

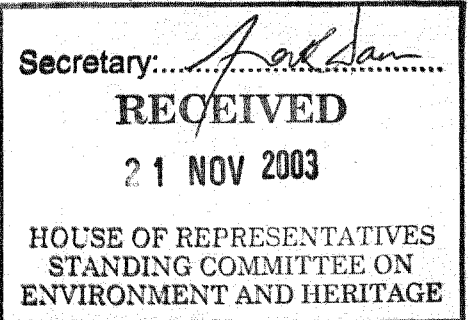


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November 20, 2003

Dr. Anna Dacre  
 Principal Research Officer  
 Environment and Heritage Committee  
 House of Representatives  
 Parliament House  
 Canberra ACT 2600



Dear Dr. Dacre,

### Sustainable Cities 2025

I appreciated the chance to discuss with you, recently, the objectives and interests of the impending national parliamentary inquiry into *Sustainable Cities 2025*. The inquiry coincides with an evident uptrend within the historical cycles of interest and concern about the form and future of cities and the urban environment, and the consequences for urban communities.

Historically, in western societies, the first upsurge of concern about cities and urban living arose in the wake of the crowding, squalor and environmental pollution of European cities early in the industrialisation era. In the latter half of the nineteenth century, sanitary reforms, stronger civic infrastructure, and, in England, the idea of "garden cities" (with some suburban decentralisation) arose. Early in the twentieth century, a "healthy cities" movement evolved in North America. Subsequently, in the 1970s-1980s, with rapid urban population growth and (in developed countries) the ascendancy of road-based transport, new concerns arose, and were shaped by the World Health Organization into an international "Healthy Cities Program". Much of this program's emphasis was on engaging urban communities in shaping urban environments, exercising local autonomy and enriching social networks.

Now, in the early twenty-first century, there are concerns over the burgeoning size of major cities, the rise of outer-suburban isolation, the escalating costs of infrastructure support, the future of urban transport, and the massive size and wider environmental impacts ("ecological footprint") of a typical city's "metabolism" – its energy use, waste generation and greenhouse gas emissions. These concerns, in turn, all entail risks to human wellbeing and health, both now and into the future.

I would like to emphasise three basic points:

1. Large cities are a relatively modern manifestation of human culture: hence, we still have much to learn about the design and management of city living. Meanwhile, cities are now becoming the dominant human habitat, globally. During the evolution of cities, there has been a changing series of mismatches between urban environments and the needs of human biology and psychology. Today, various such mismatches contribute to the burden of poor health and disability, at all ages.

In nineteenth century cities, the major urban health penalties were due to: (i) infectious diseases, both endemic and epidemic, (ii) limited food supplies and quality, and (iii) local chemical pollution of air and

water. In eliminating most these problems, we have acquired a new set of urban health penalties. These include: (i) a systemic imbalance in daily energy balance (energy-dense foods, reduced physical activity), leading to the marked rise in obesity in both children and adults, (ii) declines in life-satisfaction and in mental health, reflecting, variously, time-pressures at work, fewer social contacts, an increased emphasis on material acquisitions, and a lesser sense of safety, and (iii) the growing longer-term risks to wellbeing and health from urban pressures on the world's climate, coastal ecosystems, productive farmlands, and freshwater supplies.

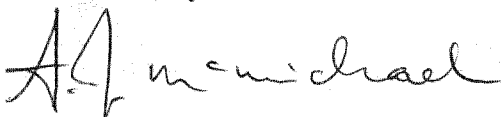
2. Cities are major centres of economic activity, innovatory design, social opportunity, education and artistic endeavour. This, of course, is why we like city life and are drawn to live there. However, the real criterion of "sustainability" must be measured in terms of the quality of human experience, and the capacity to maintain it a high level. Measures of economic activity, prosperity, infrastructure, availability of education and health services, and so on are thus only *means* to human *ends*. Therefore we should treat contemporary "triple bottom-line accounting" carefully, since those several indices of economic activity, environmental conditions and social relations/structures are all at one remove from what really matters – i.e., the levels of human autonomy, opportunity, security, wellbeing and health.
3. Related to the above point 2, we in Australia should think creatively about the set of indicators that we could develop and use to assess and monitor the sustainability of our cities. As is increasingly appreciated, "sustainability" is a big, and challenging, issue. It is not merely about improving the quality of local air, nor ensuring the flow of goods and services. Rather, sustainability is about whether we have the collective wit to create urban living conditions that are good for human comfort, wellbeing and health and are supportive of the planet's life-supporting systems. It is for this reason that we are beginning to see explorations of less conventional, more integrative, indicators such as the "genuine progress indicator", the urban "ecological footprint", and indices of human wellbeing and health.

I would be pleased to elaborate on any of these points, if it would assist. In the meantime, I enclose two published items of possible interest:

- The chapter on cities and health from my recently-published book: "Human Frontiers, Environments and Disease: Past Patterns, Uncertain Futures" (Cambridge University Press, 2001).
- A paper published three years ago: McMichael AJ. The urban environment and health in a world of increasing globalisation: issues for developing countries. *Bulletin of the WHO* 2000, 78: 1117-26.

I look forward to hearing of the work and achievement of this important and timely inquiry.

Yours sincerely,



Anthony J McMichael  
Professor and Director

2 enclosures (see above)

**Human frontiers,  
environments  
and disease**

**Past patterns, uncertain futures**

**Tony McMichael**

 **CAMBRIDGE**  
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## Cities, social environments and synapses

If we still believe that cities are the most complicated artifact we have created, if we believe further that they are cumulative, generational artifacts that harbor our values as a community and provide us with the setting where we can learn to live together, then it is our collective responsibility to guide their design. Kostoff S, 1991<sup>1</sup>

Towns and cities are at the heart of human history. Even so, they are a relatively recent product of cultural evolution, and a radical transformation of the human habitat. As urbanisation gathers momentum around the world, the urban environment increasingly dominates the landscape of human social interactions and physical exposures. Life in cities presents a complex profile of gains and losses for human health.

Settled living first occurred in the Fertile Crescent of the Middle East as early agrarianism emerged. The consequences for infectious diseases and nutritional disorders have been explored in chapters 4 and 5. Equally importantly, the advent of settled agrarian living transformed humankind's social and economic relations, resulting particularly in the concept of 'property' – occupied farm-land, permanent dwellings, and a local market for exchanging surplus products. As rural settlements grew into larger villages, the increasing productivity of the land allowed the development of social stratification. As Charles Darwin remarked in his journal, commenting on the equality that he observed in the primitive inhabitants of Tierra del Fuego during his voyage on the Beagle: 'It is difficult to understand how a chief can arise till there is property of some sort by which he might manifest his superiority and increase his power.'<sup>2</sup>

Towns first formed around 7,000 years ago in the Fertile Crescent, soon to be followed by the emergence of large cities and city-states. In the land of Sumer (the Kuwait and southern Iraq of today) the organisation of urban society was accompanied by the beginnings of monumental architecture, sculpture, cylindrical seals for authenticating accounts on clay tablets, and, around 5,000 years ago, the world's first writing. These early Mesopotamian

cities, such as Ur, Uruk and Babylon, were the seat of centralised hierarchical societies in which rulers, priests, scholars, soldiers, bureaucrats, technicians and artisans lived in a symbiosis with a large, subordinate and impoverished peasantry. Early Mesopotamian artwork portrays the 'priest-king' in diverse poses: in prayer, as victorious warrior, or as ensuring the abundance of the harvest and the fecundity of livestock.

By around 3,000 years ago there were only four cities in the world with an estimated 50,000 or more inhabitants, including Thebes and Memphis in Egypt. By 2,000 years ago, when world population approximated 200 million people, there were still only about 40 such cities. Most of humankind continued to live in rural villages until the new European forces of mercantilism, industrialisation and intercontinental imperialism thrust city living to the fore. Even so, less than 5% of world population lived in urban environments in 1800. Today, however, this figure has reached 50% and by 2030 the proportion will be 65%.

This ongoing move from countryside to city is as momentous a change in human ecology as was the ancient move from hunter-gatherer itinerancy to agrarian settlement. The current worldwide migration into cities reflects various factors: the lure of jobs, the contraction of rural employment in the face of increasingly mechanised food production, the flight from food insecurity and other forms of insecurity, and the search for variety and stimulation. Cities, despite their crowds, aggravations, squalor and hazards, remain centres of glamour, wealth, dreams and hope. Urbanisation may also reflect a basic social instinct. Humans, with their emotions, speech and cognition, are evolutionarily oriented to social existence and the sharing of experiences. Anthropologists tell us, however, that the functional interactive group size for hunter-gatherer humans is no more than 100–200.<sup>3</sup> Aristotle, too, doubted 'if a very populous city can ever be properly governed'. Nevertheless, via our various legal, moral and technical reinforcements, we mostly manage to live satisfactorily in these large and complex communities.

Cities are a cultural artefact, occurring late in humankind's story. We thus differ from other social creatures such as ants, bees and termites. The winnowing processes of natural selection have imbued those organisms with a hard-wired instinct for building their 'cities'. For example, each of the giant termite mounds that stand 3–4 metres tall in northern Australia is the product of programmed construction by tens of thousands of toiling termites. Elliptical in cross-section, the mounds are oriented side-on to minimise exposure to the midday sun. The vertical ribbing maximises the cooling effect of passing



breezes. The termites are not experimenting, nor are they casually improvising; they are doing the bidding of their genes. We humans, however, carry no genes for city building. Through inspiration, trial-and-error and the evolution of technology, we have found how to live in settled communities, build houses and large public buildings, transport ourselves around our cities, import and distribute food and material needs, and dispose of wastes.

THE URBAN ENVIRONMENT is a spontaneous, changeable and historically unfamiliar habitat. We continue to reinvent ways of city living. It is therefore no surprise that cities pose an array of risks and benefits to health and wellbeing. In the twentieth century we looked back at nineteenth century European cities, with their inner-city cesspools and their dark satanic mills, with fascinated horror. Later in the twenty-first century our successors may well look back with similar bemusement on the huge, largely treeless, major cities of the late twentieth century, congested with private motor cars and veiled in air pollutants. They may also be struck by the massive 'ecological footprints' of today's cities, with their high levels of consumption and waste generation.

Cities provide physical security, cultural and social diversity, excitement and fulfilment. They are the dominant source of employment in modern economies. They can improve access to health-care and schooling. Urban living typically reshapes family and social relations, and offers extensive contact networks. However, in sprawling Third World shanty towns life is often crowded, unhygienic and physically precarious. Cities also create the possibility of mass consumer markets. Urban populations represent vast captive markets, easily reached by advertising, recruited into patterned behaviours, subject to peer-consumer pressures and enticed to visit seductive shopping malls. This urban consumerism has many health consequences, as dietary patterns change, levels of physical activity decline, smoking rates increase and, for poorer people, as the sense of relative material deprivation is heightened.

The modern era of urbanisation began in Europe and North America. However, most of the change is now going on in non-Western countries. The majority of the world's very large cities with populations over 15 million are in poorer countries such as India, Pakistan, China and Brazil. Mexico City now has over 20 million inhabitants, 4 million cars and perhaps the world's worst air pollution. When the pollutant levels become too high in Mexico City industrial production is halted and people are urged to stay indoors. This, however, is just one of many health hazards of the contemporary urban environment. Many large Third World cities have vast, struggling urban-fringe

populations that typically face a double health jeopardy – first, the diseases of poverty, especially infections, injury, the hazards of unsafe drinking water, solid waste accumulation and toxic wastes;<sup>4</sup> and second, the chronic adult health disorders and diseases that result from the late-industrial urban lifestyle, such as obesity, diabetes, heart disease and lung cancer. In 1996 the UN Centre for Human Settlements said of sub-Saharan Africa in its *Global Report on Human Settlements*:

the deterioration in the built environment is sharply in evidence throughout most of urban Africa. As more of the urban population was forced into unplanned settlements on the outskirts of large cities, or into more crowded living space in an already deteriorating housing stock in the more established 'high density' areas, as a lower proportion of the populations had direct access to clean, piped water, regular garbage disposal and good health services, the quality of life for the vast majority of the population deteriorated during the 1980s and 1990s.<sup>5</sup>

Over the next three decades 2 billion more people will be added to the world's urban population. The volume of resources consumed and of pollution created will grow exponentially. Yet it is likely that half of this expanding urban population will be living in shanty towns, without running water, electricity or sanitation. The environmental, social and public health problems graphically described above for African cities exist also in many large cities of Latin America and Asia. On current trends, therefore, the proliferation of urban populations portends additional environmental pollution, massive pressures on adjoining and distant ecosystems, a continuation of the diseases of poverty, and a world polarised into very rich and very poor. On an optimistic view, emerging trends in economic liberalisation and political transparency may lead to material advances and to reductions in poverty. In reality it appears that economic globalisation, in its current form, is widening the rich-poor gap, increasing employment insecurity, and extending urban slums and shanty-towns.

