Chapter 2
Urban Health and Well-Being Challenges

2.1 Introduction: Global Health and Well-Being Challenges

Nicola Demsey and colleagues [22] have discussed 'the social dimension of urban sustainability', arguing that the term sustainability must include social and even economic dimensions, in addition to the biophysical ones discussed in Chap. 1. Challenges to social sustainability include the perennial (and often inter-related) urban problems of physical and mental health and well-being, unemployment, income and social inequality, crime, and homelessness. This chapter only fully addresses two of these critical urban problems—well-being and health. Nevertheless, it is vital that the solutions proposed for urban physical eco-efficiency and health improvement, at the very least, do not worsen these other problems; ideally, they should support their amelioration.

The remainder of this section examines global health and well-being. The case of OECD cities is explored in Sect. 2.2. Section 2.3, looks at the cities of the industrialising world in general, while Sect. 2.4 examines the important and special case of Chinese cities and the problems that the extremely rapid industrial and urban growth there have caused.

2.1.1 Physical Health and Mortality Worldwide

According to Jonathan Scrutton and colleagues [64], the future of the world's health is being challenged by two developments: first, an ageing society brought about by increases in longevity and falling birth rates, and second, limited resources to pay for rising health expenditures. These authors also argued that globally there is a shortage of healthcare workers. Although on average global longevity is steadily rising, the rise is far from uniform, with some countries even experiencing a decline in longevity [51]. One consequence is that the world's population is also ageing,

S. J. Wang and P. Moriarty, *Big Data for Urban Sustainability*,
https://doi.org/10.1007/978-3-319-73610-5_2

with clear implications for health provision, such as the proportion of the population with chronic illnesses. In 1950, with a world population of 2525 million, only 0.56% were aged 80 years or over; by 2015, the corresponding figures were 7350 million and 1.70%. For developed countries, the growth in the aged population was even greater; in Japan, those aged 80 or over comprised 0.44% of the total population in 1950, but 7.80% in 2015, a figure expected to rise to 15.1% by 2050. Already in 2015, there were almost 17 million people worldwide aged 90 years or over [74].

Perhaps not surprisingly, health costs are also rising. The World Health Organization (WHO) [84] data showed that averaged globally, health expenditures (the sum of both private and public costs) were 8.6% of global GDP in 2012, up from 7.7% in 2000. Percentage expenditures were highest for the 'high income' country category (averaging 11.6% of GDP in 2012). The US easily had the highest percentage expenditure in the world—17.0% in 2012, up from 13.1% in 2000. In the US at least, this expenditure as a share of GDP is expected to continue to rise sharply: Font and Sato [27] have projected that by 2050 in the US, health's share will have risen to over 35%, although such a large share is unlikely to be sustainable. Evidently, due to financial constraints alone, the world in future will find it increasingly difficult to maintain present levels of health care, let alone improve them. Radically new approaches to health care are thus urgently needed to contain costs.

At present, most global deaths are the result of non-communicable diseases, for example, the various types of cancer, diabetes, and respiratory diseases. All such diseases today account for 63% of global deaths, and an even higher share in OECD countries [64]. But the health problems facing the populations of Africa, Asia, and Latin America can be very different from those in OECD countries. For a start, infectious diseases are an important cause of death in many countries in these regions, as are vector-borne diseases like malaria and sleeping sickness. In tropical Africa, for example, the United Nations [72] mortality data shows that AIDS, infant mortality from lower respiratory and diarrhoeal diseases, tuberculosis and nutritional deficiency explain much of the 'longevity gap' compared with high-longevity countries.

Low incomes explain much of the differences in the burden of disease and mortality between high- and low-income countries. Income-based differences in health are not only important in low-income countries. A US study [82] compared the mortality data for adults differentiated by education levels, a proxy for socio-economic differences. Their results showed that merely reducing mortality levels of the less educated to that of the better educated group would avoid eight times as many deaths as would the gains from medical advances. Their findings help emphasise the importance of basic public health measures, even in high-income countries. They also show that the strong effects of inequality on health disparities. Another US study found that 'there is as much as a 35-year difference in life expectancy between the healthiest and richest US neighbourhoods and the most ill and deprived' [65].

Other recent US research [31] has found that not only is income inequality growing in the US, but its deleterious effects on health is getting stronger. The study results also suggested that even allowing for income differences, African Americans had poorer health than European Americans. In their case, at least, 'wealth can't

always buy health'. But as Case and Deaton [16] have documented, mortality and morbidity are also rising among middle-aged European Americans. Clearly, something is very wrong with the US health system. An earlier study [57] found similar effects for the UK.

Air pollution is a leading cause of global mortality and illness. One study in *Nature* journal estimated that outdoor air pollution alone caused between 1.6 and 4.8 million premature deaths worldwide, mainly in Asia [42]. Estimation of 'premature deaths' with air pollution—whether indoor or outdoor—as a factor is, however, subject to considerable uncertainty [25], as other official estimates have put it as high as seven million [76, 85]. The leading culprit was fine particulate air pollution, especially particles with diameters <2.5 μm ($PM_{2.5}$). The source of these particles varied, but the main source of $PM_{2.5}$ was found to be from domestic combustion for heating and cooking, particularly in China and India. Emission from power stations and vehicular transport were also important in some regions, but in other regions of the world, $PM_{2.5}$ from agriculture was the leading source [42]. Global pollution from $PM_{2.5}$ appears to be still rising: Brauer et al. [13] calculated that it increased 6% in population-weighted terms from 1990 to 2005.

