a proactive and inclusive concept where multiple institutions, policies and populations work to address and redress socioeconomic disadvantage and historical injustices, which can help ensure that groups and place-based communities currently experiencing inequities have *enhanced* opportunities to access health-promoting resources. Urban health equity is about social justice in cities, where existing access barriers are removed through inclusive and fair decision-making processes and progress is measured by the elimination of health inequities.

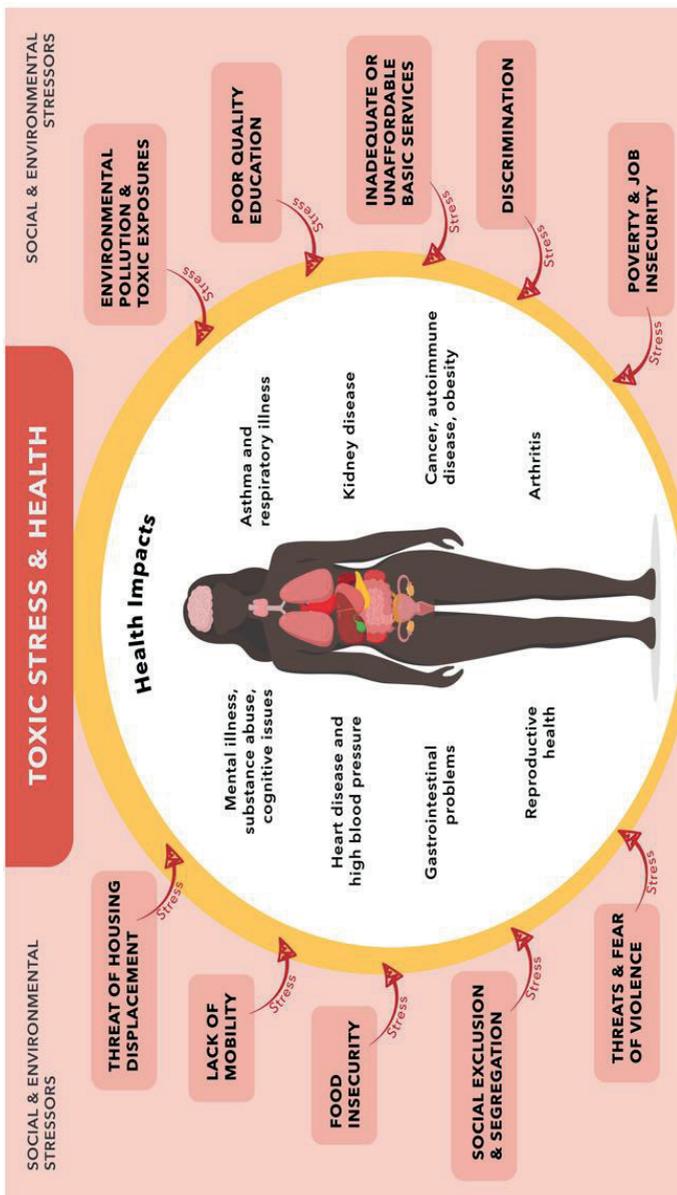
**Why a systems approach to urban health equity?** A systems approach to urban health equity can help guide research and action in specific ways. For example, a systems approach might help highlight the multiple and often cumulative exposures that burden certain urban population groups. A systems approach that recognizes multiple inputs to urban health may suggest that hard to reach informants can act as ‘citizen scientists’ and offer unique spatial data. Thus, engaging residents in processes that identify risks, and geographically mapping these, can be an important aspect of urban health science. A systems view of urban health equity also implies

that the meanings and ways people interact with their environments are contingent and contested, implying that practitioners must combine quantitative, qualitative and narrative data to fully grasp how multiple urban inequities might be adversely impacting residents.

A systems approach also points us to the emerging science of cities. Since at least the mid-19<sup>th</sup> century, urban researchers and practitioners have been aware that socioeconomic status, workplace and living conditions together contribute to health inequities. Yet, the urban health response has too often been focused only on a limited response; reducing one adverse social or environmental exposure at a time, addressing poverty and/or improving access to and frequency of health care and medical services more generally. The major problems with this public health approach, which continue to plague much urban health today, are that researchers and practitioners continue to try to isolate and address one variable or ‘exposure’ at a time – ignoring the cumulative burdens of multiple urban insults. This variable centered approach also fails to include those already burdened in the inquiry and action process, and tends to ‘treat’ people only to send them back into the living and working conditions that are contributing to their illnesses in the first place.

Insights from decades of biologic research on how multiple social and physical stressors influence our biology should encourage urban researchers to shift their focus; from measuring disparities and inequities, to implementing and measuring the biologic impacts of health equity strategies that aim to reduce the multiple stressors burdening the wellbeing of the urban poor and marginalized populations (Figure 8).

**Toxic Stress: A Call to action for urban health equity.** A key challenge for urban health equity practitioners is defining the ways urban inequities get “under our skin”, or are embodied to influence human biology. Research that has defined the ways stress is toxic to our brains and bodies has helped highlight a way forward for urban health equity. While stress can be life-saving for most - think of the fight-or-flight mechanism - constant adversity is toxic, meaning that the prolonged activation of the stress response systems can disrupt the immune system, increase susceptibility to infections, stunt brain development, and bring on premature cellular ageing. A fundamental source of toxic stress are chronic inequalities, such



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Figure 8: Examples of multiple chronic stressors that contribute to urban health inequity

as poverty, racial, gender and other forms of discrimination and marginalization, physical or emotional abuse, exposure to violence and housing instability, to name just a few. Other toxic stressors plaguing certain urban populations appear in Figure 8. Richard Wilkinson and Kate Pickett in the UK have shown that while absolute poverty is bad for your health, poverty amid plenty (most often the case in cities around the world) can be worse by just about any measure: infant mortality, life expectancy, obesity, murder rates and others. Cities with more inequality have greater mental health problems, alcoholism and drug use, lower levels of happiness and less social mobility.

Urban health inequalities also impact the rich in cities, who tend to expend more resources insulating themselves from those 'living under the bridge' through gated communities, private schools, bottled water and influencing governments to maintain their elite economic status.

The impact of multiple and chronic stressors on the body happens early in life and is influencing today's most pressing public health issues, from heart disease to obesity to diabetes to mental health and premature mortality. Thus, we need urban health strategies that eliminate the sources and causes of chronic stress – not short-term behavioral, built environment or treatment interventions that are currently ignoring the biology of toxic stress.

Toxic stress influences urban health through at least three biologic factors: chronic inflammation, brain function and chromosomal ageing. The chronic stress from urban inequalities contributes to body-wide inflammation, because the body is in a constant battle to return to a normal, non-stressed state. As shown in Figure 9, under "normal" stressful situations, the human body has a range of physical and chemical responses, but primarily epinephrine (adrenaline) and cortisol are released to bring the endocrine and immune systems back to homeostasis (Figure 9, solid line).

In toxic stress situations, stressors are constant and the chemical release of "fight or flight" hormones does not properly regulate or shut-off (Figure 2, dashed line). This leads to an array of body parts functioning less than optimally and wears away at the immune system, producing inflammation. Chronic widespread inflammation causes molecular damage throughout the body and contributes to poor glucose regulation, arterial plaque, weak-

ened immune system and susceptibility to infection, and other autoimmune diseases.