Beyond these material problems there is the interesting question as to the suitability of cities as the social, emotional and spiritual habitat for a species whose Pleistocene genes have attuned it to open spaces, trees, grasslands, personalised contact networks and the presence of other animal species.<sup>6</sup> Do sub-urban gardens (or window boxes) and the family dog provide sufficient compensation? In the 1890s the pioneering sociologist Emile Durkheim wrote of the anomie and alienation that is the experience of many urban dwellers.<sup>7</sup> Today's social scientists continue to debate the optimal size and form of cities,

having generally agreed that the scale of modern cities is not appropriate to human social and biological needs. Among urban planners and urban dwellers there is now increasing discussion of the ideas of liveability and sustainability. The broader issues of how social environments influence patterns of health and disease will be discussed, albeit briefly, later in this chapter.

### Industrialisation, cities and health: recent history

The history of urbanisation and human health is well illustrated by Great Britain, the first country to begin industrialising. As England's larger cities underwent a rapid population growth in the late eighteenth and early nineteenth centuries, a new underclass of powerless factory workers and their families was created, drawing particularly on dispossessed rural workers. As noted in earlier chapters, conditions in the cities were squalid, malnutrition was widespread, infectious diseases rife and death rates typically exceeded birth rates. Nevertheless, urban populations were able to expand because of immigration from the countryside – where the impacts of closure of the commons, the aggregation of landholdings and the mechanisation of agriculture had produced an earlier impoverished underclass. This continued stream of rural immigrants, coming from environments in which they had been much less exposed to the 'crowd' infectious diseases of childhood, replenished the urban pool of young adults at risk of early death.

The first urban public health crisis, in 1840s England, prompted the creation of the Health of Towns Commission. This, as we saw in chapter 6, was linked to Edwin Chadwick's drive for urban sanitation along with other public health legislation in mid-nineteenth-century England. Meanwhile there were advances in nutrition, housing, general social modernisation and other important public health interventions such as smallpox vaccination. These advances, as we saw in chapter 7, dramatically reduced deaths from infectious diseases. These health-enhancing urban planning ideas were carried forward by Benjamin Ward Richardson, an English physician-sanitarian. In 1875, he proposed 'Hygeia', the ideal city with a population of no more than 100,000 persons, medium-density settlement, well-ventilated smoke-free housing, networked sewers, tree-lined streets, parks, public transport and community-based facilities for the sick and disabled.<sup>8</sup> Richardson's ideas were influential in both Britain and North America. Accordingly, the Canadian government's Commission on Conservation aspired to cities that were both pleasant and

health-promoting. Toronto in the 1920s, for example, undertook systematic city-wide pasteurisation of milk supplies, chlorination of drinking water supplies and educational programmes in 'municipal housekeeping' (family hygiene, sanitation, nutrition and child-rearing).

With industrialisation, cities throughout the Western world began to expand. In earlier centuries, cities had been more compact. They were often circumscribed by fortified walls, and had much smaller populations. Mediaeval London accounted for a mere 700 acres. The visitor to Italian cities such as Florence or Siena readily senses the original human scale of those old walled cities. The public buildings, churches, main piazzas, galleries and museums are all within a 15-minute walk of one another. These, like Athens and Rome, were 'walking cities'. As industrialisation advanced in nineteenth-century Europe the influx of rural poor impelled many middle- and upper-class people to move out to newer, more salubrious suburbs, serviced by radial roads, horse-drawn street-cars and railways. In this process, particularly evident in England, lay the origin of suburban sprawl.

Late in the nineteenth century, electrification appeared. In the United States in 1890, around 80% of urban railways were horse-drawn. By 1900 the proportion had shrunk precipitously to around 1% as electrified tram and light-rail systems took over. Whereas London had begun building its steam-engine underground railway in the 1860s, from around 1900 other Western cities built electrified underground railways which enabled rapid movement of even larger numbers of people. City life was becoming more energy intensive; urbanism was gaining momentum. The urban mortality penalty was receding. Gains in life expectancy, reflecting the greater numbers surviving childhood, now allowed urban populations to grow of their own accord, no longer dependent on rural replenishment.

THE EARLY TWENTIETH century saw suburban sprawl continued, assisted by the extension of suburban railway systems. As factories relocated towards the periphery of cities, the non-residential city centre became transformed into a hub of financial and commercial activity. The residential flight to the suburbs continued, soon to be abetted by the advent of the private motor car. In the United States in the 1930s, urban mass transit systems were purchased and then dismantled by a conspiratorial cartel of car manufacturers. The future of American cities was thereby secured for the private motor car. 'Automobile cities' had arrived. Indeed, the foundations for a century of automobile-dependent city growth had already been laid.<sup>9</sup> The long and harrowing history of

urban epidemics and their associated miasmas had imbued town planners with a fear of crowded living. Likewise, the squalid environmental hazards of early industry and food processing had led to a preference for keeping housing, factories and markets apart. Where possible, then, low-density urban development was favoured, with differentiation of zones. Here was the inspiration for the auto-dependent cities of North America and Australia.

The striving for healthy cities in Western countries dissipated during the 1930s recession and World War II, and was then overshadowed by the prosperous post-war era of automated production, industrial expansion and mass consumerism. Consequently, the quality of the urban environment in developed countries declined. Investment in public transport contracted; indeed, over half of downtown Los Angeles is now occupied by streets, freeways, parking facilities and garages. During the 1980s and 1990s the decline of inner-city areas and public housing estates created major social problems. Rising unemployment, persistent pockets of poverty, a contraction in social services and urban infrastructural decay all contributed to an environment where alienation and violence naturally arise. In contemporary New York and London around 1% of the population 'sleep rough' on the streets or in emergency shelters. The combination of a vulnerable underclass, structural unemployment, well-organised criminal networks and increasing supplies of high-grade heroin and cocaine from rural Third World sources has triggered a rising epidemic of drug addiction, accompanied by increases in property crime and infectious disease transmission.

The resultant residential decline of the inner city is now being widely countered, in developed countries, by inner-urban renewal programmes. However, unless done in a varied and socially equitable fashion, urban renewal may simply reverse the residential relationship of rich and poor, consigning the disadvantaged to the remote outer suburbs, underserved by public transport.

Overall, then, we are at a crossroads in our planning and management of cities. Urbanisation has occurred over the past several centuries in response to mercantilism, industrialisation and the labour-saving mechanisation of agriculture. The move to live and work within large urban-suburban environments has been made possible by fossil fuels, electrification and motorised transport. Modern communications and the international deregulation of trade and financial transactions have further boosted the role of cities as the hub of globalised private enterprise. Meanwhile, for many people in the developed world city life has become more difficult, more stressful and less conducive to good health.

## The health impacts of urbanisation

The range of urban environmental influences on health is great. The benefits of ready access to health care and educational facilities have been noted earlier in this chapter. The historical deficit in life expectancy in industrialising cities relative to surrounding rural populations has been eliminated in high-income countries. Nevertheless, there are many characteristics of contemporary city life that increase the risks of various diseases and health disorders.

The urban environment potentiates the spread of infectious diseases via crowding, patterns of human mobility and contact (sexual and other), and the persistence and spread of unhygienic conditions in slums and shanty-towns. Research in Kwa-Zulu Natal, South Africa, has shown that the vector-borne infection schistosomiasis, which spreads via infected water-snails, is infiltrating into urban areas via the migration of the rural population to shanty towns around the cities. Similarly, rural-to-city migration and insanitary living conditions have caused filariasis (elephantiasis), a disease transmitted by mosquitoes that breed in contaminated pools of water, to spread in Recife in northeast Brazil. Cities also affect patterns of infectious diseases in the developed world, especially sexually transmitted infections and the poverty-associated diseases such as tuberculosis and cholera. The incidence of childhood tuberculosis in the residentially crowded sections of the Bronx in New York City is six times higher than the city's average, while in London tuberculosis rates are markedly higher in the unemployed and in those living in cheap rented accommodation.

Urban living also influences a number of non-infectious diseases. The worldwide increase in obesity discussed in chapter 8 is essentially a manifestation of urban living, combining reduced physical activity with more abundant energy-dense diets. Such diets, along with increased mechanisation in the workplace affect body weight, blood pressure and other precursors of cardiovascular disease. Research in Kenya, for example, has shown that, when people move from rural western Kenya to Nairobi, their blood pressure increases as do their weight and dietary salt intake.<sup>10</sup> Cities can amplify social isolation, contributing to the depression that often accompanies old age. Cities also contain nodes of violence, criminality and drug dependence among the poorer, jobless and socially marginalised sub-populations. For such reasons, adult life expectancy among black men in Harlem, New York, is less than in men in Bangladesh.

Many of these influences on health can be viewed within the larger framework of urban human ecology. Of particular interest are the more systemic aspects of the urban environment that, by acting at the population level, affect

the rates of disease or death in the urban population overall. An example, previously mentioned in chapter 1, is that of the relationship between heatwaves, the form of cities and the resultant excess mortality. The conventional (and perfectly respectable) question that an epidemiologist might ask is: 'What type of individual is most likely to die during a heatwave?' Meanwhile, at the collective population level, an equally interesting question is: 'What characteristics of the urban environment influence the extent of excess mortality during a heatwave?' The two questions are complementary; they address different phenomena, at different levels. The latter question is overtly an 'ecological' enquiry about the characteristics of the human urban habitat that increase the population's vulnerability to thermal stress. It holds the promise of genuine and long-term primary prevention of excess mortality, via improvements in the design of cities.

A few more details about the relationship between heatwaves and mortality will illustrate how various aspects of urban ecology influence patterns of health.

### Heatwaves and mortality: systemic versus individual factors

The Pleistocene hunter-gatherers in equatorial Africa lived in a reasonably equable climate. The subsequent human colonisation of other continents exposed populations to a great variety of climatic regimes, often with strong seasonal contrasts. Houses, settled living and the growth of cities have enabled some modulation of exposures to those weather extremes. However, many of today's large cities tend to amplify extremes of temperature. In particular a 'heat island' effect occurs in summer, because of the expanse of brick-and-asphalt heat-retaining structures, the treeless expanses of inner cities and the physical obstruction of cooling breezes. Temperatures therefore tend to be several degrees centigrade higher in inner-city areas than in the leafier suburbs and the surrounding countryside, and night-time cooling is thereby diminished. In winter the downtown area in some cities, with its street-canyons of tall buildings, funnels chilly winds which cause a further drop in temperature. This is sometimes called a 'cold island' effect.

Severe heatwaves typically cause a transient rise in the death rate, particularly in the elderly, the sick and the frail. Some of the deaths are due to heat stroke, when the body is unable to counter adequately the extreme heat load. Most of the deaths occur in persons with advanced heart or blood vessel disease or chronic lung disease. The mortality impact of heatwaves is typically

greatest in the centre of large cities, where not only is the temperature highest but often the residents are poor and without air-conditioning.

In July of 1995, in the United States, more than 460 extra deaths over the course of a week were certified as due to the effects of the extreme heatwave in Chicago when temperatures reached 40°C. The rate of heat-related death was much greater in blacks than in whites, and in persons who were bed-ridden or otherwise confined in poorly ventilated inner-city apartment-block housing. One week later that same severe heatwave arrived in England and Wales where it caused a 10% excess of deaths during a 5-day period, particularly adult deaths from heart attack, stroke and respiratory disease. In Greater London, where daytime temperatures were higher and night-time relief was less than in the countryside, the mortality increased by around 15%. Concurrent rises in air pollution during the heatwave could account for no more than half of the excess deaths.<sup>11</sup>

Studies in both the United States and Europe have indicated that urban populations living at lower, warmer latitudes are less affected by summer heat extremes than are urban populations living further north. However, those northern populations are less affected by winter cold extremes. Each population is most vulnerable – because of housing design, clothing, behaviour and physiological adaptation – to seasonal weather extremes of the kind that is least familiar in that location. A further issue, from studies in the United States and Germany, is that over the past few decades urban populations in temperate zones have been experiencing progressively fewer excess deaths during summer heat extremes. This may reflect the increasing availability of air-conditioning. It may also reflect the decline, since around 1970, in the prevalence of cardiovascular disease, a major source of individual susceptibility to heatwaves. (If so, then populations in low-income countries, where coronary heart disease is now on the increase, may become *more* vulnerable to dying from heatwaves in future.)

### Urban transport systems, cars and health

The character of modern cities has, as already noted, been substantially shaped by automobile dependence. Private car ownership and travel has increased spectacularly over the past half-century. This has undoubtedly created new freedoms and opportunities. By the year 2000 there was a total of 600 million cars in the world, plus 15 million commercial vehicles, increasing by around 10 million per year. China, with over 2 million cars, will have around 4 million by



2010. In the absence of affordable underground trains or light rail systems in cities in low-income countries, the demand for private cars is rapidly increasing. In São Paulo, where the population of 17 million now owns around 5 million cars, the proportion of motorised trips taken by car has doubled over the past quarter-century, from around 25% to 50%.