Traffic fatalities are another leading cause of injury and death globally. Global deaths are estimated at around 1.3 million [86], mainly in industrialising nations, with China and India the leading countries. Many millions also suffer injuries of varying severity annually, which can be economically catastrophic for the affected families, because of the combination of loss of income if the victims are wage earners, and medical bills.

Climate change will have major effects on global human health. Existing diseases will usually increase their range, and new diseases will emerge. For example, the spread to higher latitudes and elevations of the *Anopheles* mosquito, the vector for malaria, could well greatly increase the number of annual malaria cases reported—already 200 million in 2014. The new human populations exposed to malaria may have no natural immunity. *Anopheles* and other mosquito species are also the vectors for additional diseases such as yellow fever, dengue, and chikungunya [55]. Moreover, the combination of climate change and increasing urban populations will act together to worsen global health problems, since cities function as incubators for infectious diseases [49]. At an even more basic health level, 'a positive relationship has been observed between regional trends in climate (rising temperatures and declining rainfall) and childhood stunting in Kenya since 1975, indicating that as projected warming and drying continue to occur along with population growth, food yields and nutritional health will be impaired' [46].

2.1.2 Well-Being: Another Component of Health

So far we have only examined illness and mortality. But the World Health Organisation [85] now see health in far broader terms: 'Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' [34].

There is now a vast literature on 'quality of life' (QOL) indices. Various indices have been developed to measure QOL, and to rank nations and cities globally on this basis [79]. The best known national-level measure is the UNDP's Human Development Index (HDI) which combines three normalised parameters: life expectancy at birth, number of years formal education, and GNI per capita. Each parameter can vary between 0 and 1 in the UNDP's 2010 revision. The HDI of a country (and the index could be readily adapted for cities) is the geometric mean of the three parameters [77]. The HDI can be criticised—only averages are considered, which can hide inequalities across populations in all three parameters, and more fundamentally, why only these three parameters and not others? One notable omission is income differences *within* each country. Average longevity and education level conceal similar disparities within countries. But the HDI (and other suggested indices which aim to improve on the HDI) do provide a readily understood means for roughly comparing welfare in different countries, and for tracking progress in any one country.

Income distribution inequalities are widening even as average per capita incomes, measured on a national basis, are converging. In a number of major OECD economies, including the US, Japan and many of the countries of Western Europe, this increasing inequity has taken the form of a steady rise in the share of both wealth and income going to the top one percent of families or income earners. Declining top tax rates has been an important reason for their gains [5]. It suggests that this elite is gaining increasing control over the political process in these countries. Income inequality is also rising in most non-OECD countries; in China, there is also rising regional inequality. The effect of this inequality for cities in various regions will be considered further in each of the following sections.

A specifically *urban* index of QOL is the Mercer Quality of Living Survey, which ranks 221 of the world's cities. Singapore, ranked at 26th, is the only city outside the OECD to be placed in the top 50 cities [47, 78]. The aim of the Mercer survey is to help companies decide on remuneration for their employees working overseas, and so is only indirectly concerned with how ordinary residents view their urban QOL. Mercer does now offer an *infrastructure* rankings, which are based on transportation infrastructure, water quality and reliability of electricity service. Again OECD cities dominate the highest rankings, with the important exception of Singapore, which was ranked first in 2017. The reasons for the relative absence of non-OECD cities, even some high-income Asian cities—in Mercer's top 50, will become clear from the discussion in Sects. 2.3 and 2.4. Looking just at US cities, one economically-oriented study found that neither large urban populations nor high densities decreased the QOL for residents [3].

2.2 Urban Health in OECD Cities

In OECD countries, the health of urban residents overall is usually better than those living in rural areas, mainly because of higher levels of medical services and higher incomes. (Nevertheless, a study in the UK [61] found that urban residents suffer more from mental

health problems than do rural residents). For the US, Susan Blumenthal and Jessica Kagen [11] have cautioned that low-income residents have poorer than average health, regardless of where they live. One review study reported that, if the Gini coefficient (a measure of income inequality) was reduced below 0.3 for 30 OECD countries, 1.5 million annual deaths could be avoided [58]. This finding suggests that lessening social and economic inequalities is a important approach for improving overall health levels.

OECD cities will face several major health challenges in the future. Three, already discussed, concern all areas: an ageing population, rising health costs, and new diseases (and the geographical spread of existing ones) because of climate and land use change. But health threats that are far more pronounced in urban than rural areas include the still serious health effects of air pollution—and also noise pollution. In future, ongoing climate and global land use change could cause worsening air pollution levels, even at constant annual pollutant emissions to the atmosphere.