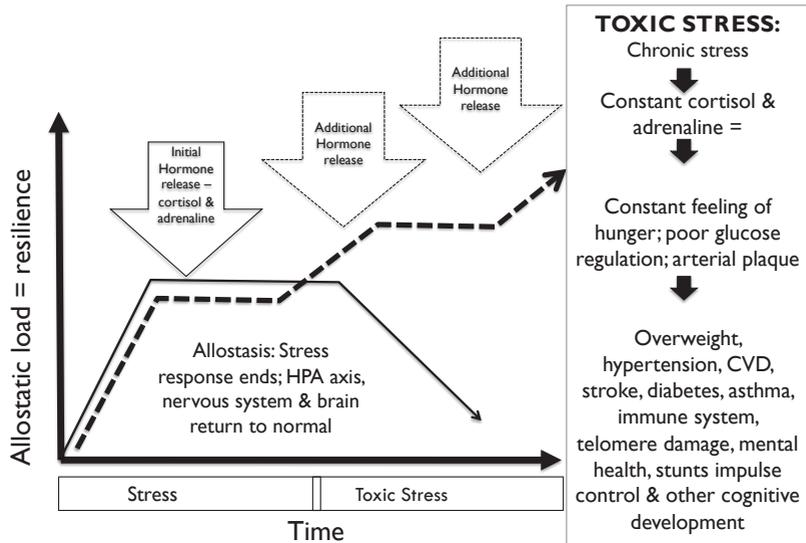


Figure 9: The biology of Toxic Stress (source: J. Corburn, jcorburn@berkeley.edu)

Exposure to chronic stress also impacts the brain and behavior. The hippocampus, a region in the brain critical to learning and memory, is dampened down by excessive release of stress hormones, which in-turn limits memory. The amygdala, another area of the brain central to reacting to fear and anxiety, is over-activated by stress hormones. This can increase anxiety-driven mental illness. The prefrontal cortex, an area of the brain key for long-term planning, executive function and impulse control, is weakened by the constant release of stress hormones and thus can contribute to humans making reactive, impulsive decisions. These multiple biologic impacts of toxic stress are likely behind the rise and persistence of both NCDs and increased susceptibility to infections for the most vulnerable groups in urban areas.

Finally, toxic urban stressors are influencing epigenetic processes that regulate whether genes are expressed or suppressed. Stressful inequities and the wear and tear on the body influence the length of telomeres, which are DNA-protein complexes capping the ends of chromosomes that protect them against damage and ageing. Chronic social stressors including perceived poor neighborhood quality, witnessing or experiencing violence, chronic poverty, and racial discrimination can contribute to post-traumatic stress disorder and accelerate telomere shortening. What this means is that chronic stressors are a leading cause of genetic susceptibility to disease and early death, not the other way around.

**Practicing Urban Health Equity.** Of course, we need to find better ways to understand the biologic consequences of urban inequality. However, we know enough already to fundamentally shift our focus in urban health from single diseases, behavioral change and narrow built environment changes, to healing the scars of chronic stress. Urban health equity is about healing-centered interventions, generated with those suffering the most, targeted at the social inequities, institutional decisions, and resulting living and working conditions that are behind many of the multiple stressors all too prevalent in cities around the world today (Figure 10).

In summary, health inequities are avoidable differences in overall health conditions which are deemed unjust. A systems approach helps to address the multi-factorial and cumulative exposures that burden certain segments of urban society and it engages the disadvantaged population groups in identifying specific exposures to risks and risk perception. A systems approach helps to avoid the temporary treatment of single symptoms which are actually caused by a multitude of interacting social and physical stressors in the urban environment, to which the marginalized and poor are disproportionately exposed, causing a toxic mix of stress. These exposures to chronic stress in urban environments of high inequality, need to be addressed at their root to avoid mental health impacts, which in turn can increase the susceptibility to infectious diseases and manifest the persistence of non-communicable diseases.

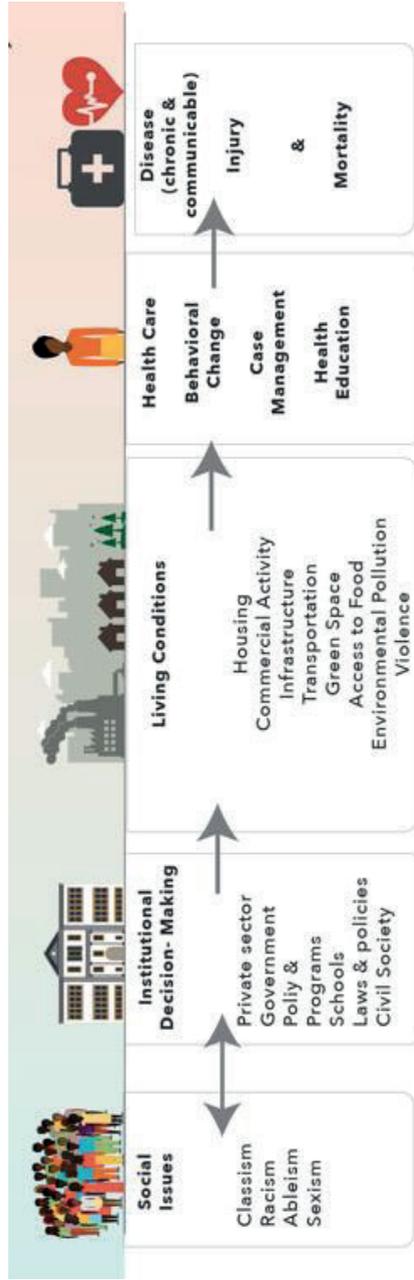


Figure 10: The drivers of urban health inequities

So far in this Little Book, we have looked at international work to measure healthy cities, and have discussed the complexity of cities and how a systems approach would be the best approach in order to ensure the health of both citizens and the cities themselves. We have looked at some of the causes of illhealth and also, how toxic stress in urban environments are experienced by the most disadvantaged groups. We argue, again, that a systems approach would be the best way to deal with these iniquities. In the following section, we move on to introduce a range of examples of the systems approach in action.

# Examples, Cases, Projects, Policies and Initiatives



Worldwide, countless efforts are being made to make cities healthy, liveable, smart, resilient, fair and sustainable, or any combination of those features. The examples listed here are only a tiny selection of projects and initiatives, which, over the period 2014-2019, have been associated with the International Science Council Program on “Urban Health and Wellbeing: A Systems Approach.” The health of cities is affected by all these different types of initiatives for making cities more liveable, by integrating health in urban planning, applying an integrated governance approach and making health relevant for all policies, aiming at making cities more resilient and adaptive to climate change, or by building knowledge-action systems. These and other initiatives, like improving urban green spaces, all find their place in the components of the systems approach (Figure 7), introduced earlier.

# 1. UN Habitat Initiative on Urban and Territorial Planning for Improved Health and Wellbeing

UN-Habitat's mandate on urban health initiatives was strengthened by Governing Council Resolution 25/4 in 2015, requesting the agency "consider health and wellbeing aspects, including the promotion of and access to health services, in developing policies on urban and territorial planning". UN Habitat's Regional and Metropolitan Planning Unit, in a meeting at UN Habitat's first assembly meeting, 27-31 May 2019, in Nairobi, underlined the importance of urban health for the new UN-Habitat Strategic Plan 2020-2023, which addresses urban health through two of the four Domains of Change:

- Domain of Change I – *Reduced spatial inequality and poverty in communities across the urban-rural continuum*, realizes the importance of expanding access to basic services (including health services) across territories, to reduce spatial and health inequalities.
- Domain of Change III – *Strengthened climate action and improved urban environment* promotes the development of clean air action plans to reduce greenhouse gas emissions and address indoor and outdoor air pollution.