Our relationship to urban traffic is complex. Each driver reasons that if only other people would drive less, then he/she could drive more easily and enjoyably. Our cities have evolved through phases of dismantling tram systems, discontinuing light-rail services, blighting footpaths with parking meters, and building massive freeway systems. Now we attempt to counter the problem by creating inner-city pedestrian malls, restricting city parking, disfiguring the roads with traffic-calming bumps, and introducing road-pricing schemes that use toll-gates or high-tech electronic tolls. In cities in the Netherlands and Denmark the provision of extensive tracks and parking facilities for bicycles during the 1980s has greatly boosted cycling, and the proportion of daily journeys taken on foot or by bicycle is well above the European average.<sup>9</sup> The city of Portland, Oregon, voted in the early 1990s against putting a modern freeway through the city. Instead, they opted for a light-rail system and restrictions on downtown car-use. Today, as un-American as it might seem, the citizens of Portland are proud of their new public transport, clean air and lower-stress lifestyle.<sup>9</sup> Meanwhile, elsewhere, both manufacturer and consumer continue to conspire against the disincentives to private transport. In the United States 'dashboard dining' is becoming popular, as car design incorporates pull-out devices for holding coffee cups and macro-muffins to enable commuters to eat breakfast in the morning traffic jam. In car-paralysed central Bangkok wealthy commuters have television sets, telephones and toilets in their enlarged cars. In wealthy countries, many suburbanites aspire to an out-of-town image by driving absurdly large four-wheel drive vehicles, many of which go 'off-road' only when parked on the footpath besides an up-market clothing shop.

Urban transport systems have wide-ranging consequences for health.<sup>12</sup> Cars clearly confer certain health benefits. These include the greater safety of late-night transport (especially for women) and reduced social isolation for the elderly and other people who find public transport difficult to use. On balance, however, the impact of cars upon urban population health is negative. Urban traffic poses two major, well-recognised, public health hazards: physical trauma and air pollution. Globally, there is a rising toll of fatal and non-fatal injuries, affecting pedestrians, cyclists and car-users. There are approximately 1 million deaths from car crashes each year, most of them in developing countries. In

developed countries, injuries and deaths on the roads are now declining, as the design of cars and roads improves, as seat-belts become mandatory and as drink-driving laws become tougher.

Exhaust-gas emissions contribute greatly to urban air pollution, particularly the formation of photochemical smog during summer. In Mexico City, for example, three-quarters of the air pollution is caused by motor vehicle exhaust. The wide range of documented health consequences reflects the diversity of pollutants: nitrogen oxides, fine particulates, carbon monoxide, various volatile organic chemicals and lead. Epidemiological studies indicate that these exhaust emissions increase the incidence of assorted respiratory diseases, including asthma attacks, and of coronary heart disease. The latter may be induced by the inhalation of very fine particulates which apparently cause inflammation of the respiratory epithelium, the resultant release of acute-phase proteins into the bloodstream and, hence, an increased tendency of blood to clot. In low-income countries, lead emissions from leaded gasoline remain a cause of impaired child intellectual development. The study of these various health impacts is difficult since air pollution is a complex exposure, the measurement of cumulative personal exposure is difficult, and coexistent risk factors such as smoking and occupational exposures abound. Further, levels of urban air pollution change over time: in many high-income countries, exhaust emissions are falling (as shown in the downward slope of graph B in Figure 6.1), whereas they are rising in most lower-income countries as urban traffic proliferates in the presence of less stringent environmental standards.

There are several less-well-recognised health impacts of cars. They cause fragmentation of neighbourhoods and intrusive noise. Sleep disturbance near roads and highways is a common complaint and source of mental stress. As discussed in chapter 8, increasing reliance on cars has reduced the level of physical activity, causing a rise in obesity in urban populations. It is not surprising that the Dutch, who have restricted their car use in favour of trams and bicycles, have both a manifest sense of urban community and Europe's flattest trendline in the rising prevalence of obesity over the past two decades.

In our redesign of cities in the twenty-first century, prime consideration must be given to the role and form of urban transport.<sup>9</sup> It is not just that motor vehicles have caused various types of adverse health impacts, along with physical and social environmental blight. They also contribute greatly to the mounting global pressures on the world's atmosphere and future climate. We have begun to solve the traffic-associated public health problems of road trauma and noxious exhaust gas emissions. We have yet to solve the problems

of physical inactivity and greenhouse gas emissions. Solutions will depend on lessening the need for private motoring, switching to non-carbon fuels, and creating convenient public transport systems.

### The urban environment and mental health

The nineteenth-century American philosopher Henry David Thoreau said that cities are places where millions of people are lonely together. While this is rather an over-statement, much anecdotal and survey evidence indicates that many city-dwellers do not feel engaged in a community; they feel disconnected from other people. Migration from countryside to city usually entails moving from a rural community-type society to an urban association-type society. The former is conservative, hierarchical and stable; it entails extended kinship and long-term friends. Association-type life in the cities brings social fluidity and more liberty; friendships are often ephemeral, and the sense of community is typically reduced.

An important and general influence on population health is the form and extent of social cohesion. At the individual level, it has long been evident that access to social networks and social support influences a person's prospects for good health and survival. Now we are beginning to understand how, at the group level, both social cohesion and the levels of material assets and equity can influence the population's overall health. That topic is considered further in the next section. First, though, how does the urban environment affect the pattern of mental health disorders?

Among city-dwellers, it is the poor, the socially marginalised and the isolated who are particularly vulnerable to mental disorders.<sup>13</sup> Many studies in North American cities have shown that the contour of mental disorders closely follows the contour of poverty in inner city areas. On the one hand, crowding and lack of privacy and control over one's living space may cause aggressive behaviour, child and spouse abuse, or drug and alcohol abuse. On the other hand, isolation and loneliness, without family or social support, may cause depression, suicide or drug and alcohol abuse. However, caution is needed here. First, causality might be 'in reverse'. Individuals with mental disorders may become detached from friends and community. Longitudinal studies are therefore required to clarify the sequence of events. Second, the diagnostic classification of mental health disorders is often difficult, and culture-dependent. Many researchers have assumed that the incidence of major psychiatric illnesses varies little between populations and cultures, even though the profile of symptoms may differ.

Recent studies, however, indicate that the occurrence of mental health disorders depends greatly on the cultural, social and economic context.

In developed countries, higher rates of psychiatric disorders have generally been reported in urban versus rural populations. In contrast, some studies in developing countries have found higher rates of psychiatric morbidity in rural than in urban populations – as, for example, have been reported for China and Taiwan.<sup>13</sup> If these urban-versus-rural differences are real, might they reflect differential probabilities of migration between city and country according to the individual's mental health status? In fact there is some evidence of a tendency for restless, agitated and psychotic people to move from rural districts to city centres, where anonymity may fulfil a desire for social isolation.<sup>14</sup>

Several studies have found a higher prevalence of schizophrenia in urban populations than in rural populations. This, some argue, is because of the 'geographical drift' of pre-schizophrenics into the cities. However, a large study of 50,000 Swedish army recruits showed that the incidence of schizophrenia is two-thirds higher among young men brought up in cities compared to those with a rural upbringing – indeed, the risk of schizophrenia was proportional to the size of town of upbringing.<sup>15</sup> What sort of environmental factor causes schizophrenia? This remains contentious, although apparently some aspect of the early-life social environment imprints upon the immature brain.<sup>16</sup> Whatever the actual causal factor, the origins of schizophrenia almost certainly entail an interaction between genes and environment. The notion of a 'nature versus nurture' dichotomy is misleading (as Shakespeare recognised in *The Tempest* in describing the anti-social and menacing Caliban as one 'upon whose nature nurture will not stick').

Neurological studies reveal that, in schizophrenics, part of the prefrontal cortex (the most recently evolved grey matter, acquired by the *Homo* lineage in the past half-million years) is imperfectly linked with other cortical and limbic system centres. This deficient neural linkage impairs cognitive coherence. Various other anti-social behaviours reflect disordered functioning of the brain's limbic system, the neural circuitry that controls how we emote, experience sensations and remember. Perhaps it is not surprising that the enormous complexity of our recently evolved cerebral cortex, especially the prefrontal cortex and its myriad connections, results in occasional malfunctions. Many of evolution's improvisations are imperfect. While disorders of the psyche are disabling for the individual – and discomforting for family and friends – yet, considered at the population level, this might be viewed as a small price for the human species to pay for the wonders and benefits of the unique *virtual reality*



that constitutes human consciousness. In other words, we incur the hazards of neurological complexity in return for the facilities of abstract thought, artistic creativity, interpreting the ideas and intentions of others, imagining other scenarios and planning the future.<sup>17</sup> Clearly, natural selection has allowed the human species to pay that price.

### Ecological footprints of urban populations

Cities also impinge on human health via a larger-scale and less immediate pathway. Since urbanism entails intensified and concentrated economic activity, cities have a great impact on the wider environment. There are, of course, major ecological benefits of city living: cities confer economies of scale, of proximity and of the shared use of resources. However, life in today's cities entails great 'externalities'. Urban populations depend on food grown elsewhere, on raw materials extracted from elsewhere, and on having their wastes disposed of elsewhere. Cities, as ecosystems, thus have inputs of energy and materials and outputs of waste; they have a large 'ecological footprint'.<sup>18</sup> Oil and gas supplies usually come from distant sources. Londoners drink wine from southern Australia, South Africa and Latin America. In Tokyo the disposable chopsticks come from the Malaysian jungles. So, too, the year-round fresh fruits and vegetables that modern affluent Western consumers now take for granted: the out-of-season green beans from Kenya and citrus fruit from Brazil. The population of 4 million in Sydney, Australia, consumes approximately 1 million tonnes of food annually, almost 1 billion tonnes of water, and generates 500 million tonnes of sewage and 35 million tonnes of carbon dioxide.<sup>9</sup>

A study of the environmental resources – wood, paper, fibre, food (including seafood) and waste-absorbing 'sinks' – consumed by 29 cities of the Baltic Sea region is illustrative.<sup>19</sup> For supplies, those cities depend upon a total area of forest, arable land and marine ecosystems several hundred times greater than the total area of the cities. A similarly large area is required to absorb the wastes. In Vancouver, Canada, the almost half-million residents, occupying just 11,400 hectares, actually require the ecological services of 2.3 million hectares (Table 9.1).<sup>18</sup> The ratio of 207:1 for the 'overshoot' of the urban population is substantially greater than the ratio of 12:1 for the population of the parent region, the Lower Fraser Basin as a whole. Neither ratio would be sustainable if applied to the world population.<sup>20</sup>

The externalities of urban living include increasing contributions to the world's problems of greenhouse gas accumulation, stratospheric ozone deple-

Table 9.1. Ecological footprints of Vancouver and the Lower Fraser Basin, Canada

| Geographic unit    | Population | Land area |            | Overshoot Factor<br>(b/a) |
|--------------------|------------|-----------|------------|---------------------------|
|                    |            | (a)       | (b)        |                           |
| Vancouver City     | 472,000    | 11,400    | 2,360,600  | 207                       |
| Lower Fraser Basin | 2,000,000  | 830,000   | 10,000,000 | 12                        |

Source: Rees W, 1996<sup>18</sup>

tion, land alienation and degradation, and coastal zone destruction. The urbanised developed world, with one-fifth of world population, accounts for three-quarters of all greenhouse gas emissions. Contemporary urbanism is thus contributing mightily to the process of global environmental changes – and, as we shall see in chapter 10, this jeopardises the health of current and future generations.

### The social environment, inequalities and health

The social and economic conditions of life have a fundamental influence on health. This may sound rather obvious. After all, we know that impoverished and poorly educated African populations have particularly high rates of HIV/AIDS, that suicide rates go up when unemployment levels go up, and that in each society poor people die younger than the rich. Nevertheless, much of the research that epidemiologists do, and much of the popular discussion about health and disease, is about the risks incurred by individuals because of their specific personal behaviours or exposures, such as cigarette smoking, occupational asbestos exposure, mobile phone use and eating high-fat diets. We rarely stand back from the detail and assess the larger contextual influences on the health of communities or whole populations.

This focus on individual risks to health reflects the priorities of contemporary epidemiology (as discussed in chapter 8). Most of that discipline's modern methods have developed in the United States, where the prevailing view of 'society' is somewhat reminiscent of Margaret Thatcher's remark in the 1980s that there is no such thing as society *per se*; there are only individuals and families. The emphasis is on the individual. Hence, in much recent epidemiological research the focus of attention has been on individual free-range consumers

who are assumed to exercise personal choices in the market-place, on the roads and in bed. There has been less interest in studying the more elusive, but more fundamental, social influences on the health of populations.<sup>21</sup>

During the 1990s a lively debate arose among epidemiologists over the appropriate focus of research into the causes of disease. Should the epidemiologists' task include asking distal ('upstream') questions about the social, cultural and economic determinants of health? After all, the proximal ('downstream') risk factors such as cigarette smoking and unsafe sex are not randomly distributed within the population. Different groups within society therefore incur different risks because of their particular circumstances: their material conditions, level of disposable income, personal autonomy, value systems, peer and commercial pressures, knowledge and attitudes.<sup>22</sup> This is not a new idea, but it is one that has been somewhat eclipsed in recent years. The sociologist Emile Durkheim proposed in the late nineteenth century that it was a society's characteristics at large that determined the suicide rate.<sup>23</sup> The rate, he said, was not simply the aggregate of individual suicidal tendencies. Rather, it reflected characteristics of the population: the underlying social values, the types of social relations, and the moral significance accorded to the act of suicide. Individual-based explanations, said Durkheim, were inadequate.

There are two dimensions of complexity here that must be addressed by researchers. The first task refers to deciding on the appropriate level and type of analysis of disease causation. The second task refers to how we envisage the evolution of health risks over time; over the course of a life.