2.2.1 Urban Air and Noise Pollution

It might be thought that air pollution is no longer a problem in the cities of the mature industrialised countries, that the soot and lead pollution problems that are too often a feature of cities in the industrialising world are largely a thing of the past. It is true that emissions of sulphur oxides have been dramatically reduced, following deadly air pollution (smog) episodes in Donora, a mill town in Pennsylvania USA in 1948, where hundreds died, and in London in 1952, which killed an estimated 4000, and made 100,000 ill. (In London in 1952, $PM_{2.5}$ levels rose to 3000 μg m^{-3} [44], far in excess of even the worst levels in today's Beijing or Delhi.) Both episodes were an important impetus for air pollution legislation in those countries. But two remaining air pollutants are proving far harder to reduce: very small particulates and oxides of nitrogen.

Although diesel fuel has long been the main fuel for heavier road vehicles, its use for passenger vehicles has lagged, particularly in the US. In Europe, however, diesel-fuelled cars have been promoted because of their better fuel efficiency than petrol vehicles. But the health problems arising from particulate emissions, particularly particles <2.5 μm ($PM_{2.5}$) emitted by diesel vehicles has led the city government in Paris—and France leads Europe in the diesel share of the car fleet—to enact a ban on diesel-fuelled cars beginning in 2020 [56]. Further, with the emphasis on RE and especially bioenergy in the EU, wood-burning stoves are becoming popular. But even correctly installed ones can deliver very high levels of $PM_{2.5}$ for the house occupants—even much greater than living on a heavily polluted street [41]. These microscopic particulates have greater health effects than larger ones—they cause greater levels of 'oxidative stress' in cells. It may even be the case that exposure to $PM_{2.5}$ is implicated in increased risk of dementia and Alzheimer's disease [71].

In London, the legal EU pollution limits for NO_2 (an air pollutant causing heart and lung problems) for the whole of year 2017 were already exceeded by 5 January 2017 [6]. Overall in the UK, [40] particulate emissions are estimated to be responsible for 30,000 deaths annually, and NO_2 for 10,000.

Noise pollution is increasingly recognised as a health hazard in its own right. Like air pollution, it is not a new phenomenon—ancient Rome reportedly banned carts from its streets at night because of their noise. A 2011 WHO study on noise effects in Europe [83], found that noise exposure from road traffic increased the risk of heart disease. Both road and aircraft noise increased the risks from high blood pressure. There was also some evidence that school children subject to prolonged noise suffered cognitive impairment, which persisted for 'for some time' after the noise exposure stopped. Other effects found included annoyance and sleep disturbance.

The high population densities found in many cities, particularly in the central and adjacent areas, exacerbate the impact of air and noise pollution. Not only do the high density of residents and workplaces generate high levels of passenger and freight traffic, but the resulting traffic congestion increases both noise and air pollution emissions per km of vehicular movement, and the large numbers of exposed people living, working or moving through such areas increases the absolute health impact of these pollutants.

Urban health is not independent of the other sectors we have discussed in Chap. 1. Apart from the obvious health implications of traffic casualties, transport adversely affects the health of urban residents, particularly those living near heavily trafficked highways through air pollution and noise emissions. A further impact arises from the choice of travel mode. Not only can shifting from motorised to non-motorised travel, through the exercise it provides, improves the health of the individual non-motorised traveller, but by helping to reduce air and noise pollution, all non-motorised travellers confer health benefits on other urban residents. In fact, there is considerable synergy between efforts to reduce air pollution and climate mitigation and adaptation efforts [32].

2.2.2 Climate Change Effects on Urban Health

The combined effects [43] of UHI (see Sect. 1.3) and climate change-related increases in duration and frequency of heatwaves in some regions have already resulted in thousands of heat-stress deaths, particularly in Europe; the 2003 European and 2010 Russian heatwaves are estimated to have caused excess mortality of 80,000 and 54,000 respectively [81]. Mortality occurred disproportionately in cities, and among the elderly [52]. Since the global population is ageing, any future increase in either the frequency or severity of heatwaves, urban or not, is of concern. Camilo Mora and colleagues [50] reviewed numerous studies on heat waves globally and found that, at present, about 30% of the global population experienced climatic conditions that lead to excess mortality from heat waves for at least 20 days each year. By 2100, this percentage could rise to 48% (strong GHG reductions) to as high as 74% (GHG emissions continue their growth).

If the world follows the business-as-usual scenarios (RCP6.0 and RCP8.5) of the IPCC, global temperature rises of 3 °C or more above pre-industrial can be expected by the end of this century [35]. Prolonged outdoor activity would then be dangerous, and, in the absence of air-conditioning, even indoor living. If fossil fuels were

continued to be used for electricity, the resulting greatly increased use of air-conditioning would worsen climate change at the global level. We thus need to be careful that local urban climate mitigation or adaptation solutions are not at the expense of solutions at the global level.

Along with many other areas, OECD cities will see the spread of diseases like malaria to formerly temperate areas as temperatures rise (see Sect. 2.1.1). Temperature increases, whether caused by UHI effects or climate change, are also forecast to increase levels of some pollutants in urban areas. Levels of air pollution depend not only on the emissions per day or per year, but also on atmospheric conditions. Favourable conditions can rapidly disperse urban airborne emissions, but conditions such as temperature inversions can prevent this, thus leading to rising urban concentrations, and with it adverse health effects from such pollution.