Urban health challenges, such as cardiovascular and respiratory diseases related to ambient (outdoor) air pollution, are merely the visible symptoms of underlying complex systems which are cross-sectoral, interconnected and uncertain of common concern. They happen at multiple levels and thus need to be addressed at the right scale, in time.

UN-Habitat, in collaboration with the WHO and other urban health organizations and with the support of the Government of Norway, is working on implementing the International Guidelines on Urban and Territorial Planning (IG-UTP) for Improved Health and Wellbeing. This initiative aims

to improve human health and wellbeing through urban and territorial planning and design. In line with this objective, the IG-UTP and Health program at UN-Habitat works across four areas: building an evidence base for the benefits of planning for health, developing normative tools, testing and implementing pilot projects and conducting capacity-building activities, and building partnerships with urban health organizations.

UN-Habitat is currently developing the Health-focused Planning System Assessment which is drawn from the premise that integrating health considerations and health professionals in the planning process, not only promotes more compact, socially inclusive, better integrated and connected cities and territories, as promoted by the International Guidelines on Urban and Territorial Planning (IG-UTP), but also yields better health outcomes for all. Therefore, the assessment provides a platform for stakeholders involved in the planning system to evaluate and discuss, in a simple and structured way, their perception on whether their current planning system is delivering healthy outcomes.

## 2. Health in All Policies

The World Health Organization (WHO) has been driving the Health in All Policies (HiAP) initiative and its roots go back to the origins of the WHO itself. At the 8th Global Conference on Health Promotion, Helsinki, Finland, (10-14 June 2013), the Helsinki statement on Health in All Policies (WHO 2014) had been agreed on. At that meeting the participants called on governments to commit to health and health equity as a political priority and announced:

*“... Health in All Policies is an approach to public policies across sectors that systematically takes into account the health implications of decisions, seeks synergies, and avoids harmful health impacts in order to improve population health and health equity. It improves accountability of policymakers for health impacts at all levels of policy-making. It includes an emphasis on the consequences of public policies on health systems, determinants*

of health and wellbeing. We recognize that governments have a range of priorities in which health and equity do not automatically gain precedence over other policy objectives. We call on them to ensure that health considerations are transparently taken into account in policy-making, and to open up opportunities for co-benefits across sectors and society at large.”

As an example for HiAP in practice, WHO (2014) mentions Ecuador’s National Good Living Plan (Plan Nacional para el buen vivir, or NPGL) which has become the roadmap for the development and implementation of social policies in Ecuador, with the full backing of the highest political authority:

“The concept of Good Living is based on a broad definition of health. Health is one of a set of specific sectoral work plans, each of which has to be consistent with national strategy and priorities. The health sector work plan is guided by the social determinants of health approach, and its goals are realized through the Development Coordinating Ministry, which supervises the Ministries of Health, Labour, Education, Inclusion, Migration, and Housing. Between 2006 and 2011 when the Program was implemented, social investments increased 2.5 times; the proportion of urban homes with toilets and sewage systems increased from 71% to 78%; rural homes with access to collection of waste increased from 22% to 37% and health appointments in the public service sector increased by 2.6 per 100 inhabitants (PAHO 2013).”

Another recent example is the Urban Health Model of El Salvador (**Modelo de Salud Urbana**) which was presented in June 2017 by the El Salvadorian Ministry of Health (MINSAL) as an essential component of its health reform and is now adopted also by other countries in the region. The model generated an extensive consultation process including inputs from public institutions and civil society organizations, as well as the global science program on Urban Health and Wellbeing: a Systems approach, which was launched under the International Science Council (ISC).

### 3. Healthy Cities in China

In 1984, the World Health Organization (WHO) promoted the concept of a 'healthy city' and launched a healthy city movement. In 2003, the Alliance for Healthy Cities (AFHC) was created. It consists of an international network aiming to protect and enhance the health of city dwellers. According to the WHO Europe (2018), a healthy city should have the the following characteristics (Table 3):

In 1994 the Chinese Ministry of Health worked with the WHO to build a pilot program on Healthy Cities in China, starting with Shanghai and the Dongcheng district in Beijing. Later, in 2007, 10 further cities were chosen by the Ministry to join the program and then in 2017, after the Healthy China 2030 policy was passed, 38 cities where included into the program.

"Healthy China 2030," was a policy formally passed in 2016 with the goal of of reaching a public health standard at the same level as developed countries by 2030. The policy is mainly focusing on typical health related sectors, like the health industry and health services and health insurance, but also includes health environment factors related to air and water quality (Tan et al. 2018, Tan et al. 2017). The policy needs to be seen in the historical development context of China, which may explain a strong focus on strengthening market forces (supply and demand side reforms), improving access to health care and health coverage for a large population. The policy aims at Health in All Policies (HiAP), puts emphasis to mobilizing the public and putting health under the control and responsibility of every person, promotes the health industry, like care for the ageing, tourism, fitness and leisure, health care and disease treatment, Chinese medicine health care services and traditional Chinese medicine. Also the policy aims at the development of the commercial health insurances and people's consumption on health. Healthy China 2030 does not explicitly adopt a systems approach and does not recognize cities as complex systems.

A study by Yue et al. (2017) in the Journal of Urban Health explored the impact of the China Healthy Cities Initiative on the urban environment and found that while infrastructure development had improved, like sewage and waste treatment, no significant change had been made in green space per capita or air quality.

1. A clean, safe physical environment of high quality (including housing quality).
2. An ecosystem that is stable now and sustainable in the long term.
3. A strong, mutually supportive and non-exploitative community.
4. A high degree of participation in and control by the citizens over the decisions affecting their lives, health and wellbeing.
5. The meeting of basic needs (food, water, shelter, income, safety and work) for all the city's people.
6. Access by the people to a wide variety of experiences and resources, with the chance for a wide variety of contact, interaction and communication.
7. A diverse, vital and innovative economy.
8. Connectedness with the past, with the cultural and biological heritage of city dwellers and with other groups and individuals.
9. A form that is compatible with and enhances the preceding characteristics.
10. An optimum level of appropriate public health and sickness care services, accessible to all.
11. High health status (high levels of positive health and low levels of disease).

Table 3: WHO Healthy City Checklist

Urban planners in China have recently launched a **China Healthy Cities Initiative**. In urban planning, according to their definition of urban health, ‘the health of the city’ and ‘the health of people in the city’ is combined (Wang 2018). The health of a city refers to the healthy development of the city itself, including a healthy environment, a healthy economy and a healthy society. The health of the people in the city is affected by the health of the city. The aim of the initiative is to contribute to the national Healthy China 2030 policy and to improve urban health by addressing following planning factors (Wang 2018):

1. **land use type**, development intensity and mix-use level are all factors which urban planning impacts and has the potential to reduce exposure to pollutants and promote physical activity;
2. **urban form** can extensively impact the level of pollutant concentration in air. The scale and structure of the city will impact daily commuting times and distances causing air pollution, while the urban fabric density and height affect the concentration and dispersion of pollutants;
3. **road and transportation** systems impact commuting times and therefore, air pollution levels and street connectivity and intersection density will impact dwellers’ physical activity;
4. **green and Open Spaces**, based on its scale, layout and plant arrangement, will impact on pollutants’ distribution and dispersion, and moreover, create the opportunity for residents to be physically active and achieve better mental wellbeing.