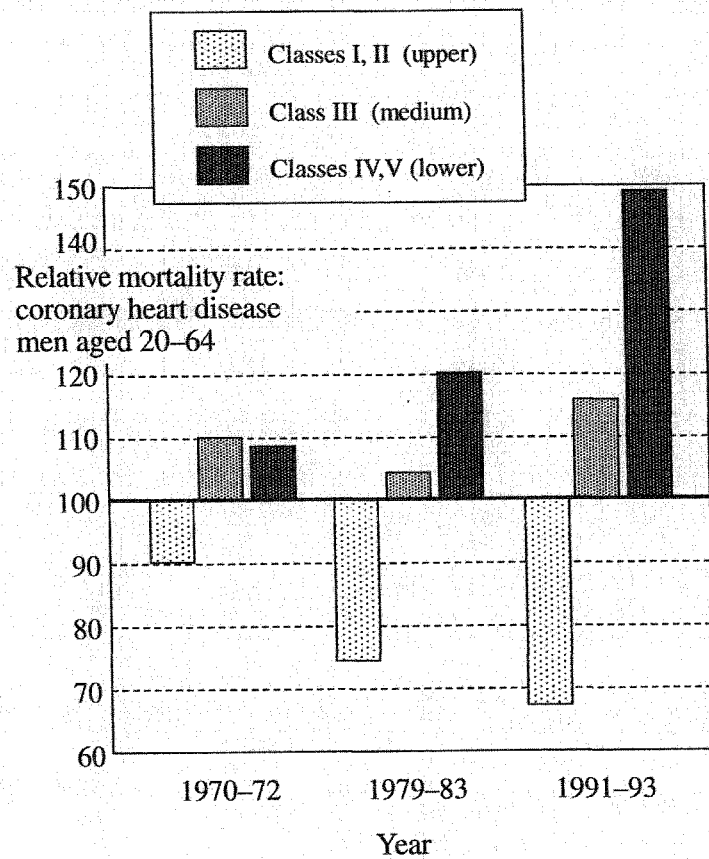
THE FIRST TASK, basically, is to get an appropriate balance between an emphasis on social (upstream) or behavioural and biological (downstream) processes. Here there is unresolved debate. In some respects these two levels of analysis are complementary, as we saw above in relation to studying heatwaves and mortality (and as we saw in chapter 8, in discussing the iterative relationship between epidemiological studies at population and individual levels). Likewise, at the population level, a generalised decline in the occurrence of early childhood infections may have predisposed recent generations of children to asthma, while, at the individual level, the determinants of asthma attack may be parental smoking or exposure to high local levels of ambient air pollution. However, one of the legacies of the biomedical model – which, as offspring of the 1880s germ theory, has dominated twentieth-century ideas about the causes and processes of disease – is the assumption that causation is specific and observable within the individual. Hence, there is an expectation that

important causes of disease will both act at and have direct biomedical manifestations at the individual level.

The recently rejuvenated debate over the causes of socioeconomic inequalities in health, in developed countries, has thrown into sharp relief three different ways of thinking about disease causation: the psychosocial, the materialist and the 'political economy of health'. These three conceptual models, discussed below, both compete with and complement one another. The debate is an important one because the long-observed inequalities in health between rich and poor in Western countries have been increasing over recent decades. In Britain, for example, the social class differential in lung cancer death rates widened markedly during the third quarter of the twentieth century and has subsequently persisted. The inverse social class gradient in coronary heart disease death rates in Britain approximately doubled over the later decades of the twentieth century (Figure 9.1). In the early 1970s the rate of premature death from coronary heart disease was 1.2 times greater in men in the lowest social class than in the highest social class; by the early 1990s the ratio had increased to around 2.2.<sup>24</sup> Now, this could be the result of a class-related divergence in adult life experiences over approximately that same period from the 1970s to 1990s, or it could be the result of early-life or cumulative lifelong differences between social classes. In each case, the mortality difference could have arisen either because of divergent psychosocial experiences and levels of life-stress, with resultant pathophysiological disturbances. Or it could have arisen because of differences in the material conditions of life, such as access to health care, types of diet eaten, occupational exposures or peer-influenced smoking habits.

Underlying these 'psychosocial' and 'materialist' explanations is a more fundamental analysis of the influence of culture, politics and social structure. Applying a political-economy perspective, this analysis examines patterns of health and disease in terms of power relations, opportunities and the dissemination of knowledge.<sup>25</sup> It takes account of the political and cultural history of the population. This type of analysis is analogous to economist Amartya Sen's elucidation of the root causes of hunger in the world – that is, the notion of whether or not individuals have 'entitlement' to food, by dint of land ownership, money to spend or particular social status (e.g., Buddhist monks who receive food from the community).<sup>26</sup>

The psychosocial model is well illustrated by the follow-up studies of Whitehall civil servants by Michael Marmot and colleagues, documenting health differences between hierarchical occupational grades.<sup>27</sup> Across the four main



**Figure 9.1** Increase in the social-class-related gradient in death rate from coronary heart disease in men aged 20–64 years in England and Wales during the period 1970–93. Social class is based on usual occupation; rates are adjusted for age differences. For each of the three time periods, the whole-population rate is set at 100 for ease of comparison. During this past quarter-century, death rates from coronary heart disease declined in Britain as they did in other Western countries. The decline began earlier and occurred faster in the upper social classes than in the lower classes. Hence the widening of the class gradient.

occupational grades there is a threefold inverse gradient in coronary heart disease mortality – that is, the lowest grade has a death rate three times higher than the upper grade. This gradient appears to be only partly explained by differences in individuals' conventional biomedical risk factors. What else in their social-environmental experience could be contributing? The essence of the psychosocial approach lies in studying how individuals' psychosocial experiences (as a function of their status, control, job satisfaction and so on) translate into neurological, hormonal and immunological responses that then influence the disease process. As we will see below, there is evidence from primate studies that status and chronic situational stress affect blood cortisol levels and, in turn, the pathogenesis of cardiovascular disease. The psychosocial model thus offers an explanation of how seemingly elusive social experiences, unequally shared in society, can translate into biomedically based health inequalities. The focus of this model is the individual experience, and biological consequences, of the workplace environment, of hierarchical status, or of a personal sense of relative income deprivation. It may invoke 'social capital' as a determinant of health outcomes, but it does so in a way that emphasises informal (horizontal) networks of support for individuals within the community.

Critics of the psychosocial model point out that this approach does not explore how these socioeconomic class-related differences arose. Nor does it seek an understanding of who benefits, and at whose cost. In contrast, the broader political-economy perspective, invoking the notion of the 'social production of disease', seeks explanations at the community or population level in terms of social conditions, economic relations and the particular history of that population.<sup>25</sup> Specific disease outcomes are paid less attention, in large part because the weight of evidence indicates that, even if some particular diseases are greatly reduced, the overall death rate changes little so long as social conditions persist. Therefore, although this perspective affirms the power of history and social context, and the generic health gains that would flow from improvements in equity, autonomy and material circumstances, it is unable to provide an itemised agenda specifically for public health intervention.<sup>25</sup>

The materialist model brings these ideas about the importance of the underlying structural conditions of life into somewhat sharper focus. It also draws upon the important idea that health deficits accumulate across the individual's life-course. Thus, the physical conditions of daily life, the quality of housing and diet, access to knowledge about risks to personal health, occupational exposures, and access to formal health care all influence, cumulatively

over time, the individual's health outcomes. These material conditions also contribute to collective levels of health-related knowledge, motivation and opportunity within local communities.

These, then, are the contending points of view in seeking to understand how unequal social experiences translate into health inequalities. Their respective proponents often overstate the differences between these models. After all, in many respects the models are complementary. Yet the differences in emphasis *are* important, since they carry differing implications for social policy. Does one, on the psychosocial thesis, advocate the strengthening of community networks, the amelioration of community relations and the alleviation of work-stress and hierarchical tensions in the workplace? Or does one advocate, from a materialist perspective, a redistribution of wealth and opportunity, a more equitable access to basic facilities (including health care), and an improvement in the physical conditions of living and working? Or both? Further, should remedial efforts be directed primarily at the social experiences of adults, or should longer-term investment be made in optimising the material conditions of childhood, adolescence and adult life?

THE SECOND TASK – that is, how we envisage the evolution of risks to the individual's health over time – was introduced in chapter 8 in discussing how the experiences of fetal and infant life influence various adult risks of disease. The evidence suggests that suboptimal nutrition and growth in those early stages are important. Suffice it to say here that as the long-running follow-up studies of cohorts of children from mid-twentieth century yield results, and as studies of primates provide further corroborative findings, so we will understand more clearly how the risks of adult disease are pre-conditioned early in life.

The pattern of neuroendocrine responses to social stimuli and stressors, in particular, is affected by early-life family and social experiences. Undoubtedly, the choice of a high-fat diet in adulthood will influence the occurrence or progression of coronary heart disease. However, its actual biological impact on the coronary arteries will be modulated by the form and function of those vessels as a consequence of their growth pattern during fetal life and by the individual's socially-patterned, learned response to social stressors and the resultant levels of the stress hormone cortisol in the blood.

There is more to this complex topic of social inequalities in health than the above two tasks. The issue is central to human social ecology, reflecting how deficiencies in our social structures and relationships influence patterns of

population health. The next several sections therefore consider further aspects of the topic.

### **Inequalities, hierarchies and health: causal pathways**

Socioeconomic gradients in various aspects of health have long characterised settled human societies. We noted in chapter 5 the evidence of disparities in nutritional status and life expectancy between rich and poor in early agrarian communities. On the other hand, as recounted in chapter 4, infectious disease epidemics in Europe's urban populations were great levellers for many centuries. Then, in the wake of the industrial revolution, large class-related differences in life expectancy emerged in nineteenth-century industrial England. In the United States, death rates in men are inversely related to socioeconomic status across fourteen classes, for whites and blacks separately.<sup>28</sup> In Australia, life expectancy in Aborigines (approximately 55 years) is a stark two decades less than for non-indigenous Australians.

This inverse socioeconomic gradient applies similarly to many types of disease. However, for some diseases the gradient is in the opposite direction. Thus, among cancers, those of the stomach, cervix and lung generally occur at higher rates among poor individuals, while cancers of the breast and prostate typically occur at higher rates in society's better-off members. This pattern is also evident at the level of national populations within greater Europe: the poorer nations (Russia, Central and Eastern Europe and Portugal) have higher rates of the cancers of 'poverty' than do the richer nations.<sup>29</sup>

Explaining these socioeconomic differences in health status is a complex task. A primary question is: Does being poor cause poor health, or vice versa? Commonly, causality flows in both directions. In relation to the former direction of flow, from wealth status to health status, three additional questions arise:

- (1) Is the effect of socioeconomic disadvantage due to psychosocial stress and its biological consequences or to material deprivation (poor diet, lack of access to health knowledge and health care, occupational hazards, etc.)? This issue has been discussed in the preceding section.
- (2) Is part of the 'socioeconomic effect' due to high levels of avoidable personal risk behaviours, such as smoking, excessive alcohol consumption and being overweight?
- (3) To what extent does a relative lack of social capital, as a collective deprivation, exacerbate the health risk of socioeconomic disadvantage? (And is this separate from the contextual experience of social class, race, and gender?)



Untidily, the answer appears to be that all of the above are relevant. This should not surprise us since we are talking about an intrinsically complex system: human society, its internal social linkages, the shared and longitudinal experiences of its members, and a diverse set of disease outcomes.

It is an easier task to identify socioeconomic differences in specific exposures that account for observed health differences. For example, differences in smoking habits underlie the very strong class gradients for lung cancer deaths in Britain (and may help to explain the recent widening of the class gradient in coronary heart disease in Figure 9.1). Before the 1950s, lung cancer did not show a social class gradient in either men or women, reflecting the fact that class differences in smoking emerged only decades after the habit became common, initially in men, in the inter-war period. However, since mid-century the lung cancer death rates were clearly higher in the lower social classes, and the downturn in rates began a decade or so later in those classes. Whereas that gradient for lung cancer is readily attributed to differences in adult smoking, the inverse socioeconomic gradients for stomach cancer and stroke appear to depend more on early-life experiences.<sup>30</sup> The inverse social class gradient for stomach cancer may well reflect a greater prevalence of early-life colonisation of the stomach and duodenum by the bacterium *Helicobacter pylori* in poorer people – an infection that apparently induces chronic inflammation and reduced gastric acidity, thereby enhancing the formation of carcinogenic chemicals within the stomach.

It remains difficult to give a full account of the socioeconomic gradient in coronary heart disease. Various studies have shown that the inverse gradient applies across the full spectrum of society; it is not merely the poor and the uninformed who are at increased risk. So it is apparently not just a matter of more cigarette smoking and fattier diets in the lower socioeconomic stratum. Indeed, in the above-mentioned Whitehall follow-up study of British civil servants, only about half of the threefold inverse gradient in heart disease mortality could be explained by the measured differences in the main known risk factors: blood pressure, blood cholesterol, relative weight and smoking.<sup>27</sup> This observation and similar research elsewhere suggests that social hierarchies have important health consequences – even when everyone has secure employment. Hence, research within this domain has begun to focus on the neurohormonal consequences of social status, control and associated life stress.