Dominique Charron and colleagues [17] have documented the incidence of waterborne diseases in North America, noting how extreme rainfall events can increase the risk of enteric diseases. Since increases in extreme rainfall, floods, and higher temperatures can all be expected under future climate change, enteric disease risk can also be expected to rise. The risk of food-borne diseases is also likely to rise following climate change. For instance, *Campylobacter* is the most frequently reported gastrointestinal disease in Europe, with contaminated poultry the main source of human infection (40–70% of cases). Kovats et al. [38] reported that increasing seasonal temperatures lead to a corresponding rise in the number of humans infected with *Campylobacter*.

2.2.3 Stress and Mental Illness

It is not always easy to place physical and mental illness in separate compartments. Loneliness, for example, is thought by some researchers to be implicated in several physical diseases [48]. Although temporary feelings of loneliness are common, chronic loneliness may affect the 'cardiovascular immune, and nervous systems'. This, in turn, could help explain why the longevity of socially isolated people are found to be lower than others. Nor is mental illness an isolated problem: in the US, a 2017 report found that levels of mental illness were at their highest level for at least 60 years [7]. According to the survey, some eight million US adults were experiencing mental health problems.

It may even be the case that city life itself is making us ill, that the term 'big city disease' is more than a metaphor. City living has been found to be associated with a variety of mental illnesses, including schizophrenia [39]. A long-term longitudinal study of mental health in Camberwell, a London suburb, found that over the period 1965 to 1997, the incidence of schizophrenia per 100,000 population had roughly doubled. However, no such rise was found in the general UK population [1]. Since most of the global population are now already urban, and the UN [73] expect this share to rise, any link between city living and mental illness is worrying. The link is unproven, even if it is easily explained: 'City dwellers typically face more noise, more

crime, more slums and more people jostling on the streets than do those outside urban areas. Those who have jobs complain of growing demands on them in the workplace, where they are expected to do much more in less time' [1]. One theory is that the stress of city living increases the risk of mental illness mainly in people who are already susceptible because of other life problems or because of their genetic makeup.

One intriguing idea is that not only urban stress, but even crime and levels of aggression, can be ameliorated by the provision of more green spaces in the city [28]. In the US, researchers [8] surveyed a range of urban and rural environments in the state of Wisconsin. They found that, after adjustment for length of residence: 'Higher levels of neighborhood green space were associated with significantly lower levels of symptomology for depression, anxiety and stress, after controlling for a wide range of confounding factors'. *Local* provision of green space may be especially important—and effective in improving mental well-being—for those with limited ability to travel outside their immediate area, such as the elderly and low-income groups. Julie Dean and colleagues [20] go further and have hypothesised that restoring biodiversity in urban areas is important for mental health.

Extreme weather events can also adversely affect mental health [26], suggesting that, *ceteris paribus*, cities can expect levels of mental illnesses to rise as climate continues to change.

2.2.4 Discussion

So far in this section, we have looked in turn at urban pollution as a present serious urban health hazard, and ongoing climate change, which will have increasingly important future influence. We then examined whether urban life itself and the stress it generates is at least partly responsible for the rising mental illness levels recorded in many cities, and discussed the role of urban vegetation and green spaces as a remedial measure.

A very different explanation for much illness, whether physical or mental, is income and social inequality. For physical health, much of the health disparity is no doubt mediated by different pollution levels, access to health services, and lifestyle factors experienced by different income classes. But for mental health, much evidence suggests that inequality itself has a largely unacknowledged deleterious effect [58].

2.3 Urban Health and Liveability in Non-OECD Cities

The health of those living in urban areas is recognised as presenting its own specific problems, with a dedicated journal: *The Journal of Urban Health* [21, 75]. For the very poor in cities in tropical Africa and parts of Asia, the key urban health problems may stem from malnutrition, lack of clean drinking water, and poor sanitation. These basic problems, which can account for a high proportion of deaths in low-income cities [86], will obviously not be solved by providing more hospitals, medicines, or health care

professionals. Nevertheless, other health problems are also important, including established contagious diseases such as AIDS, and the threat of emerging diseases such as Ebola in West Africa, and Zika in Latin America.

Many low- and middle-income countries are undergoing a transition in mortality causes. For the West African city of Accra, Ghana, Agyei-Mensah and de-Graft Aikins [2] have discussed what they termed the 'epidemiological transition' that the city has experienced as it modernised over the past century. They found that the protracted shift from infectious diseases to chronic diseases varied according to class, with wealthier residents increasingly likely to experience morbidity and mortality from chronic diseases such as hypertension and diabetes. For poorer residents, infectious diseases, particularly AIDS in recent decades, were more important, but chronic illnesses were also now an additional health burden. They identified three factors as important for their 'protracted polarised model of epidemiological transition in Accra: urbanization, urban poverty, and globalization.'