Further, by paying attention to the implementation and design strategy of those planning factors, the design of healthy cities can be improved by different approaches, like, decreasing air pollution and its human exposure, promoting physical activities and communication, or providing access to health facilities.

## 4. Resilient Cities

Gunderson (2000) introduced the concept of resilience in order to describe the non-linear, dynamic behavior of natural ecosystems. The term was defined as “the amount of disturbance that an ecosystem could withstand without changing self-organized processes and structures.” Others define resilience as a return of a system to a stable state after a shock or perturbation. Generally, it is recognized that ecological and other systems have more than one stable state and resilience is then often defined as the capacity of a system to adapt or renew itself (from one into another stable state). In management theory, resilience is about sustaining the capacity for renewal in changing environments. Resilience can be perceived as a buffer protecting a system from management failures which occur because of incomplete knowledge. It allows managers and policy makers to learn and make gradual improvements.

Resilient cities are cities that have the ability to absorb, recover and prepare for future shocks (OECD 2019). Many organizations have taken up the idea of resilient cities and launched programs or initiatives, among them the United Nations Office for Disaster Risk Reduction with its “ Making Cities Resilient” program; the World Bank; the Centre for Resilient Cities research lab in Wisconsin, US; the Stockholm Resilience Centre, an environmental research center in Sweden; the 100 Resilient Cities project of the Rockefeller Foundation; the International Council for Local Environmental Initiatives (ICLEI) which is hosting its resilience series; or technology-driven solutions for resilience in cities by companies like Siemens.

Resilience Brokers is a networked organization, with global alliances and partnerships across industries, sectors and communities that applies systems thinking to create health and wellbeing in city regions. Among others, they are developing innovative systems modelling tools to support data driven, regional and urban planning.

The City Resilience Index (CRI) developed by ARUP and Rockefeller Foundation defines “health and wellbeing” as one of the four thematic dimensions of the index. According to the CRI report (2019) “City resilience describes the capacity of cities to function, so that the people living and

working in cities – particularly the poor and vulnerable – survive and thrive no matter what stresses or shocks they encounter.”

## 5. Transforming the Engineering of Cities for Global and Societal Wellbeing (Liveable Cities)

Liveability is another systemic concept applied to cities with strong ties to health and wellbeing. According to the Liveable Cities research project (2019) their aim is “to create an holistic, integrated, truly multi-disciplinary city analysis methodology, which uniquely integrates wellbeing indicators, is founded on an evidence base of trials of radical interventions in cities, and delivers the realistic and radical engineering solutions necessary to (...) transform the engineering of cities to deliver societal and planetary wellbeing...”. For that purpose, among others, they have developed an urban analysis framework for holistically measuring the performance of UK cities with regard to wellbeing, resource security and CO<sub>2</sub> emissions.

Liveable Cities worked across five domains:

### 1. City analysis

A city analysis framework was developed to holistically measure the performance of UK cities with regard to wellbeing, resource security and CO<sub>2</sub> emissions. It demonstrates the need for, and defines the parameters for, solutions that do not compromise wellbeing and provides a model for other countries to leverage the liveability of their cities.

The framework included an urban metabolism model, designed to reveal how energy, water, waste and food flow within and through cities – not just the quantities, but also the reasons for their movement (what is causing their demand), who is paying for them and who controls them. It also looked at the need for these resources in the

first place, how locally controlled resources increase (or otherwise) resource security, the need for and use of local materials, and alternative paradigms for resource security.

Urban living is made possible through the goods and services derived from both local and distant natural systems, often subsidised by the extensive use of fossil fuels. For example, crops are typically farmed outside of cities, with fossil fuels underpinning the fertilization of soils, crop harvesting and processing, transport to consumers and the removal of the resulting waste. Urban living is also made more liveable by natural systems within and adjacent to cities. Parks provide accessible recreational space, whilst allotments can facilitate community development.

A green landscape has health benefits as well, such as removing pollutants from the air. Biodiversity underpins many of these benefits and changes to the diversity of natural systems may alter their ability to supply key services. Finally, walking to and through green spaces - whether pockets, corridors or expanses - provides physical health benefits, while simply seeing and hearing nature in cities provides mental health, or wellbeing, benefits. The programme therefore explored how natural systems can play a vital role in successfully delivering future low-carbon cities as well as cities that are better in so many other ways.

## 2. Wellbeing

To thrive, low-carbon cities must deliver individual and societal wellbeing. This requires a deep understanding of people's aspirations, quality of life and everyday mobilities – recognising that some of these factors may be in conflict with what urban designers and engineers are currently developing to promote a low-carbon, resource-secure lifestyle. However, in addition to alignment with aspirations, in order for decision-makers to implement ideas, suitable criteria, guidelines, engineering and design briefs must be developed.

The programme explored the fit between society's response to low-carbon cities and the degrees to which such cities deliver an

acceptable quality of life (within the norms of wellbeing), do not dilute the meeting of aspirations and do not disrupt the mobilities of people and objects.

### 3. Energy

This work responded to the apparent progress of UK cities towards achieving emission reduction targets, which can be misleading as the emission reductions are mainly the result of the steady replacement of carbon intensive electricity generation technologies (coal and oil) with gas and renewables – the majority of which is taking place outside of the UK. As such, this research focussed upon the power of cities to effect change within their own area of influence. It explored, from the building perspective, how energy consumption can meet low carbon targets, the impacts of infrastructure ‘lock in’ for improving the carbon performance of the urban environment, engendering and embedding low carbon pathways, and engineering solutions for urban demand reduction and power generation.

### 4. Future visions

It is now widely understood that climate change is adversely affecting our planet and our lives, and in order to ensure our future we must take action immediately to prevent further climate deterioration. And yet, inaction prevails in our policies, in our businesses and in our personal lives. Part of the problem is that we cannot clearly see where we are heading – that there is no clear vision of our low-carbon, resource secure future and thus developing a roadmap to achieve it is impossible. Liveable Cities tackled this this by envisioning such a future – an ideal city incorporating six urban typologies: the healthy city, the courteous city, the city as a public space, the evolving city, the temporal city, and the active and inclusive city.

## 5. Policy, governance and economics

Taking all of the above into account, what does an engineering strategy and pathway to implementation that embraces finance, policy, regulation and governance look like? This required understanding not only the best use of policy in the implementation of well-engineered design solutions, but the extent to which policy itself must be re-engineered if it is to be fit for purpose in the context of future city liveability.

Many of the structures and accepted norms within policy-making are based on an outdated understanding of cities and the way they work. Taking this as the starting point, this research teased out the underlying values, trajectories and drivers for policy decisions, and used the common ground between them to create a holistic framework on which each policy can be hung, demonstrating synthesis whilst allowing for difference and flexibility. It is therefore less important to ensure that all activities are aligned in terms of timescale, milestones, boundaries and parameters and more useful to ensure that the majority of activities are contributing to an overarching long-term vision. The quality of this vision – and in particular, the values underlying it – is the primary tool in joined-up policy-making.