In seeking neurohormonal explanations for empirically observed differences in health outcomes to the workplace environment, this line of research is reestablishing connections with the mid-twentieth century ideas of Hans

Selye, René Dubos and others. Selye, exploring the direct response of the human organism to stressors in the immediate environment, pointed out that the modern human social environment contains additional stressors to those faced by traditional hunter-gatherer living.<sup>31</sup> Some of these stressors, being chronic and embedded in social relations, are not resolvable via our innate 'fight-or-flight' responses. If a person's biological responses are excessive or insufficient, entailing changes in stress-related hormones (particularly cortisol, secreted by the adrenal gland), then disordered biology or disease follows. For example, a range of studies has shown that individuals who have a low sense of control at work, a low effort-to-reward ratio (i.e., unsatisfying work) and a chronic sense of subordination have a higher risk of disease, especially cardiovascular disease.

These characteristics of the workplace capture, in microcosm, some of the experiential aspects of living within a social hierarchy. Hierarchical structures characterise most human societies at large. However, they are not exclusively a product of human culture; they are inherent in wider nature. Diverse animal species exhibit various types of stratification, focused on priorities in feeding and breeding. The stratification may entail either a rigid caste system of the kind seen in ant and termite colonies, or a more fluid, contestable and socially reinforced hierarchy as seen in birds and mammals. Jane Goodall's pioneering work with chimpanzees in Africa in the 1970s made clear that the within-family hierarchical behaviours that we sometimes glimpse in zoos is fundamental to life in the wild.

Studies in primates, as in humans, indicate that social hierarchies affect patterns of health. Experiments in free-living baboons and in monkey colonies appear to implicate status-related levels of unresolved stress as a conditioning factor for organic disease.<sup>32</sup> For example, the loss of social status in monkeys rehoused with dominant animals was associated with a fivefold increase in coronary artery atherosclerosis.<sup>33</sup> However, the situation is not straightforward. In stable hierarchies of animals the low-status individuals are under chronic stress,<sup>34</sup> whereas in unstable hierarchies it is the (temporarily) high-status individuals that are stressed.

In Kenya, studies of free-range olive baboons by Robert Sapolsky, an American primatologist, show that the dominant males have a different pattern of endocrine response to stress compared to the subordinate males. The surge of adrenalin and cortisol into the bloodstream is shorter lived in the dominant males. However, in the subordinate males, who do not expect to dispel the threat nor regain control quickly, the cortisol levels stay raised as their low-level

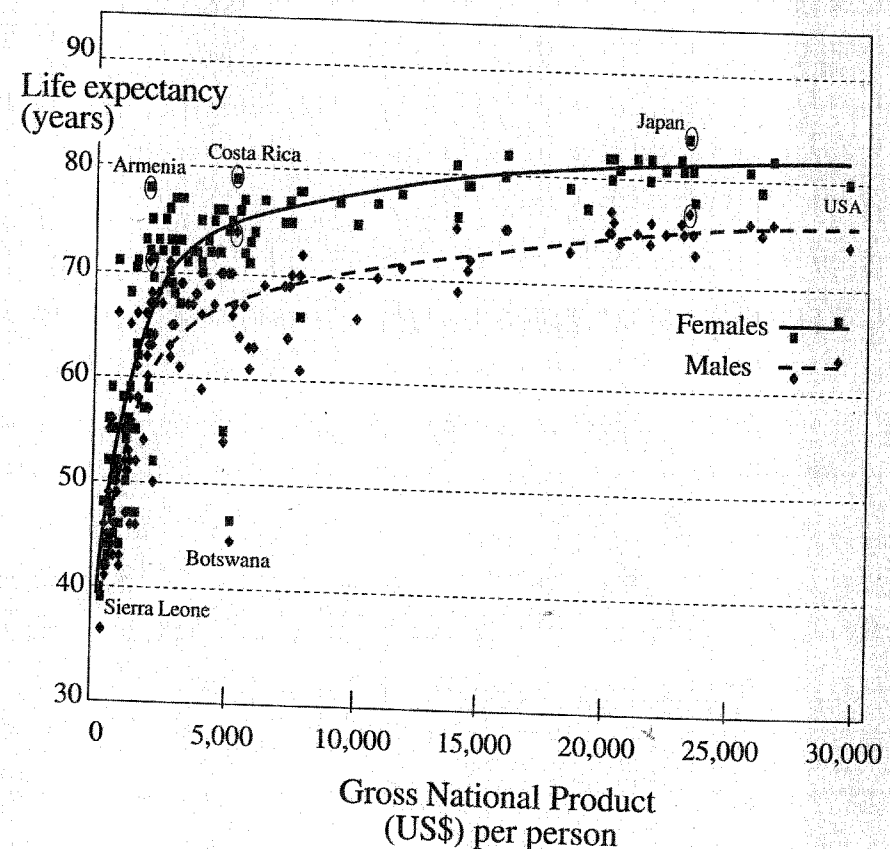
anxiety persists. While this pattern of differential response is evident within a hierarchically stable group of baboons, when the hierarchy is destabilised it is the erstwhile dominant males who now register some prolongation of the stress reaction. This pair of findings is revealing because it makes clear that the cortisol profile of the dominant individuals is crucially dependent on social context. Meanwhile, studies in macaque monkeys show that, for a given high intake of dietary fat, there is a severalfold greater extent of coronary atherogenesis in the low-status monkeys compared to the high-status monkeys. Evidently something about the hormonal status of the low-status individual potentiates the vessel-damaging effect of high blood cholesterol levels. These primate studies thus suggest that low social status and chronic stress are conducive to cardiovascular disease, via higher blood pressure and readier atheroma formation. As always, however, extrapolation of the results of animal studies to the human situation must be done with caution. Not only are there inter-species differences, but the configuration of the social context is of critical importance.<sup>34</sup>

No amount of political correctness can dispel the fact that social hierarchies, in nature, are intrinsic to the evolutionary process. Greater reproductive success goes to the more 'fit'. However, since humans have a unique culturally based capacity for modifying, indeed over-riding, biology, so the possibility exists of achieving an egalitarian society. We have not yet managed to translate that possibility into an enduring reality. The case for doing so is strengthened by the accruing evidence that social inequalities are bad for health – both that of the disadvantaged individual and that of society at large.

Two lines of recent research have shed further light on how social hierarchies and relationships might affect patterns of health and disease. One has examined macroscopic patterns in national and sub-national populations, characterised by differing levels of income inequality and social capital. The other refers to studies of recent mortality trends in the countries of Central and Eastern Europe.

### Health inequalities: evidence at the population level

Within populations, wealthier individuals live longer. Scaling up this observation, one might therefore expect wealthier populations to have higher average life expectancies. Although that is broadly true, it is not a linear relationship. As national per-person income rises so does average life expectancy, but the curve begins to flatten out above an income level of approximately US\$5,000 (Figure 9.2). The fact, however, that it does not actually flatten out among the



**Figure 9.2** Relationship between gross national product (GNP) per person and life expectancy in 133 countries, for males and females separately. GNP is in US\$, adjusted for purchasing power parity. At higher income levels, the gain in life expectancy becomes less sensitive to an increase in wealth. Further analyses have shown that those countries above the fitted line tend to have more equal internal income distributions than do those below the line.

There is a similar (but inverted) relationship between per-person GNP and child (under-5) death rates. In countries with per-person GNP over about \$10,000, there is little further reduction in child mortality below 5–10 deaths per 1,000 live births. Below that GNP figure, the rate increases, reaching around 250 per 1,000 live births in the poorest countries. (In some poor countries, young girls have higher death rates than boys because of culturally based discriminatory behaviours, especially with food and access to health care.)



high-income countries indicates that material conditions can exert a significant residual influence on a wealthy nation's health outcomes and hence life expectancy.<sup>35</sup>

Among these high-income countries, nevertheless, life expectancy is more closely related to the *distribution* of income within each population than to its average level.<sup>36</sup> The more egalitarian countries such as the Scandinavian countries, Japan, the Netherlands and Switzerland have higher life expectancies than do countries with large income differentials such as the United States, Britain and West Germany. Richard Wilkinson has demonstrated that the relationship is fairly robust: it is evident no matter what cut-point is used to differentiate high and low income earners within each population – that is, it is independent of whether the cutpoint refers to the share of total national GDP that goes to the bottom 20%, 30%, 40% (etc.) of income-earners. The relationship has also been observed at the state level in the United States.<sup>37</sup> (However, this inter-provincial relationship is not evident within several other developed countries with, on average, less skewed income distributions than the United States.)

How might income inequality *per se* affect a population's average level of health? Is it that the greater the sense of an individual's relative deprivation within society, the more likely is that individual to smoke, eat poorly, and take or encounter physical risks? Or, alternatively, might there be some property of the population, associated with income distribution, that is not reducible to the individual level – something that influences the general 'tone' of health within that population? Returning to the discussion of the 'McKeown thesis' in chapter 7, might it be that those societies that share their wealth more equitably also tend to invest more in social infrastructure and facilities, increasing the stocks of social and human capital?

At that population level, indices of socioeconomic inequality appear to reflect something about the society's internal dynamics: the patterns of social interaction, the quality of social capital, and the profile of access to information and health-sustaining medical care. Survey research in the United States indicates that people living in states with greater inter-individual differences in income report that they experience their social environment as more hostile and mistrust other people.<sup>37</sup> This suggests that income inequality somehow erodes social coherence in a way that impairs population health. Supportive evidence has been adduced from a study of the community of Roseto in Pennsylvania, United States.<sup>38</sup> Earlier in the twentieth century this egalitarian and richly socially networked Italian migrant town had unusually good health

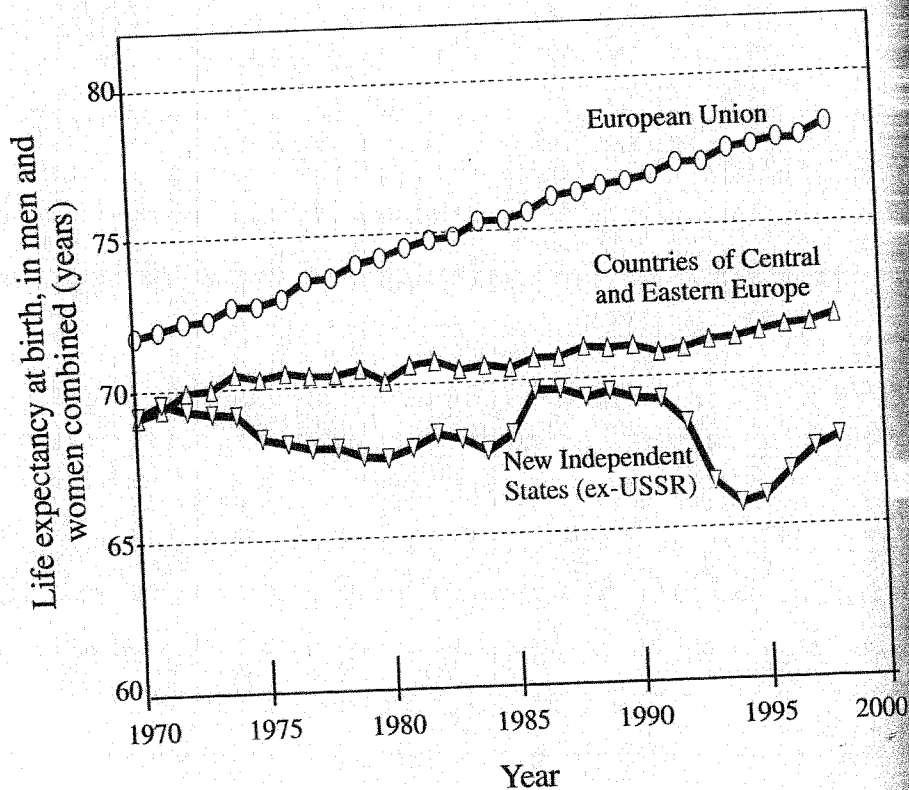
indices relative to the general American population. Then, as social structures eroded, as young people moved to bigger cities, and as competitive individualism increased, so the relative health advantage of Roseto declined. Since dietary habits and other material circumstances also changed, assigning causation is not straightforward. Nevertheless, various commentators have concluded that, early on, there was a beneficial community-level influence on the health status of Roseto.<sup>36</sup>

Meanwhile, at the individual level, income distribution affects a person's actual material assets as well as the sense of relative deprivation. Both may affect social cohesion. The debate about level and type of mechanism continues.

### Social cohesion and health: Central and Eastern Europe

The bleak mortality experience of Central and Eastern Europe (CEE) in recent decades raises similar population-level questions. Since the 1960s there had been a widening gap in mortality between the East and West, with life expectancy in the West improving steadily, while life expectancy in the East had plateaued or, in men, even declined (see Figure 9.3).<sup>39</sup>

During the 1970s and 1980s the CEE countries experienced increasing death rates, especially in young and middle-aged men, from many causes, including heart disease, stroke, respiratory infections, and accidents and violence.<sup>39</sup> It has not been possible to explain the striking east-west divergence in death rates during those decades simply in terms of individual-level risk behaviours (such as smoking and drinking) or exposure to environmental pollutants. It is fairly clear that deterioration in dietary patterns within the Soviet bloc, such as excessive intake of animal fats and deficient intake of antioxidants in fresh fruit and vegetables, contributed to the divergence. However, the health deficit was so marked relative to the adjoining Western Europe that something more fundamental was probably also occurring. Perhaps the centralised state control of daily life, the poverty of community networks and suppression of individual initiative induced a collective learned helplessness and community disengagement.<sup>40</sup> Hungary fared particularly badly. Not only were premature death rates from coronary heart disease and various cancers very high during the 1980s and 1990s, but suicide rates escalated over several decades as did deaths from alcohol-induced liver cirrhosis. The alcohol consumption levels in Hungary were about one-third higher than in other CEE countries. Further, Hungary experienced an extreme loss of social morale in association with substantial inequalities in material and health-care circumstances.