Cities everywhere run higher risks from epidemics than do non-urban areas. There are several reasons for this. In the industrialising countries of Africa and Asia, migration to cities is proceeding apace, and in all countries, travel between cities is growing; both factors help make cities centres for infection [4]. Also, cities are by definition densely populated, which facilitates the spread of infectious diseases, including HIV [52].

In 2006, Mike Davis published an article called '*Planet of Slums*' [19]. In many of the cities of the industrialising world, informal settlements—slums, *favelas*, *bidonvilles*—are the home of a significant share of the urban population, both new urban migrants, and locally born residents. The UN has estimated that 863 million people, or about one-third of the urban residents of the industrialising world, live in such slums [24]. Figure 2.1 shows two such slums, one from Kenya and one from Brazil, with the latter illustrating the steep slope locations characteristic of many Latin American slums. The number of slum dwellers is likely to swell as migration to cities continue, whether because of rural poverty, drought or political instability. Ebola was formerly limited to rural regions, but in the 2014 outbreak, the cities of the relevant West African nations were not spared. Moreover, in these cities, the urban poor were the worst affected. Slums also often lack clean drinking water and basic sanitation, creating ideal conditions for the spread of other infectious diseases such as typhoid.

The rest of this section examines the effects of both air pollution and climate change on the health of urban residents in cities outside the OECD. The case of Chinese urbanisation is so important it is considered separately in Sect. 2.4.

2.3.1 Urban Air Pollution and Climate Change Effects

Air pollution has long been a problem for urban settlements everywhere. Millennia ago, the main causes were indoor fires and in some cases, industries such as lead smelting. But a combination of growing levels of vehicular transport, vastly increased industrial activity, and lax enforcement of anti-pollution legislation (even assuming it exists) has seen air pollution rise to unprecedented levels in many cities

Fig. 2.1 Slums. (**a**) Kibera slum in Nairobi, Kenya. (**b**) *Favela*, Rio de Janiero, Brazil ((**a**) ['Scenes from Kibera slum in Nairobi' by khym54, available at http://bit.ly/2uWr3o2 under a Creative Commons licence 2.0 Generic. Full terms at http://creativecommons.org/licenses/by/2.0.]. (**b**) 'Favela, Rio de Janiero' by Eloise Acuna, available at http://bit.ly/2eGEVeR under a Creative Commons licence 2.0 Generic. Full terms at http://creativecommons.org/licenses/by/2.0.])

of the industrialising world. For example, Delhi, the world's most polluted megacity, has average annual levels of $PM_{2.5}$—the particle size which causes the most serious health problems—of 122 micrograms per cubic metre (122 μg m^{-3}) two orders of magnitude above the 10 μg m^{-3} WHO standard [68]. In winter, pollution levels can be even worse, rising as high as 600 μg m^{-3}, the result of a combination of domestic fires for heating and cold-weather temperature inversions.

In many industrialising countries, exposure to high concentrations of *lead* is an important health problem, particularly in urban areas. The risk is greatest for children, as it can affect their neurocognitive development. Although leaded fuels have been phased out in OECD countries, such is not the case in many other countries, especially in Africa. Other sources of lead in the environment include various industries such as smelting and battery manufacturing. The lead from such fuels and industries finishes up in the atmosphere, dust, and soils. Lead pollution is of serious concern in the industrial areas and cities of other countries as well, such as China, Bangladesh, India, and Mexico. For example in Dhaka, the megacity capital of Bangladesh, 'lead concentrations in airborne particulate matter averaged 453 ng m^{-3} during the low rainfall season of November to January' [69].

Ongoing climate change is anticipated to have significant effects on health everywhere, with the effects rising with temperature. Many of these impacts, such as water- and food-borne diseases, are already major problems in poor cities. Another crucial impact could be rising malnutrition, the result of extreme weather events like drought, but also of declining yields for key crops expected in hot regions as plants move closer to their physiological tolerance limits [35]. The various health impacts, like other impacts, however, will be highly uneven; poor households with correspondingly low carbon footprints have contributed least to global warming but will experience the greatest deleterious effects [15].

Further, the modelled results of Jeremy Pal and Elfatih Eltahir [54] suggest that by the end of this century, the human adaptation limits to temperature may be reached in cities in the Persian Gulf region, even under business-as-usual scenarios for climate change. At wet bulb temperatures (which combine temperature and humidity levels) above 35 °C, humans can no longer adapt to the heat by perspiration evaporation. At even higher temperature increases, large regions of the world would become uninhabitable [66]. Matthews et al. [45] have argued that even if we are successful in limiting global temperature rises to 2 °C, a number of the worlds megacities will experience deadly heat stress, similar to that occurring in 2015 in Kolkata and Karachi. Among the newly affected megacities would be Lagos and Shanghai, even if the temperature rise above pre-industrial was limited to 1.5 °C, as advocated at the Paris climate conference.