Along with such clear motivations for re-engineering the machinery of policy-making, it is necessary to reflect on how individual cities can re-animate their own decision-making machines. With the pre-requisite of a strong and long-term underlying vision, it is obvious that principles, values and beliefs are of crucial importance. These are intrinsic to a community and are, in part, a reflection of the character of that community. In more diverse cities, there may be more difference than common ground, so working together requires strong leadership and a high level of investment in communication.

Drawing all of this together, and working in conjunction with the Foresight Future of Cities project, the Liveable Cities programme established the Liveable Cities Method, a nine-step decision-making process that enables the user to envision a desired low-carbon, liveable urban future; to identify what needs to change in order to achieve it; and to pressure test the

resilience of the proposed changes to future uncertainty.

## 6. New Zealand Centre for Sustainable Cities

The Centre perceives cities and complex systems and wellbeing not simply as economic wealth but also as people's health, social, cultural and environmental conditions. It is recognized that "when we understand cities as complex systems, we can gain a much better understanding of factors that effect the resilience's of our cities, as well as the health and wellbeing of the people who live there" (Howden Chapman et al. 2017). The center takes a closer look at issues such as governance and democracy and participation in urban planning, especially of the indigenous population, infrastructure, housing, energy, transport and mobility, modeling of environmental impacts on cities.

Important knowledge gains have been made by the researchers at the center. For example, in one case it was found that more than twice as much energy was used to commute to an office building which was built according to modern energy codes, than by the building itself. Another example demonstrated how natural environments and local government systems have co-evolved the relationship between town treatment of stormwater and the quality of nearby streams and estuaries.

Some of the central insights derived from the work of the center is that governments do not and cannot have control over multiple factors that all interact in complex ways to shape the overall health and wellbeing of a city and its people. There is a need for integrated urban policies and a need for participation and partnerships between the government and local urban residents in order to address those issues of complexity.

The conventional approach, of balancing or trading off the benefits of development against the impact on the natural environment, is severely questioned. Instead, integrated and systems approaches are called for. For example, instead of reducing greenhouse gas emissions through central

government policy measures, a systems approach “recognizes that the interplay of the built environment and the natural environment, reflected in how we use and move around urban spaces, can contribute to a number of positive outcomes. These include better health through increased uptake of walking and cycling, reduced emissions and improved air quality through less motor vehicle use and better cultural and community connectivity in well-designed urban places” (ibid: 9).

## 7. Urban Knowledge-Action Systems (KAS)

Many of the challenges cities are facing today, such as climate change, public health, and social justice, are too large, dynamic, and complex for city governments to address on their own. A more systemic and collaborative, multi-actor network approach is called for. This new urban governance model is characterized by:

1. systems-based and flexible management approaches that do away with agency boundaries in favor of institutional integration and coordination;
2. ‘opening’ of governments structures to include multiple voices, values, and visions in the development and steering of transition pathways;
3. co-production of knowledge, scenarios, and strategies where government officials, civic society organizations, private sector, and researchers collectively identify problems, produce knowledge, and put that knowledge into action through collaboration, synergy in implementation, and adapting processes.

Urban governance transitions are achieved through the development of a systems-based governance analysis framework: the so-called knowledge-action systems analysis (KASA). KASA is an interdisciplinary framework to map current governance conditions and networks relevant to

health and wellbeing of a city, evaluate the extent that the structure, social preferences, and knowledge systems of these networks enable or constrain transitions, and identify leverage points or interventions for change (Muñoz-Erickson 2014). By making use of tools and approaches from institutional analysis, social network analysis, and knowledge systems analysis, the KASA is a tool for urban decision makers for identifying ways to better connect and work together in building cities which are healthier and more resilient to climate change and health risks.

An application of KASA in San Juan, Puerto Rico (Erickson-Muñoz 2014), involved the mapping of the organizations and networks relevant to land use planning, the knowledge that was circulating across the network, and the influence (or power) that actors had on how that knowledge was applied. The analysis revealed that a diverse network of organizations were involved in the production and use of knowledge regarding land use, including civic organizations (Figure 11 A.). However, there were also sites in the network that potentially posed barriers to the design of urban sustainability and resilience, and therefore would need institutional innovation. These included:

1. a significant breakdown in knowledge flow between the Municipality and the state's planning agency that acted as a barrier in communicating knowledge of local conditions to the state agency (Figure 11 B.);
2. distinct power asymmetries between the Municipality's visions and knowledge systems which included social dimensions of urban planning (e.g., quality of life and equity goals) and the state's hegemonic ideas of the city as a node for regional economic power.
3. fragmentation in the knowledge systems tasks and functions of organizations relevant to land use planning and decision-making instead of collaboration and alignment of agendas and strategies;
4. knowledge asymmetries were observed, with conventional knowledge types associated with state administration, such as economic and technocratic approaches to planning, have more influence in the network over other alternative types of knowledge (e.g., local, political, social, etc.).

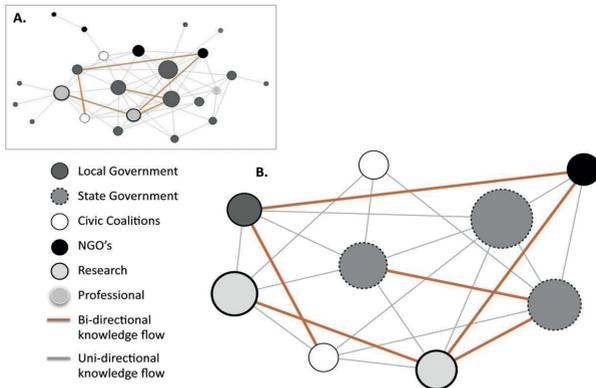


Figure 11: Network of knowledge flow among organizations involved in land use governance in San Juan, Puerto Rico. The figure on the top left (Figure 11 A.) shows all organizations linked through knowledge flows. Different weights of the nodes mean different levels of centrality, with greater nodes having greater influence over knowledge flow. The larger figure on the right (Figure 11 B.) shows only the central actors in the network that have higher degree centrality and betweenness (i.e., brokers) and the reciprocal ties among them (in orange) (Muñoz-Erickson and Cutts 2016).

## 8. The Role of Money in a Healthy Economy to achieve the UN Sustainability Goals

Max-Neef (1932-2019) and his colleagues at the Centre for Development Alternatives (CEPAUR) and the Institute of economics at the Universidad Austral de Chile in Valdivia have worked on a new development paradigm based on a revaluation of human needs, described as existential (having, doing, being) and as axiological (values) and the things needed to satisfy them at the heart of their development alternatives lies the principle of practicing economics as if people matter, working for the reorientation of development in terms of stimulating local self-reliance and satisfying fundamental human needs and advocating a return to the human scale.

Part of that work focuses on financial resources. The current crisis humanity faces in the age of the Anthropocene can be described by three major problems: financial crisis, inequality and the destruction of the environment or climate change. In 2015, more than 190 world leaders recognized that the world is on a “collision course” (Max-Neef, 2010) and committed to 17 Sustainable Development Goals (SDGs). Many conferences and high-level meetings have been held since then and one of the major topics is regularly how to finance these goals. There is a widespread belief that coming up with more money for sustainable development, will do the ‘trick’. However, it is not only more money that is required but a different financial system.