**Figure 9.3** Time trends in life expectancy, for men and women combined, in Western Europe, Central and Eastern Europe and the new independent states (ex-USSR). For each grouping, figures have been averaged across member countries. The lower graph reflects the experience that was shown in more detail for Russian women in Figure 1.4. State campaigns against excess alcohol consumption in Russia and its satellite countries during the later 1980s and the greater optimism associated with glasnost policies under Gorbachev may both have contributed to the temporary rise in life expectancy. This, however, was followed by a transient plunge in life expectancy, especially in Russian men, following the collapse of communism and the onset of economic and social disorder. Meanwhile, the countries of Central and Eastern Europe fared better in the early 1990s than did the new independent states. Poland and the Czech Republic made rapid gains in life expectancy, although others, such as Hungary, experienced setbacks.

After the collapse of communism in this region in 1989, there were striking falls in life expectancy. In 1994, life expectancy at birth in the former communist countries of Central and Eastern Europe was 71.3 years compared to 77.3 in the countries of Western Europe. Between 1990 and 1994 life expectancy in Russia among men fell from 64 to 58 years, while among women it fell from 74 to 71 years. In Russia, after the dissolution of communism in 1989, social disintegration and individual frustration underlay the dramatic surge in premature male mortality, some of which is attributable to the excessive alcohol consumption that occurred during 1990–95.<sup>41</sup> However, analysis of regional mortality in Russia shows that the decline in life expectancy was also clearly correlated with local labour turnover, crime rates and unequally distributed income.<sup>42</sup>

There is much other historical evidence that social, cultural and political characteristics of a society influence the population's susceptibility to disease. For example, following European settlement the pattern of emergence of coronary heart disease and the change in life expectancy in indigenous Amerindian, Maori and Australian Aboriginal populations reflected not only the characteristics and changes in the social structures of those populations but also the characteristics of the settler populations with which the indigenous populations interacted.<sup>43</sup>

### Cities, societies and synapses

Building cities is a triumph of our cerebrally based culture. It is therefore an irony that some aspects of family and social relations within the modern urban environment may adversely affect childhood brain development and, in turn, adult biological functioning and health. In particular, socially learned patterns of response to life stress are laid down in early life. The resultant cohesiveness of neuronal networking within the young individual's brain affects subsequent adult coping and competence. Further, early educational experiences affect the 'plasticity' of the brain, and perhaps its resilience against later-life dementias.<sup>44</sup>

There is mounting evidence that deficits in parenting and other aspects of family life, in social networks, and in the richness of early environmental stimuli can cause critical deprivations in the early-life maturation of the brain. The neonatal brain comprises billions of nerve cells, mostly still 'unwired'. There is an intense process of 'sculpting' the neuronal content of the young brain: connections are made between cells; unconnected cells are abandoned;

neuronal pathways are established and are then consolidated by repeated experience and stimulation. The baby begins to see, to recognise, to smile, to change body position, and then – most human of all – to respond to words. Primitive grasping reflexes that echo our primate past, where a lax grip might result in a fall from the tree, are quickly replaced by newly acquired motor skills. The infant brain has flexibility; the capacity for learning is vast; and the balance and richness of social and environmental stimuli are of crucial importance. More generally, there is a growing recognition that the environments and experiences of early life, including the fetal period, are reflected in biological changes that increase the risks of dysfunction throughout the life cycle – a process that has been termed ‘biological embedding’.<sup>44</sup>

The importance of these early-life processes is corroborated by recent research that reveals an intimate linkage between the nervous and endocrine systems. Cells of the two systems have some identical receptors on their membranes, and various messenger neuropeptide (hormone) molecules are thus able to coordinate the responses of the two systems via the bloodstream. For example, the lymphocytes of the immune system have cortisol receptors which, when activated by increased cortisol in the bloodstream, damp down immune activity. Further, nerve fibres of the autonomic nervous system (which mediates the body’s ‘fight-flight’ physiological response) intimately entwine the lymphoid tissues of the immune system. It thus appears that our immune system contributes to the body’s integrated reaction to perceived stress. Overall, then, we are beginning to appreciate the myriad ways in which the early-life social environment, especially within the modern urban setting, can influence cognitive development, stress reactivity and immune system functioning – and hence wellbeing and health.

A FINAL ISSUE to consider is the optimal size of cities and urban populations. Animal behaviourists write about optimal population size in the wild, and how various physiological and behavioural mechanisms stabilise population size. In the early 1970s, ideas emerged about the decentralisation of urban populations into small village-like settlements of about 500 people, aggregated into larger communities of around 50,000. In this way, ‘human-scale’ communities would replace the social and ecological problem of the modern, ever-expanding, megalopolis. They would have their own internal sense of identity, shared responsibility and cooperation. However, critics argued that such small and self-contained settlements would breed social pressures and moral coercion, would recreate the pettiness, rigidity and tedium of life in small villages.

Others foresaw intellectual and cultural constraints, antithetical to the magnificent urban expression of human creativity and striving.

The creation of small cohesive communities, nurturing a sense of belonging, must also be balanced against considerations of efficiencies of scale. That is, considerations of social sustainability must mesh with those of ecological sustainability. In general, ecological considerations require greater population density, well-planned green areas, and better transit, biking and walking areas.<sup>9</sup> Moving sewage and solid waste away from its origin to adjoining environmental sinks may have sufficed for small European cities, but Victorian-style sanitary engineering solutions to the problems of contemporary cities are no longer adequate. In the globalised world of the twenty-first century, we will need to modulate our design of cities. This will entail bringing back nature, via urban greenery, gardens and horticulture. It will require intra-urban community facilities on a human scale, for high-density ‘urban village’ nodes, separated by parklands, recreation facilities and garden plots, and connected by light-rail transport. Energy generation and transport will depend increasingly on environmentally benign technologies.

Urban population density can be increased by redesigning cities as aggregates of semi-detached ‘urban villages’, facilitating local self-sufficiency. The urban village concept, which originated in Europe, is now attracting more attention in North America and Australia. This type of urban environment is more integrated, less car-dependent and more oriented to the notion of ‘urban commons’ than is low-density privatised suburbia.

## Conclusion

City living has become the dominant feature of modern human ecology. Cities are *sources* of ideas, energy, creativity and technology, and can, with luck, become the proving ground for enlightened, congenial multicultural living. However, they have also continued to be *sinks* for human poverty, inequality and environmental health hazards. Homelessness, social exclusion and severe privation are evident in cities in North and South. Meanwhile, as fossil fuel combustion increases, as consumer expectations rise and as human numbers increase hugely, so cities are acquiring increasingly large ecological footprints. In these several respects, urbanisation has recently become both socially and ecologically somewhat dysfunctional. This situation poses risks to the sustainability of good health.



We are social animals, craving comfort, security, variety and opportunity. Worldwide, cities have proliferated rapidly over the past two centuries; we are becoming a predominantly urban species. We cannot reverse this mighty trend in urbanisation, the culmination of 10,000 years of history. However, we *can* modify our urbanism – the way we live in cities – to fit better the needs of human biology and the needs of the ecosphere. Indeed, our predecessors in nineteenth-century cities achieved great modifications in pursuit of safer and healthier environments. We must now extend, quantum-like, that achievement to embrace the needs of sustainability.

Tackling these large-scale social environmental problems of cities will only become possible if done in conjunction with reducing socioeconomic inequalities and the local environmental hazards afflicting the poorer sections of most cities. 'Healthy Cities', as recently promoted by the World Health Organization, are an excellent idea. Ecologically sustainable cities, based on low-impact technologies, social enlightenment and the sharing of 'urban commons', are an even better idea.

# The urban environment and health in a world of increasing globalization: issues for developing countries

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Urban living is the keystone of modern human ecology. Cities have multiplied and expanded rapidly worldwide over the past two centuries. Cities are sources of creativity and technology, and they are the engines for economic growth. However, they are also sources of poverty, inequality, and health hazards from the environment. Urban populations have long been incubators and gateways for infectious diseases. The early industrializing period of unplanned growth and laissez-faire economic activity in cities in industrialized countries has been superseded by the rise of collective management of the urban environment. This occurred in response to environmental blight, increasing literacy, the development of democratic government, and the collective accrual of wealth. In many low-income countries, this process is being slowed by the pressures and priorities of economic globalization. Beyond the traditional risks of diarrhoeal disease and respiratory infections in the urban poor and the adaptation of various vector-borne infections to urbanization, the urban environment poses various physicochemical hazards. These include exposure to lead, air pollution, traffic hazards, and the 'urban heat island' amplification of heatwaves. As the number of urban consumers and their material expectations rise and as the use of fossil fuels increases, cities contribute to the large-scale pressures on the biosphere including climate change. We must develop policies that ameliorate the existing, and usually unequally distributed, urban environmental health hazards and larger-scale environmental problems.

**Keywords:** urban health; urban population; urbanization; environmental health; environmental pollution; international cooperation; socioeconomic factors; poverty.

Voir page 1124 le résumé en français. En la página 1124 figura un resumen en español.

## Introduction

*Homo sapiens* is undergoing a radical transformation of its ecology. The proportion of the world's population living in large towns or cities has grown from around 5% to 50% over the past two centuries. Demographers estimate that by 2030 approximately two-thirds of all people will live in large towns or cities. The human population is thus becoming urbanized. In future, urban populations will have a distinctly higher proportion of older people than they do today.

Urban migration reflects many things: the advent of industrialization, insecurity about the availability of food in rural areas, the search for refuge from conflict and environmental damage and the lure of jobs, amenities and stimulation. Africa, where the relation between economic development and urbanization is weaker than in other regions, is currently the least urbanized major region in the world. Nevertheless, it is also the most rapidly urbanizing region. In sub-Saharan Africa much of the rapid growth in the urban population reflects a

combination of flight from rural poverty and high fertility rates in urban areas. In Latin America, in contrast, urban growth has been driven more by the pull of industrialization and economic opportunity. Hence, urban growth has slowed in Mexico City, São Paulo and Buenos Aires during the past decade of economic recession (1).

## Historical perspective

Cities have historically been associated with the evolution of ideas of public health and practice. The modern public health revolution began in European cities in the 19th century where, under the pressures of industrialization, poverty, crowding and the breakdown of traditional ways of living, the conditions of daily life had deteriorated for most people.

The economic historian Szreter argues that in England, which led the industrial revolution, rapid economic growth in the first half of the 19th century disrupted traditional structures of authority, social relationships and ideologies. This caused urban environmental blight, the flight to the outer suburbs by the economically better off, further worsening of deprivation in inner urban areas, and increases in disease and death (2). In mid-19th century England those in the suburbs largely ignored the plight of the

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urban poor. The resultant policy stasis and the growing crisis of urban poverty, disease and overflowing workhouses precipitated Chadwick's report on the conditions of workers (3).

Chadwick argued that averting additional environmental degradation would remedy the social crisis more effectively than would further workhouse "relief" under the provisions of the Poor Law of 1834, the law that required the unemployed poor to work for their daily subsistence. Even so, within the prevailing laissez-faire ethos, the struggling middle-class representatives of inner urban electorates were too preoccupied with the immediacies of their own commercial survival to embrace grander urban improvement schemes. Hence, Chadwick's centrally controlled programme to develop a network of local boards of health, established under the 1848 Public Health Act, met with widespread resistance from unsympathetic local politicians. The composite problem of economic deprivation, urban squalor and severe health inequalities was eventually remedied by devolving sanitary powers to local municipalities through the Sanitation Act of 1866 (2, 4). Over the next three decades urban authorities in England, using new sanitary technologies and public borrowing, transformed sewage and water services from private enterprises to public services.

There is a contemporary relevance to this historical account: the failure of many large cities in low-income countries to implement similar changes has left them with problems of environmental blight, inadequate housing, poverty and disease. The process has been further slowed in many countries by the pressures, distortions and priorities of economic globalization.

Until the second quarter of the 20th century, the dominant cause of mortality among industrialized urban populations was infectious diseases. However, mortality from infections had begun to decline during the 19th century. McKeown attributes most of the decline in mortality after the 1850s to improvements in social and environmental factors (5). He emphasizes that improvements in food supplies and nutrition boosted biological defences against infectious diseases. He notes that better housing, safer water supplies, increasing literacy and the idea of domestic hygiene gave further protection to infants and children. Various commentators have broadly concurred with McKeown. However, others have emphasized the important role of deliberate public health interventions including sanitary engineering, refuse disposal and vaccination (6). In France, for example, substantial gains in life expectancy emerged first in Lyon in the 1850s, then in Paris during the 1860s and 1870s (albeit more slowly), and then in Marseille around 1890; each gain was directly associated with the deliberate improvement in the supply of public water and sanitation in each of these cities (7).