2.3.2 Mental Health, Well-being and Liveability

For the very poor in cities, the struggles to meet such basic needs as housing, adequate nutrition, and medical care are not the only problems they face. Many also suffer from a range of mental and social illnesses. Writing from a South Asian

context, Trivedi and colleagues [70] have provided the following list: 'psychoses, depression, sociopathy, substance abuse, alcoholism, crime, delinquency, vandalism, family disintegration, and alienation.' The authors stressed that poverty and mental illness cannot be easily separated. Further, lower-income residents are not only more likely to turn to crime, but also to be its victims. For the case of the megacity Delhi, Gautam Bhan [9] has even referred to the 'impoverishment of poverty' when discussing the evictions of the poor from illegal settlements, and their *de facto* 'criminalization' and loss of any rights as urban citizens.

2.4 Urban Health and Liveability in Chinese Cities

2.4.1 Rapid Urbanisation in China

There are several features of urbanisation in China which make it unique and are important for the health and well-being of urban residents there. First is the sheer scale of urban resident numbers. According to the UN [73, 74], an estimated 787 million resided in cities, 20% of the global urban population. China in 2015 had some 115 cities greater than one million population. The second remarkable feature is the *rate* of urbanisation in recent decades. The historic urban growth rate has been very uneven, as Fig. 2.2 shows. Although urbanisation began in China four millennia ago [14], the country was only 11.8% urban by 1950. It rose during the Great Leap Forward beginning in the late 1950s, but the urban share actually fell during the ensuing Cultural Revolution of 1965–1975. Since the opening up of the economy, the rate has sharply accelerated, and the urban share has more than doubled since 1990 to 55.6% in 2015, slightly above the global average of 54% [73]. From another point of view, the urban built-up land area in China expanded by 513% between 1981 and 2012, from 7438 to 45,566 km^2, with an annual growth rate of 6% [18].

With average annual national urban growth rates of around 3%, and national population growth rates of only 0.6%, it is clear that the growth of China's cities is fuelled largely by massive migration from rural areas. So urban growth and change has been paralleled by corresponding population change in rural areas, and the accompanying social changes. Moreover, this trend is expected to continue: from 2010 to 2025, according to the Ministry of Housing and Urban-Rural Development in China, the plan is to transfer a further 300 million people who are now living in rural areas to urban areas. In this migration from rural areas to cities, China is similar to many other countries in Asia and Africa [73], and it produces the same problems for the newcomers to cities. The recent rate of growth of urbanisation in China is unprecedented; in Western Europe, for example, it took the entire eighteenth century for the urban population to grow from 21.4% to 40.6% [29]. Put another way, for the past decade or more, China has been adding the equivalent of a new Chicago to its urban population every *month* [62].

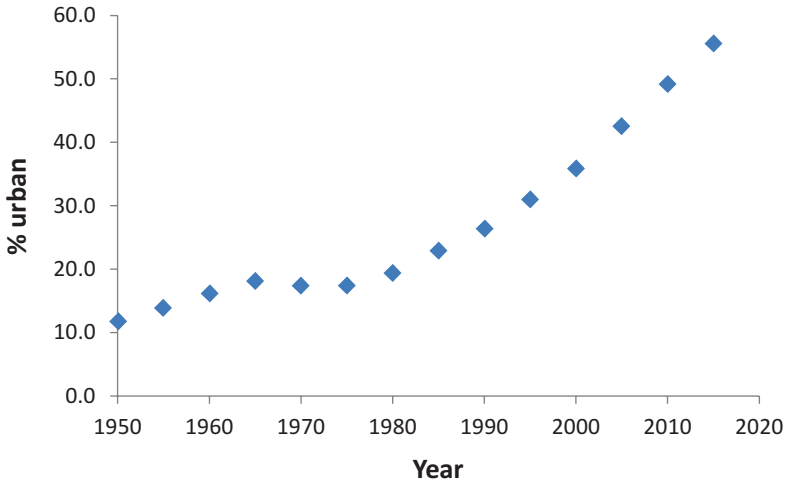

Fig. 2.2 Urbanisation in China, 1950 to 2015. Source: [72]

The third distinct feature of Chinese urbanisation is the uncertain status of the rural migrants to cities. Already in 2008, these numbered 140 million, or 10% of the national population, a number expected to grow [33]. These migrant workers, who tend to be young, male, and single, cannot become full urban citizens; they live in a semi-urban state, they do not enjoy (or only partially enjoy) the rights urban residents have for national education, health, social security and assistance, and housing security. Nor do they enjoy the right to vote or to be elected to public office. If their number was deducted from China's urban population, China's calculated urbanisation rate would be much lower.

Not only are these migrants ineligible for public health insurance, but their health profiles are different from the rest of the urban population. They have a greater incidence of infectious diseases such as 'acute respiratory infections, diarrhoeal, parasitic, and sexually transmitted diseases, and tuberculosis' [33]. The rates of innoculation for diseases such as tuberculosis and measles for the children of such migrants is also lower than either that of their fellow urbanites—or even that for rural regions [30].

Given the risk of spread of these diseases, the general health of cities requires that their plight be given priority. Nevertheless, the migrant workers tend to be younger and healthier than the general rural population when they arrive in cities. But if they get seriously ill through disease or industrial accidents, they are likely to return home for family support to avoid the high medical costs they would incur. As Hu et al. [33] have summarised: 'In essence, the countryside is exporting good health and reimporting ill-health.' In countries like China that are rapidly urbanising, the health of rural and urban populations are interrelated.