The problems with the financial system are that it is unnatural and builds on a conception of the role of money in society, which is unhealthy (Fuders et al 2013; Fuders 2016; Fuders & Max-Neef 2014). Unlike other goods, money is storable and does, therefore, not easily circulate in the economy. Money can be described as the blood of our economy. Similar to the blood circulation in the human body, the economy gets sick if money does not circulate well. Money is supposed to be a medium of exchange to facilitate the exchange of goods and services. But, because people tend to have the preference for liquidity, people like to save up money. The fact that people like to save for future times is a natural risk mitigating behaviour. Nevertheless, in nature it is only possible to hoard goods in a very restrictive way, since real goods perish. Food spoils rapidly, technical products lose value due to technical obsolescence, and services are not possible to hoard at all. Any excessive hoarding would –in time– result in the loss of the hoarded goods. This means that nature keeps our natural instinct to hoard in check. But our money, as it is designed today, makes it possible to hoard any surplus without restriction. Our instinct-driven impulse to hoard is being perverted by the fact that our money does not perish and has a monopolistic-like position compared to any real and perishable good (Gesell 1949). The design of our current financial system makes possible the hoarding of the value produced, which gives an incentive to produce more than is actually needed.

Researchers at the Centre for Development Alternatives (CEPAUR) and the Institute of Economics at the Universidad Austral de Chile in Valdivia study and analyze conventional economic theories in order to formulate a new model for a market economy that is not perverted by the need to grow.

There is much to learn from the proposal offered by the German-Argentine economist *Silvio Gesell* in his work, “The natural economic order”. Gesell (1949) proposed a currency that cannot be hoarded eternally, and thus circulates continuously. This currency, would serve solely as a means to facilitate interchange of goods and services and not to store wealth. Consequently, it would truly comply with the concept that conventional economic theory usually calls monetary neutrality but which cannot be sustained under today’s financial system. Today, money is not neutral. Rather, it generates a constant increase in a country’s total debt (and, in fact, also in inequality since deposits and debt grow in a likewise manner); and generates the obligation to grow, and with it contributes significantly to the destruction of the planet.

As any unnatural behavior in the long run causes illnesses, also our unnatural money makes our economy sick (Fuders 2009). If we want an economy that helps people to satisfy fundamental human needs, that is a Development at Human Scale (Max-Neef, et al., 1991)<sup>2</sup>, if we want a healthier economy that serves people and vice versa, then an economy is needed in which gaining money is not an end in itself. This does not mean that a financial system with characteristics like those proposed by Gesell would automatically stop any destruction of ecosystems or the production of goods and services with negative ecological balances. We can envision, however, that without the obligation to grow and without the possibility of accumulating large amounts of *virtual wealth* the abuse of nature could decrease to an extent that nature’s ability to assimilate negative effects might no longer be overwhelmed. Under the current financial system, a sustainable future is not possible. A healthy financial system is the precondition for sustainable and, above all, healthy development.

<sup>2</sup> Human needs in the Human-Scale-Development-Approach are seen as ontological, i.e. stemming from the condition of being human and can be characterized as few, finite, classifiable and do not vary through all human cultures and across historical time periods in contrast to the notion of what economics define as “wants”, which are infinite and insatiable. What do change over time and between cultures are the strategies by which these needs are satisfied. An index that measures the subjective perception of the satisfaction of fundamental human needs is the “Human Scale Development Index” (Fuders, et al., 2016).

# Summary

Cities are the centers of creativity and innovation but also a major source of the anthropogenic threats to climate and planetary health. Achieving the global sustainability goals requires more than the treatment of isolated urban ills. It requires rethinking cities as urban systems. In this Little Book we have provided food for that kind of rethinking by:

- showing that cities are multi-level complex systems and explaining why urban health is a systemic problem;
- illustrating how urban health lies at the heart of sustainable development;
- what a systems approach to urban health is;
- what it means to take a systems approach to urban health;
- illustrating why a systems approach to urban health equity is necessary;
- providing examples of cases in which systems thinking has been applied in cities.

As cities continue growing rapidly, the health of cities needs to be of paramount concern for the health of people and the planet. Both depend on one another and are interconnected. Cities are the nodes of legal, institutional, social, and economic networks which spread across the entire planet. Their infrastructures facilitate the flow of energy, resources and information, which is key for them to function healthily and sustainably. In this Little Book we have shown why urban health is not only about urban growth, but rather about the functioning of the systems which are able to process information, respond to their environment and adjust their mode of operation in order to sustain a healthy life in cities, of cities and that of the planet.



The implications of taking a systems approach to urban health and wellbeing are far-reaching for both, science and society, and call for 1) inter- and transdisciplinary science for a better understanding of urban complexities, 2) the co-production of knowledge by science with people and 3) participatory governance. These requirements are not the result of ideological stances, rather they result from insights into the new science of cities as complex systems. The overall task for achieving positive urban health and wellbeing outcomes is, therefore, to create networked systems of interconnectivity to measure, monitor, model, project and review strategies and modes of governance, so as to continuously adjust and adapt human behavior to the rapidly changing urban environment.

An integrated system of governance for cities is needed to improve urban health and wellbeing. It is a strategy that defines urban environmental as well as social and mental health goals for all urban sectors and is part of “the brain of the city” (Ebikeme et al. 2019), which measures and monitors success towards the defined health goals. Such a unit can exist as part of a polycentric system of health promoting networks in the city. The “brain of the city” enables the management of a city towards sustainable development goals. Taking a systems approach, e.g. by integrating health in all policies we are able to move from health as the pulse of the New Urban Agenda (NUA), to a concept of health which is at the heart of the Sustainable Development Goals.

# References

Alcott, B. 2008. "Historical Overview of the Jevons paradox in the Literature". In JM Polimeni; K Mayumi; M Giampietro (eds.). *The Jevons Paradox and the Myth of Resource Efficiency Improvements*. Earthscan. pp. 7–78. ISBN 978-1-84407-462-4.

Baccini, P. 2007. A city's metabolism: Towards the sustainable development of urban systems. *Journal of Urban Technology*, 4(2): 27-39

Bai, Xuemei, Alyson Surveyer, Thomas Elmqvist, Franz W. Gatzweiler, Burak Guneralp, Susan Parnell, Anne-HePrieur-Richard, Paul Shrivastava, Jose´ Gabriel Siri, Mark Stafford-Smith, Jean-Patrick Toussaint and Robert Webb 2016. Defining and advancing a systems approach for sustainable cities, *Current Opinion in Environmental Sustainability*, 23:69–78, doi: 10.1590/0102-311XDE01S115

Batty M. 2009. Cities as Complex Systems: Scaling, Interaction, Networks, Dynamics and Urban Morphologies. In: Meyers R. (eds) *Encyclopedia of Complexity and Systems Science*. Springer, New York, NY

Batty M. 2014. *The new science of cities*. Boston: MIT Press

Bettencourt, L. M. 2013. The origins of scaling in cities. *science*, 340 (6139), 1438-1441.

Bichell, R.E. 2017. The Plague is back. This time in New Mexico, Accessed Mar 5, 2019 at: <https://www.npr.org/sections/goatsandso-da/2017/06/29/534863486/the-bubonic-plague-is-back-this-time-in-new-mexico>

Boyko, C.T., Dunn, N., Cooper, R. (eds) (2021) *Designing Future Cities for Wellbeing*, Routledge, London.