As industrialization intensified the general absence of air quality controls allowed pollution levels to increase in industrialized cities. Spectacular

episodes of air pollution occurred during the mid-20th century in Europe and North America, including the great London smog during the winter of 1952. These experiences ushered in new legislation, which has since led generally to a decrease in air pollution in developed countries. The various major categories of air pollutant have followed a multiphase trajectory (7). Smoke emissions from William Blake's "dark satanic mills" of industrialized Europe began to decline in the early 20th century, and sulfur dioxide emissions declined from the middle of the century. However, emissions of carbon dioxide and very fine particulates are still rising.

The rise and fall, or "inverted U", trajectory displayed by measurements of smoke and sulfur dioxide is sometimes referred to as the "environmental Kuznets curve"; this refers to the graph described by the economist Kuznets in the 1950s of the increase and then decrease in income disparities within a country that occurred as industrialized countries grew wealthier. Not all urban environmental pollutants, however, have followed this trajectory (8). For example, household sanitation problems in western countries have been on a downwards trajectory (decreasing) since the early stages of industrialization, but carbon dioxide emissions and consumer wastes are continuing on an upward trajectory (increasing). The current trend for these latter pollutants will, presumably, turn out to be the up slope of the longer span of the inverted U.

This sequence of rise and fall in environmental contaminants is not a law of nature. In the megacities of the developing world, such as Mexico City, São Paulo and Delhi, residents often face the worst of both the traditional and modern worlds. They encounter a wide spectrum of pollution ranging from a lack of sanitation (with exposure to human excrement and unsafe drinking-water) to exposure to hazardous synthetic organic chemicals in their air, food and water. In Delhi, India, for example, the coliform count in the city's main river, the Yamuna, increases 3000-fold from the time it enters the city to the time it leaves (9). That stretch of the river also receives about 20 million litres of industrial effluent. Meanwhile, Delhi's air quality, especially in the colder months, is among the worst in the world (10).

Chaplin argues that there are three reasons why a successful urban sanitation programme has not arisen in India (4). Firstly, local government in urban areas lacks the resources and commitment to counteract problems in inner urban areas that are associated with poverty, overcrowding and haphazard urban growth. The influential middle classes and upper classes have relocated to new, leafier, suburbs. In the atmosphere of indifference both corruption and incompetence flourish. Secondly, there is no manifest political threat from the illiterate, fragmented, relatively powerless, urban poor. Thirdly, the availability of vaccinations, antibiotics and effective domestic plumbing have rendered the middle class oblivious to the environmental health hazards faced by the poor. Modern medicine and sanitary technol-



ogy insulate the middle class from the threats of infectious diseases.

The three main pathways through which the urban environment impinges on human health are through the social changes that accompany urbanism and the way in which these changes alter behaviour-based risks to health; the way that the physical urban environment poses various microbiological risks and risks of toxicity; and the way that the larger-scale environmental impact of modern urban populations creates wider-spread and longer-term risks to health through their disruption of the life-support systems of the biosphere.

### Urbanism: changes in social relationships and individual behaviour

Urbanism potentiates many changes in human behaviour that affect disease risks. For example, cities are characterized by high levels of tobacco smoking, traffic injuries, fatalities and adult obesity (11). The increase in the incidence of obesity illustrates several aspects of urban living. Among city dwellers, it reflects the combination of easier access to energy-dense processed foods and a decline in physical activity at work, at home, and recreationally. Typical urban living thus entails an imbalance in the energy budget that leads to obesity, and this greatly increases the risk of high blood pressure and type II (adult onset) diabetes (11, 12).

The urban facilitation of microbial traffic, via the increased intensity and diversity of human mobility, contact and sexual behaviours, may have been critical in launching the otherwise poorly transmissible human immunodeficiency virus (HIV) in the 1980s (13). Urbanism, increased mobility and the relaxation of traditional cultural norms yield new patterns of human behaviour, including changes in sexual activities and the use of illicit drugs (14). The extensive transmission of the human immunodeficiency virus in the 1980s and 1990s owed much to the combination of new sexual freedoms, movement between urban and rural areas, and long distance travel. Similarly, reported rates of food poisoning have increased in industrialized countries during the past two decades and have almost doubled in the United Kingdom between the mid-1980s and mid-1990s (15). This probably reflects a mix of factors including increasingly long "supply lines" between production and consumption in complex urban social environments, changes in consumer behaviour and, perhaps, consistently warmer summers since the 1970s.

However, urban life also confers many health benefits. Within cities, there is readier access than in rural settings to health services, education, and financial and social services. Community life can be rich and fulfilling. The urban environment is diverse, stimulating and full of new opportunities. Individual and family mobility make it easier than in a conservative rural community to escape from oppres-

sive social relationships. On the other hand, cities are often impersonal, alienating and sometimes menacing.

### Microbiological, physical and chemical hazards

Large cities in the least developed countries typically combine the traditional environmental health problems of poverty, particularly respiratory and enteric infections, with those of poor quality housing and unregulated industrialization. Residents therefore are often at risk from diseases and injuries associated with poor sanitation, unsafe drinking-water, dangerous roads, polluted air, indoor air pollution and toxic wastes. The United Nations Centre for Human Settlements has written that "the deterioration in the built environment is sharply in evidence throughout most of urban Africa... This trend seems to have been accentuated by the effects of structural adjustment in many countries, according to which urban workers lost more than rural smallholders" (16).

In developing countries infant mortality is typically four or more times higher in poorer segments of urban populations than in richer segments. There are also large differences between richer and poorer populations in the incidence of environmentally related infectious diseases such as tuberculosis, typhoid and cholera, and in exposure to local air pollution and indoor air pollution (7). Psychosocial health problems are also related to income including depression, alcohol and drug abuse, suicide, violence and murder. In large cities everywhere, poor people are the main victims of property crime, assault, rape and murder. In response, the richer people raise higher barricades and employ more security guards. The vulnerability of poor people then increases further because the adaptive behaviours of crime and violence are inevitable with high levels of unemployment and poverty.

Poverty, then, is more than income deprivation. Urban poverty is the most important predictor of environmental health risks when its definition includes other forms of deprivation such as physical assets, political influence, access to basic services and access to social capital (17). Satterthwaite concluded that: "Although considerable progress has been made since 1990 in improving housing conditions for low-income groups in certain cities and more effective approaches are now being more widely applied, the number of people suffering serious environmental health burdens in urban areas probably increased significantly during the 1990s — in part because urban populations continue to grow rapidly in most of Africa, Asia and Latin America, in part because of weak and ineffective urban governance, in part because of continued increases in urban poverty in many nations" (18). He argues that what is often forgotten is the contribution towards reducing poverty that is made through the health benefits gained by improving housing and providing clean water, sanitation and waste removal.

### Microbiological hazards

As it reshapes modern human ecology, rapid urbanization is expanding the traditional role of cities as gateways for infections. Crowding and unsanitary conditions are important amplifiers of the transmission of infectious diseases: many infectious diseases thrive where there is a lack of water, and inadequate drainage, sanitation and solid waste removal. Population movement from rural areas into cities and greater mobility within cities are bringing new opportunities for otherwise marginal and obscure microbes (19). Research in Kwa-Zulu Natal, South Africa, has shown that the vector-borne disease schistosomiasis is spreading to urban areas through the migration of the rural population to informal settlements around the cities (20). For similar reasons, including poor sanitary facilities, filariasis, another vector-borne infection, (also known as elephantiasis and spread by a culicine mosquito that breeds in contaminated pools of water) has been spreading in towns in Recife, in north-eastern Brazil (21). Yellow fever, plague (especially in Madagascar), Lyme disease and cutaneous leishmaniasis have all become more urban in their distribution, reflecting ongoing changes in human demography and behaviour and in the environment as urbanization proceeds (22).

A new concern is that as global temperatures continue to rise, which they have done over the past quarter of a century, mosquito-borne infections, such as malaria, will become more prevalent in highland cities in low-latitude countries (such as Nairobi and Harare). Recent movements of such vector organisms and their diseases to higher altitudes may be an early response to climate change (23), although causal attribution remains difficult because of the limited evidence. Associated with this is the belief held by some climatologists that rainfall patterns will intensify as a result of global warming and more local flooding will occur, facilitating the breeding of mosquitoes and causing microbiological contamination of urban sources of drinking-water.

The advance of dengue fever in tropical and subtropical zones has been aided by the expansion in urban areas of breeding sites for the *Aedes aegypti* mosquito. This disease is now the most frequently occurring vector-borne infectious disease in urban areas. The more recent spread (particularly via the international trade in used car tyres that contain mosquito eggs) of the second mosquito vector of dengue fever, *Aedes albopictus*, has increased the risk of infection in urban settings in several subtropical and warmer temperate zones.

### Physical and chemical hazards

The modern urban environment combines industrialization, crowding, waste generation, and dense transport systems. This combination, compounded by the periurban poverty that surrounds many cities in developing countries and the poverty of inner urban areas in cities in the developed world, introduces many environmental health hazards

(1, 24). These may be overt, as in the cases of road trauma or the increase in asthma attacks that occurs during episodes of high air pollution, or more insidious, as with exposure to environmental lead.

**Environmental lead exposure.** In 1997, the World Bank made the phasing out of lead in petrol the top priority of its 10 main objectives for improving health and the environment (25). Exposure to lead has developed in the urban environment over many decades; the lead comes from industrial emissions, house paints and the use of leaded motor fuel (24, 26). Many high-income countries, including the United States and Australia, have recently set new, lower standards for environmental exposure to lead to protect young children. However, childhood lead poisoning — a particular hazard in the neurocognitive development of children — is an increasing problem in many low-income countries, especially in urban environments. High concentrations of lead in blood have been observed in cities such as Bangkok, Jakarta, Taipei, Santiago and Mexico City (7, 26). In Dhaka, Bangladesh, the airborne lead concentration is one of the highest in the world, and the mean concentration of lead in blood in 93 randomly chosen rickshaw pullers was 53 µg/dl, five times higher than the acceptable limit in high-income countries. The lead content of petrol sold in Africa is the highest in the world and is associated with high concentrations of lead in the atmosphere, dust and soil. Many other exposures in Africa come from industrial sources, cottage industries and domestic sources. In recent surveys, more than 90% of the children in the Cape Province, South Africa, had lead concentrations in blood over 10 µg/dl (27).

The best available estimate of the neurotoxicity of lead at low doses in childhood comes from cohort studies conducted in industrialized urban populations. These studies indicate that preschool-aged children whose blood concentrations of lead are in the top and bottom quintiles, and which thus differ by around 10 µg/dl, have a persistent 2–3% difference in measures of intelligence (28). Lead-induced deficits in children's intelligence are therefore probably widespread in cities of developing countries that have persistently high levels of environmental exposure to lead.

**Urban transport and air pollution.** One consequence of the global influence of transnational corporations is that private car ownership is increasing spectacularly. In 2000 there are more than 750 million cars in the world. This rapid growth in car ownership reflects the influence of advertising, the power of the roads lobby, the wealth of consumers and their desire for status, comfort and mobility. In cities where there is no public transport, private cars are especially desirable. Car congestion is now endemic in cities everywhere (29). In addition to the fragmentation of neighbourhoods, intrusive noise, and restrictions on physical exercise, there are three broad categories of public health hazard from urban car traffic. Firstly, over 750 000 people die from car crashes annually, including car occu-

pants, pedestrians and cyclists, most of them in developing countries (30).

Secondly, emissions from vehicles cause local air pollution, particularly photochemical smog during summer. Urban air pollution has, in recent decades, become a worldwide public health problem, particularly in many large cities in the developing world. An estimated 130 000 premature deaths and 50–70 million incidents of respiratory illness occur each year due to episodes of urban air pollution in developing countries, half of them in East Asia (31).

In Mexico City, for example, three-quarters of the air pollution is caused by motor vehicle exhaust, and nearly half of the toxins within that pollution come from the same source (32). In São Paulo, which currently has a population of around 17 million, rapid development has created a culture of car dependency, with little investment in the subway and rail systems. The proportion of trips in a motorized vehicle taken by car in São Paulo has doubled over the past quarter of a century, from around 25% to 50%; the number of vehicles in the city is estimated at five million, two-thirds of which circulate within the city each day (33). Studies elsewhere have shown that increases in airborne nitrogen oxides and fine particulates are followed by an increase in the incidence of, and mortality from, respiratory diseases in children and the elderly over the ensuing several days. The local topography and climate exacerbates air pollution in winter, when strong thermal inversions trap the pollutants close to the ground (33).

Thirdly, exhaust emissions contribute to acid rain and to the global accumulation of carbon dioxide. Each of these have wide ranging consequences for human health. In developed countries, traffic exhaust accounts for approximately one-quarter of all carbon dioxide emissions.

#### *Heatwaves, urban vulnerability and mortality.*

Heatwaves adversely affect health. The frequency and intensity of heatwaves will likely increase over the coming century as world temperatures rise (34). The impact of heatwaves on mortality is typically greatest in the centre of large cities, where not only do temperatures tend to be higher than in the suburbs and surrounding countryside but night-time cooling is lessened. This “heat island” effect is caused by the large heat-retaining structures and treeless asphalt expanses of inner cities and the physical obstruction of cooling breezes.