Yet the notion of 'urbanisation' itself can be problematic, and nowhere is this more apparent than in contemporary China. Christian Sorace and William Hurst [67], in an article that examined the creation of 'ghost cities' in China, have contested the idea that rural to urban migration is the main driver of urbanisation. They believed

that, unlike the case in tropical Africa, the Chinese government actively encourages the rapid urbanisation of China.

2.4.2 Air Pollution in Chinese Cities

The massive industrialisation and urbanisation of China in recent decades has been accompanied by serious pollution of China's air, waters and soils. The Chinese leadership has repeated stressed the need to push forward with urbanisation. If the vast majority of the Chinese people are to live in urban centres, it is thus of great importance to find ways to develop healthy cities, to avoid and overcome the 'big city disease'.

Urban residents in China regard air pollution as a key problem, and the findings back them up. In China overall, total deaths from air pollution were recently calculated at 1.6 million annually [62]. For cities, the main cause of anthropogenic air pollution is rising energy production, which is concentrated in urban and peri-urban areas. China is by far the world's largest coal producer, consuming exactly half the world's total in 2016 [12]. Not surprisingly, coal accounts for nearly two-thirds of energy consumption, although its use fell slightly from 2014 to 2015. Consequently, China is not only the world's largest emitter of CO_2, as well as of SO_2, but is also a major emitter of other GHGs, methane, and carbon black [12, 37]. Much of this coal is still used for domestic heating in urban and other areas. The resulting air pollution mainly consists of coal smoke, especially fine particulate matter and SO_2.

Beijing, China's capital, is one of the world's most polluted cities (see Fig. 2.3). A record was set on 12 January 2013, when $PM_{2.5}$ levels rose to 886 μg m^{-3} in Beijing in the evening. That winter day's average was 22 times the WHO safe level, and over January, authorities advised residents to stay indoors. SO_2 emissions have fallen since 1999, because of SO_2 scrubbers on power stations. But, in addition to $PM_{2.5}$, NO_2 levels remain high. The region's unfavourable topography can hem the smog in over winter months, when domestic coal burning is at its highest [44].

Starting in 2012, however, China has progressively introduced a nation-wide air quality reporting system, and by 2015 this had already covered 945 sites in 190 cities. 'These automated stations report hourly via the Internet, and focus on six pollutants: particulate matter <2.5 μm ($PM_{2.5}$), particulate matter <10 μm (PM_{10}), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O3), and carbon monoxide (CO)' [62]. These cities already make this air quality data immediately available to the public, and the plan is that the rest of China's 338 major cities will soon follow. Beginning in 2014, the public will also be able to access on the Internet the real-time air emissions and discharges into waterways from over 15,000 national heavy polluters [60].

Accurate assessment of pollution levels in cities is urgently needed. Also needed, of course, are strong anti-pollution policies. In 2014, the Chinese government announced two important changes to combat urban and regional air pollution. First, a shift from coal as the dominant energy source to cleaner burning natural gas and renewable energy. Second, the implementation of tougher controls on emissions.

Fig. 2.3 Pollution in Beijing, China ['Beijing Air Pollution … ' by Kentaro Iemoto available at http://bit.ly/2tSsaQo under a Creative Commons licence Attribution-ShareAlike 2.0 Generic. Full terms at http://creativecommons.org/licenses/by/2.0.]

Such implementation is anticipated to meet resistance from industry, as it will add to their production costs and partly erode the cost advantage of China's manufactured exports. Three city regions have been targetted: Greater Beijing, and the Yangtze and Pearl River Deltas, each with specified emission reductions [60]. Regions, rather than individual cities are used because of shared air basins.

Even with the high pollution levels in Chinese cities, the health of urban residents is better than their rural counterparts, because of both higher incomes and better medical services—and because $PM_{2.5}$ levels can also be high in rural areas [13, 87].

2.4.3 Liveability in Chinese Cities

There are other encouraging signs that the Chinese government is recognising the serious problems presented by China's hyper-growth in urbanisation and industrialisation. The National New Urbanization Plan (2014–2020) released by the Central Government proposed a shift in thinking about cities 'from land-centered urbanization to people-oriented urbanization.' For such an approach to succeed, the general public needs to be actively involved, but must also realise that the area available for urbanisation in China is limited [18].

Unlike the usual environmental sustainability concept, liveability pays special attention to the living conditions of individuals in a compact urban environment, especially urban apartment residents in cities dominated by speculative developers. Liveability can suffer if residents must live at high population density, surrounded by other tall buildings, and with little access to green areas. Thus, while the general public may support the principle of sustainable urban development, many argue that high-density development is too costly for the individual quality of life. Ensuring sustainability is often considered a reason for urban intensification, but a very narrow definition of sustainability, with its focus on the physical environment and energy aspects, is not that commonly used in the context of personal life.

Yet the goal of liveability is concerned with how we develop and build the future urban environment, which has the function of guiding our actions, planning and redesigning functions that will support people who come from different regions, with different backgrounds, different cultures and living habits to lead a full life in the same city environment. The emphasis on the liveability is becoming more and more important at all levels to direct the future urbanisation development process.