Büchs, M. et al. (2018) Promoting low carbon behaviours through personalised information? Long-term evaluation of a carbon calculator interview, *Energy Policy*, 120, pp. 284–293. doi: 10.1016/j.enpol.2018.05.030.

Castells, M. 1996. *The information age: Economy, society and culture* (3 volumes). Blackwell, Oxford, 1997, 1998.

Costanza, R. and Mageau, M. 1999. What is a healthy ecosystem? *Aquatic Ecology* 33(1): 105-115

Chapman, R., Howden-Chapman, P., Capon, A. Understanding the systemic nature of cities to improve health and climate change mitigation, *Environment International*, 2016, 94, 380-387

Christian, D. 2008. *Big History: The Big Bang, Life on Earth, and the Rise of Humanity*, Chantilly, Virginia: The Great Courses

Ciecieszki, N.J. 2013. The Stench of Disease: Public Health and the Environment in Late-Medieval English towns and cities, *J Health, Culture and Society* 4: 91-104

CRI report 2019. Accessed Aug 1, 2019 at: <https://www.cityresilienceindex.org/#/resources>

Diez Roux A. V. 2011. Complex systems thinking and current impasses in health disparities research. *American journal of public health*, 101(9), 1627–1634. doi:10.2105/AJPH.2011.300149

Diez Roux A. V. 2015. Health in cities: is a systems approach needed? *Cad. Saúde Pública* vol.31 supl.1 Rio de Janeiro Nov, <http://dx.doi.org/10.1590/0102-311XDE01S115>

Duranton, G., & Puga, D. 2004. Micro-foundations of urban agglomeration economies. In *Handbook of regional and urban economics* (Vol. 4, pp. 2063-2117). Elsevier.

Drexel 2019. Reimagining Health in Cities. Symposium hosted by the Drexel Urban Health Collaborative at the Dornsife School of Public Health, <https://>

drexel.edu/uhc/events-workshops/symposium/

Ebikeme, C., Gatzweiler, F., Oni, T., Liu, J., Oyuela, A., Siri, J. 2019. Xiamen Call for Action: Building the Brain of the City—Universal Principles of Urban Health. *Journal of Urban Health*, <https://doi.org/10.1007/s11524-018-00342-0>

Elmqvist T., Gatzweiler F., Lindgren E., Liu J. 2019. Resilience Management for Healthy Cities in a Changing Climate. In: Marselle M., Stadler J., Korn H., Irvine K., Bonn A. (eds) *Biodiversity and Health in the Face of Climate Change*. Springer, Cham

Muñoz-Erickson, T. A. 2014. Multiple pathways to sustainability in the city: the case of San Juan, Puerto Rico. *Ecology and Society* 19(3): 2. <http://dx.doi.org/10.5751/ES-06457-190302>

Fuders, F., 2016. Smarter Money for Smarter Cities: How Regional Currencies Can Help to Promote a Decentralized and Sustainable Regional Development. In: *Decentralization and Regional Development – Experiences and Lessons from Four Continents over Three Decades*. Cham: Springer, pp. 155-185

Fuders, F. & Max-Neef, M., 2014. Local Money as Solution to Capitalist Global Financial Crisis. In: M. Pirson, U. Steinvorh, C. Largacha-Martinez & C. Dierksmeier, eds. *From Capitalistic to Humanistic Business*. New York: Palgrave Macmillan, pp. 157-189.

Fuders, F., Mondaca, C. & Azungah Haruna, M., 2013. The central' banks dilemma, the inflation-deflation paradox and a new interpretation of the Kondratieff waves. *Economía (U. de los Andes)*, Volume 36, pp. 33-66

Funtowicz, S. and Ravetz, J., 1993. Science for the post-normal age, *Futures*, 31(7): 735-755.

Gatzweiler, F.W., Zhu, Y.-G., Diez Roux, A.V., Capon, A., Donnelly, C., Salem, G., Ayad, H.M., Speizer, I., Nath, I., Boufford, J.I., Hanaki, K., Rietveld, L.C., Ritchie, P., Jayasinghe, S., Parnell, S., Zhang, Y. 2017. *Advancing Health and Wellbeing in the Changing Urban Environment. Implementing a Systems*

Approach. Springer and Zhejiang University Press

Gesell, S., 1949. Die natürliche Wirtschaftsordnung durch Freiland und Freigeld. Lauf: Rudolf Zitzmann

Giddens A. 1984. The constitution of society: Outline of the theory of structuration. Univ of California Press.

Gowdy, J. and Krall, L. 2013. The Ultrasocial Origin of the Anthropocene, *Ecological Economics* 95: 137–147

Gunderson, L.H. 2000. Ecological Resilience—In Theory and Application, *Annual Review of Ecology and Systematics* 31:1, 425-439

Howden-Chapman, P., Siri, J., Chisholm, E., Chapman, R., Doll, C. N., & Capon, A. 2017. Ensure Healthy Lives and Promote Well-being for All at All Ages. In: International Council for Science (ICSU). A Guide to SDG Interactions: from Science to Implementation [D.J. Griggs, M. Nilsson, A. Stevance, D. McCollum (eds)]. International Council for Science, Paris

Howden-Chapman, Ph. Early, L., and Ombler, J. (eds.) 2017. Cities in New Zealand. Preferences, patterns and possibilities. New Zealand, Wellington: Steele Roberts Aotearoa

Howden-Chapman, P., Keall, M., Conlon, F., Chapman, R. Building knowledge of how to increase co-benefits: two case studies of housing and transport, *ICE Urban Planning and Design*, 2015, 168, Issue DP4, 196–203 <http://dx.doi.org/10.1680/udap.14.00049>.

International Council for Science (ICSU), 2017. A Guide to SDG Interactions: from Science to Implementation [D.J. Griggs, M. Nilsson, A. Stevance, D. McCollum (eds)]. International Council for Science, Paris

Iskandar, D.D. and Gatzweiler, F.W, 2016. An Optimization Model for Technology Adoption of Marginalized Smallholders, In Gatzweiler, F.W. and von Braun, J. (eds) *Technological and Institutional Innovations for Marginalized Smallholders in Agricultural Development*, Springer: Berlin

Jayasinghe, S. 2015. Social determinants of health inequalities: towards a theoretical perspective using systems science. *International Journal for Equity in Health* (2015) 14:71, DOI 10.1186/s12939-015-0205-8

Lane D., Maxfield R., Read D., van der Leeuw S. 2009. From population to organization thinking, in Lane D., van der Leeuw S., Pomain D., West G., *Complexity perspectives in innovation and social change, methods series 7*. 11-41

Leach JM, Lee SE, Hunt DVL & Rogers CDF (2017). Improving city-scale measures of livable sustainability: A study of urban measurement and assessment through application to the city of Birmingham, UK. *Cities*, 71, 80-87

Leach JM, Rogers CDF, Ortegón-Sánchez A & Tyler N (2019) The Liveable Cities Method: Establishing the case for transformative change for a UK metro. *Proceedings of the Institution of Civil Engineers – Engineering Sustainability*, 173(1), 8-19. <https://doi.org/10.1680/jensu.18.00028>

Liveable Cities Project 2019. Accessed Aug 1, 2019 at: <https://liveablecities.org.uk/>