2.4.4 Zhuhai City Experiences

Here we describe the personal experience of Mr. Zhang (not his real name), a rural migrant who has witnessed the vast changes in one city, Zhuhai, over the past two decades. Zhuhai, a city located in the Pearl River Delta has Macau on its southern border. The northern area of Zhuhai is now part of the heavily populated Guangzhou-Shenzhen built-up area, with about 45 million inhabitants. Zhuhai, with its many islands, is an important tourist destination.

When Zhang arrived in Zhuhai for the first time in 1997, it was a typical Chinese town that had just started its urban development. He still remembers that Zhuhai Road was ‘very wide’ at that time, and that there were many places where you could ‘still smell the taste of the countryside, which means the synthesis smell of green plants, grass, manure, and haystacks, mixed with the taste of cooking smoke’. Since then, he has witnessed the city’s rise at an increadible speed—‘now, Zhuhai’s private cars have become too many, and it seems to me the road has become much narrower’ (Fig. 2.4).

‘It should be there, but now I can’t find it’, he continued, standing in the middle of a cluster of skyscraper buildings. Zhang pointed that ‘before, our school was in the back of that building; now it has been removed, moved to a more distant place from the city’. Despite Zhang’s misgivings, Zhuhai was ranked as China’s most liveable city in a 2014 report by the Chinese academy of Social Sciences [80].

‘Suddenly, the crane seemed to emerge from the ground, and there were cranes everywhere,’ Zhang continued. ‘The whole of the Golden Bay is a construction site, and many of the skyscrapers quickly filled the entire development zone of the Pearl River and are full of new small office and home office buildings.’

Fig. 2.4 Zhuhai city, China ['Foggy day, Zhuhai city skyline China' by Chris, available at http://bit.ly/2uqa2iN under a Creative Commons licence Attribution – ShareAlike 2.0 Generic. Full terms at http://creativecommons.org/licenses/by/2.0.]

'You will see a lot of young workers coming here, especially in the construction industry, because the wages are relatively high, but they say that they don't enjoy much of the life here, they will return to their hometown once they can make enough money. For these workers, there is nothing much else to do except work …only construction sites, factories and dormitories. The building site, their dormitory, and a wall are everything in their life … these migrant workers are really poor'. He shook his head sadly and recalled that: 'A few years ago, I had a relative from the country, looking for opportunities in Zhuhai, but eventually he became desperate and felt that there was no room for him.'

2.5 Discussion

The present century will not be an easy period for improving world health and well-being, because of several adverse factors. First global population is still growing, and could rise to over 9.7 billion by mid-century [74]. Two-thirds of this number are anticipated by the UN to live in cities [53], and Ruble [63] even claims the urban age is just beginning. If present trends continue, many of these will live in slums under very crowded and unsanitary conditions. By 2050, about 60% of humanity will live in the tropics, where the disease burden is higher than in temperate climates. The global population is ageing; older people are more susceptible to infectious diseases. Finally, air travel is expected to grow rapidly (see Sect. 8.1), with most of the growth expected in non-OECD countries [10].

All these factors favour the spread of newly emerging (or re-emerging) infectious diseases, mainly viral. Control of bacterial diseases (e.g. the Haiti cholera outbreak in 2010) has been made more difficult by the emergence of anti-biotic resistance, largely through the over-use of antibiotics [10]. Recent years have already witnessed outbreaks of new diseases, including the on-going Zika disease in South America,

Ebola in West Africa in 2014, severe acute respiratory syndrome (SARS), avian flu (H5N1), and swine flu (H1N1).

Climate change will also exacerbate existing urban health problems. Rising temperatures, coupled with the UHI effect, will increase the frequency and severity of heat waves. In many cities, climate change will worsen air pollution, and so its impact on urban health. Existing diseases could see their range spread to new areas. In many poor countries, climate change could adversely affect agricultural production, leading to forced migration to cities that already cater poorly to the health needs of existing residents. As global temperatures rise, a rising share of the global population will be subject to increased simultaneous risks from a variety of impacts arising from changes to water supply, ecosystems, agriculture, and disease, among others [59].

We have seen that the cities of low-income countries have more intractable health problems than OECD cities. Yet a WHO researcher, Christopher Dye [23] has provocatively argued that the main barriers to better urban health in low-income cities are not technical, nor even financial. Instead, the barriers arise from poor governance and policies for public health improvement, and a lack of social inclusion. With better access to modern medicine, higher income households can to some extent insulate themselves from the diseases of lower income households, and so ignore their health problems. The example of Cuba is instructive: longevity there in 2013 was 78 years, similar to the US value at 79 years. In 2014, GDP per capita in Cuba was only $6368, compared with $50,621 in the US ($US 2010 values) [36, 84], which adds support to Dye's argument.

This chapter has outlined the existing health and well-being problems that present urban dwellers face, and how climate and other changes will likely increase the difficulty in providing adequate health standards for all. Clearly, new ideas are needed. In Chap. 7, we will examine possible solutions to these challenges, and the many ways that application of big data can help, provided the political will is there for public health improvement, and basic human needs are first met.

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