Mekonnen, MM. and Hoekstra, AY. 2016. Four billion people facing severe water scarcity. *Science Advances* 2(2): doi: 10.1126/sciadv.1500323

Muñoz-Erickson, T.A. and B. Cutts. 2016. Structural Dimensions of Knowledge-Action Networks for Sustainability. *Current Opinion in Environmental Sustainability*. 18: 56-64

Muñoz-Erickson, T.A. 2014. Co-production of Knowledge-Action Systems in Urban Sustainable Governance: The KASA Approach. *Environmental Science and Policy*. 37: 182-191

Newell, B., Proust, K., Dyball, R., McManus, P. 2007. Seeing obesity as a systems problem, *NSW Public Health Bulletin*, vol. 18, no. 11-12, pp. 214-218

Norgaard, R. 2017. *Economics, Religion and the Climate Crisis. A Long View*. Presentation at Portland State University, Feb 1, Accessed at: <https://www>.

youtube.com/watch?v=bPCeg44BtFM, Feb 26, 2019

OECD 2019. Resilient Cities. Accessed Aug 1, 2019 at: <https://www.oecd.org/cfe/regional-policy/resilient-cities.htm>

Ortegon-Sanchez A & Tyler N (2015). Constructing a vision for an 'ideal' future city: A conceptual model for transformative urban planning. *Transportation Research Procedia*, 13, 6-17.

PAHO, 2013. Summary of the Experiences of the Americas. In *The 8th Global Conference on Health Promotion 2013*. Helsinki: PAHO.

Polimeni, J.M., Mayumi, K., Giampietro, M. and Alcott, B. 2008. *The Jevons Paradox and the Myth of Resource Efficiency Improvements*, Oxford and New York: Earthscan

Portugali, J. 2000. Spatial Cognitive Dissonance and Socio—spatial Emergence in a Self-Organizing City. In *Self-Organization and the City* (pp. 141-173). Springer, Berlin, Heidelberg.

Pradhan, P., Costa, L., Rybski, D., Lucht, W., & Kropp, J. P. 2017. A systematic study of Sustainable Development Goal (SDG) interactions. *Earth's Future*, 5(11), 1169-1179.

Ramaswami, A, Russell, AG, Culligan, PJ, Sharma, KR, Kumar, E 2016. Meta-principles for developing smart, sustainable, and healthy cities, *Science* 352 (6288): 940-943, doi: 10.1126/science.aaf7160

Rogers CDF (2018). Engineering future liveable, resilient, sustainable cities using foresight. *Proceedings of the Institution of Civil Engineers – Civil Engineering*, 171(6), 3-9. <https://doi: 10.1680/jcien.17.00031>

Rogers CDF & Hunt DVL (2019). Realising visions for future cities: An aspirational futures methodology. *Proceedings of the Institution of Civil Engineers – Urban Design and Planning*, 172(4), 125-140. <https://doi: 10.1680/jurdp.18.00010>

Rozenblat C. Pumain D. 2018. Conclusion: Toward a Methodology for Multi-scalar Urban System Policies, in Rozenblat C., Pumain D., Velasquez E. (eds.). *International and Transnational Perspectives on Urban Systems*, UN-Habitat / Springer-Nature Series "Advances in Geographical and Environmental Sciences "

Rydin, Y., Bleahu, A., Davies, M., Dávila, J.D., Friel, S., di Grandis, G., Groce, N., Hallal, P., Hamilton, I., Howden-Chapman, P., Lai, K.M., Lim, C.J. Martins, J., Osrin, D., Ridley, I., Scott, I., Taylor, M., Wilkinson, P., Wilson, J. Shaping cities for health: the complexity of planning urban environments in the 21st century, *The Lancet*, 2012, 379, 9831, 2079-2108, 10.1016/S0140-6736(12)60435-8.

Simon, H. A. 1972. Theories of bounded rationality. *Decision and organization*, 1(1), 161-176.

Sanders, T. I. 2008. "Complex Systems Thinking and New Urbanism. "New Urbanism and Beyond: Designing Cities for the Future. Tigran Haas (editor). New York: Rizzoli.

Sarkar, C. and Webster, C. 2017. Urban environments and human health: current trends and future directions. *Current Opinion in Environmental Sustainability* 25: 33-44

Shaw, C., Hales, S., Edwards, R., Howden-Chapman, P. Health Co-Benefits of Policies to Mitigate Climate Change in the Transport Sector: Systematic Review, *Journal of Transport and Health*, 2017, 5, S107-108.

Stevenson M., Gleeson B. 2019. Complex Urban Systems: Compact Cities, Transport and Health. In: Nieuwenhuijsen M., Khreis H. (eds) *Integrating Human Health into Urban and Transport Planning*. Springer, Cham

Tan, X., Wu, Q. and Shao, H. 2018. Global commitments and China's endeavors to promote health and achieve sustainable development goals. *J Health Popul Nutr* 37: 8, doi: 10.1186/s41043-018-0139-z

Tan, X., Liu, X., Shao, H. 2017. Healthy China 2030: A Vision for Health Care. Commentary. *Value in Health Regional Issues* 12C: 112-114

Tsouros, A. 1995. The WHO Healthy Cities Project: state of the art and future plans. *Health Promotion International*. 10(2): 133-141

UN Habitat 2019. Climate change in cities. Accessed Aug 7, 2019: <https://unhabitat.org/urban-themes/climate-change/>

Watson, B. and Chuang, T. 1996. *Basic writings*. New York, NY: Columbia University Press

Wang, L. 2018. Healthy City Planning: return and promotion, in Sun Shiwen et al. *High-Quality Planning*. Beijing, China Architecture & Building Press, 201-216

WHO 2019. Healthy Cities in China. Accessed Aug 10, 2019 at: [http://www.wpro.who.int/china/mediacentre/factsheets/healthy\\_cities/en/](http://www.wpro.who.int/china/mediacentre/factsheets/healthy_cities/en/)

WHO 2016.. *Health as the Pulse of the New Urban Agenda*. World Health Organization, Geneva, Switzerland

WHO 2016. *Urban Health, Global report*. WHO and UN Habitat, Geneva, Switzerland

WHO Europe 2018. *Healthy City Checklist*. Accessed July 29, 2019 at: <http://www.euro.who.int/en/health-topics/environment-and-health/urban-health/who-european-healthy-cities-network/what-is-a-healthy-city/healthy-city-checklist>

World Cities Report 2016. *Urbanization and Development. Emerging Futures*, United Nations Human Settlements Program (UN-Habitat)

Yang, J. et al. 2018. The Tsinghua–Lancet Commission on Healthy Cities in China: unlocking the power of cities for a healthy China. [http://dx.doi.org/10.1016/S0140-6736\(18\)30486-0](http://dx.doi.org/10.1016/S0140-6736(18)30486-0)

Xia Y, Guan D, Jiang X, Peng L, Schroeder H, Zhang Q. 2016. Assessment of socioeconomic costs to China's air pollution. *Atmos Environ* 2016; 139: 147–56

Zhao, P. & Howden-Chapman, P. Social inequalities in mobility: the impact of the hukou system on migrants' job accessibility and commuting costs in Beijing. *International Development & Planning Review*, 2010, 32, 3-4, 363-384. doi:10.3228/idpr.2010.13



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