Studies of heatwaves have shown that those who are most vulnerable to heat-related illness and death are elderly people, those who are sick and poor people living in urban areas. In the United States in July 1995 more than 460 extra deaths occurred as a result of a heatwave in Chicago during which temperatures reached 40 °C. The rate of heat-related death was much greater among African Americans than the rest of the population and among people who were confined to their beds or poorly ventilated inner-city apartment blocks (35). In the severe heatwave in England and Wales in 1995, a 10% excess of deaths occurred, particularly in the adult age

ranges, from respiratory and cerebrovascular disease (36). In the greater London area, where daytime temperatures were higher (and where, as in all large cities, there is less cooling at night), mortality increased by around 15%. The excess mortality risks were generally greater among socioeconomically deprived groups (37).

There is a need for studies on the impact of extremes of heat and cold on urban populations living in the developing countries. Most research has been done in the United States and Europe.

**Agriculture in urban areas.** Agriculture in urban areas is increasingly prevalent in many developing countries. Typically, between one-quarter and three-quarters of families carry out some type of small-scale gardening for food, usually despite both official disapproval and regulatory prohibition. This activity reflects both cultural and economic forces: the maintenance of rural traditions and knowledge and as a form of insurance (mostly by women) against monetary poverty.

Urban agriculture has nutritional, economic and social benefits. It also has health hazards including the potentiation of vector-borne infectious diseases (for example, the development of mosquito breeding sites in irrigation channels), exposure to pesticides and various types of contamination of locally grown food caused by the presence of lead and other heavy metals in the soil, and microbiological contamination from the use of human excrement as fertilizer.

## **The larger dimensions of urban impact on environmental health**

There is a larger framework within which to consider health in an urban environment. The impact of burgeoning urban populations on the wider environment is escalating and is bound up with the composite process of globalization. This process entails an increase in various types of interconnectedness that transcend national boundaries and other traditional demarcations (38). The process of globalization, which has been evolving over several centuries, has been greatly amplified over the past two decades by the transnational economic reshaping of world trade and investment, as free market economics has achieved ideological and political ascendancy. The concurrent revolutions in human mobility and electronic communications have contributed to this interconnectedness. The centrepiece of economic globalization is the new freedom of capital to cross national boundaries and the accompanying market in international currency, now freed from exchange controls.

Economic globalization has resulted in an international division of labour. In particular, the manufacturing of “low-end” products — such as footwear, garments, and toys — and the introduction of low-end processes — such as electronic assembly — has been increasingly outsourced by high-income industrialized countries to poorer countries where labour is cheap and workplace standards are

comparatively unregulated. Less developed countries, which have small internal markets, strive to generate wealth by exporting goods from light manufacturing to the developed world, where the low price of these products helps maintain low inflation in the developed countries. These practices have two main consequences for the less developed countries. Firstly, socioeconomic stratification is widened by supranational economic forces. People working in favoured sectors (for example, tourism) prosper; those working in export-led manufacturing earn subsistence wages; and those remaining in sectors not keyed in to the global economy (for example, many rural workers) suffer. Many rural communities thus become marginalized both globally and nationally. This results in an inevitable downward spiral of environmental degradation, increased poverty, food insecurity, the stunting of children's growth and increasing health risks from infectious diseases. Secondly, the fall of commodity prices and the low prices paid for low-end manufactured goods in a competitive global marketplace where trading loyalties no longer count, may consign exporting countries to continued poverty. The growth of slums and shanty towns in and around cities in the developing world is an expression of the persistent and widening economic inequalities in the world.

Worldwide, poorer residents of large cities bear the brunt of the adverse health consequences of environmental degradation. Industrial activities are often concentrated near impoverished communities living on the fringes of urban areas where the enforcement of environmental standards is weakest. In South Africa, for example, the industrial pollution affecting townships such as Soweto and Mafefe is well documented (39). Two-fifths of the population of Soweto lives in houses with asbestos roofs.

### Urban "ecological footprints": endangering global sustainability

Urban populations play a dominant role in the mounting pressures on the world's ecosystems. Girardet says that cities "are also vast processors of food, fuels, and the many raw materials that feed a civilization. With their complex metabolisms they are huge organisms without precedent in nature: their connections stretch across the globe" (40). Cities thus have increasingly large "ecological footprints" (41). The ecological benefits of urbanization include economies of scale, the shared use of resources and opportunities for reuse and recycling. However, there are great externalities, that is environmental and social costs not reflected in the market price. Urban populations depend on supplies of imported food, raw materials (timber, metals, fibre, etc.), external energy sources (especially fossil fuels) and on being able to dispose of their voluminous wastes elsewhere.

Urban populations depend on access to environmental goods and services from an area

vastly larger than a city itself. Feeding the residents of imperial Rome two thousand years ago was dependent on importing more than 1000 tonnes of grain daily from North Africa. Today, the highly urbanized Netherlands consumes resources from a total surface area equivalent to 15 times larger than itself. The consumption of food, wood, paper and fibres by 29 Baltic cities requires a total area 200 times larger than the combined area of the 29 cities; this total area comprises 17 units of forest, 50 units of arable land and 133 units of marine ecosystems (42). Similarly, Rees estimates that the almost 500 000 residents of Vancouver, Canada, who occupy just 11 400 hectares, actually use the ecological output and services of 2.3 million hectares (41). This ratio of 207:1 for the urban population is substantially greater than the ratio of 12:1 for the regional population of the Lower Fraser Basin overall, which includes Vancouver as a whole.

There is nothing intrinsically undesirable about such ratios, so long as urban populations in aggregate can achieve an ecologically sustainable way of life. The scale of the externalities of urban populations is growing (40, 43). The externalities now include massive urban contributions to the world's problems of greenhouse gas accumulation, stratospheric ozone depletion, land degradation, and destruction of coastal zones. Indeed, cities play a central part in much of the large-scale pressure that people impose on the biosphere's life-support systems. These systems provide environmental stabilization, biological productivity, the cleansing of water and air, and the recycling of nutrients. Whereas our predecessors could take these environmental "services" for granted in a less populated world on which they had less impact, today humankind is introducing unprecedented change to the global environment. These large-scale changes pose long-term risks to the health of human populations (44).

The most prominent of these changes is climate change, occurring in response to the human-induced accumulation of heat-trapping greenhouse gases in the lower atmosphere (34). The urbanized developed world, which accounts for one-fifth of the world's population, contributes about three-quarters of all human-made emissions of greenhouse gases (34). The contributions from urban populations in developing countries are rapidly increasing, although they are starting mostly from a lower base level.

A brief consideration of climate change and health illustrates the nature of these health hazards (45) and the fact that that, generally, poor populations in urban areas will be particularly vulnerable to the adverse health impacts of climate change (37). An increase in the incidence of heatwaves would cause an increase in heat-related mortality and illness during the summer. By contrast, less severe cold weather would reduce the documented seasonal excess of deaths in winter. Hot weather would also amplify the production of photochemical smog (for example, ozone) in urban areas, thereby increasing health risks. Other impacts of climate change on health would

arise from disturbance of the world's biophysical systems, thereby affecting the various foundations of public health, such as the sufficiency of local food production, the provision of safe and adequate drinking-water, the provision of secure community settlements and family shelter, and the ability to control various infectious diseases. Early changes may well be the result of alterations in the geographical range (latitude and altitude) and seasonality of certain vector-borne infectious diseases, such as malaria, dengue fever, schistosomiasis, leishmaniasis, Lyme disease, and various tick-borne viral encephalitides (23, 46). Health would also be jeopardized by rising seas and by the displacement of populations caused by physical hazards, land loss, a decline in water supplies, economic disruption and civil strife. These effects, and those caused by altered patterns of agricultural yields, would probably not become evident for several decades.

Estimates of the regional impact of climate change have been more difficult to generate because of the peculiarities of the behaviour of climate systems within local environments. However, regional modelling is becoming more robust. For example, climatologists estimate that by 2050 the Sahara and the semi-arid parts of southern Africa may increase in temperature by 1.6 °C. Equatorial countries such as Cameroon, Uganda and Kenya could experience temperatures that are 1.4 °C higher (34). Trends in mean rainfall for 1901–95 show that some regions in Africa have experienced an increase while others have had a decrease. Projections are that rainfall will increase in East Africa and decrease in West and North Africa (47). These projections are hampered by problems in the down-scaling to regional level of global predictive models.

There is a flip side to this calculus of health risks. If the world were to comply with targets to reduce greenhouse gas emissions then a great deal less fossil fuel would be burnt in urban environments and much of the disease and mortality in urban areas caused by toxic air pollutants would be averted (48). Estimates for China indicate that if China were to comply with the 1997 Kyoto Protocol (agreed under the UN Framework Convention on Climate Change) by reducing CO<sub>2</sub> emissions, then by 2020 the annual number of premature deaths from ambient (external) air pollution that could be avoided would range from 2000 to 16 000; the number of deaths that could be avoided by simultaneously reducing indoor exposures (where coal is currently the main domestic fuel and exposures are often extreme) would range from 50 000 to 500 000. The width of these ranges reflects both the existence of alternative technological approaches to emission reductions and the uncertainties of the dose-specific risks to health (49).

## Conclusion

City living is the keystone of human ecology. Humans are social animals, craving comfort, security, variety

and opportunity. Cities are sources of ideas, energy, creativity and technology. They can foster enlightened, congenial multicultural living. However, cities also continue to be sources for poverty, inequality and environmental health hazards. Populations in the cities of less developed countries typically experience the double environmental health jeopardy of the traditional risks from infectious diseases and the physical and chemical hazards that accompany poorly regulated industrialization, substandard housing, traffic hazards, and social violence.

Urban populations around the world are increasing the pressure on the natural environment. As fossil fuel combustion increases, as land is cleared, as the number of consumers and their expectations rise, so cities are contributing to the degradation of the world's natural systems. These large-scale environmental problems should be remedied with win-win strategies that also ameliorate the existing, and usually unequally distributed, urban environmental health hazards. Poverty is at the heart of this challenge, but better management of the environment is an important part of the solution (39).

Solutions require radical social and technological transformations. These solutions include expanding the provision of education and training; the international transfer of appropriate technology; an enhanced role for the state as a modern, efficient and transparent institution; a more equal redistribution of income, especially within developing countries; international alleviation of debt; and a true international commitment to sharing the world's common property resources (such as the atmosphere and the ocean fisheries). This last objective could be achieved via a targeted convergence granting equal access per person, internationally, to the biosphere's sources and waste-absorbing sinks. (Both the 1987 Montreal Protocol and the 1997 Kyoto Protocol, for constraining the emission of ozone-destroying gases and greenhouse gases, respectively, point in the direction of eventual intercountry convergence in per-person atmospheric emissions.)

In the 21st century we will undoubtedly modify the design and use of our cities. City planners will probably develop approaches to allow us to live in high-density "urban villages" separated by parklands, recreation facilities and garden plots, and connected by light-rail transport. Urban greenery, gardens and horticulture will thus be reinstated. Urban community structures and facilities will be recreated on a human scale. Environmentally benign technologies for transport and generating energy will be taken up. Most importantly, both social equity and ecologically sustainable ways of living will be sought.

Cities have become the great contemporary focal points of human ecology. They are a fulcrum that allows great leverage in reshaping how humankind lives. Ecologically sustainable cities, based on low-impact technologies, social enlightenment and sharing, are an essential part of our future survival. ■



## Résumé

### La santé en milieu urbain : conséquences de la mondialisation pour les pays en développement

Le mode de vie urbain est la clef de voûte de l'écologie humaine moderne. Au cours des deux derniers siècles, les villes se sont multipliées et développées rapidement dans le monde entier. Berceau de la créativité et de la technologie et moteur de la croissance économique, elles engendrent aussi la pauvreté, des inégalités et des risques pour la santé liés à l'environnement. Depuis longtemps, les populations urbaines servent à la fois d'incubateur et de porte d'accès aux maladies infectieuses. Les citoyens des pays en développement sont donc doublement exposés : aux risques classiques de maladie diarrhéique et d'infection respiratoire ; aux risques physiques et chimiques des temps modernes, liés à une industrialisation mal contrôlée, à de mauvaises conditions de logement, à la circulation routière et à la violence sociale.

La croissance non planifiée et la politique économique de laisser-faire des débuts de l'ère industrielle ont fait place à une gestion collective du milieu urbain, en réaction à la dégradation de l'environnement et du fait de l'alphabétisation, de l'avènement de la démocratie et de l'accumulation de richesses. Dans de nombreux pays à faible revenu, ce progrès est freiné par les impératifs et les tendances anti-corporatistes de la mondialisation de l'économie.

On peut répartir les effets du milieu urbain sur la santé en trois grandes catégories. La première concerne les changements sociaux dont s'accompagne l'urbanisation et la façon dont ils modifient les risques pour la santé liés au comportement. Le régime alimentaire, l'activité physique, les comportements toxicomaniaques, la sexualité et la nature de l'engagement social changent. Le risque de maladie cardio-vasculaire, de diabète sucré, de certains cancers, d'infection sexuellement transmissible et de problèmes mentaux évolue lui aussi.

La deuxième catégorie concerne les risques microbiologiques et les risques de toxicité présents dans le milieu urbain. A la menace que constituent habituellement les maladies infectieuses pour les citoyens pauvres s'ajoutent des dangers de nature physico-chimique tels que l'exposition au plomb (dans l'air, le sol et l'eau), la pollution atmosphérique, les accidents de la circulation et l'amplification des vagues de chaleur dans les zones urbaines.

Troisième point : l'influence des populations urbaines modernes sur l'environnement atteint une telle ampleur qu'elle entraîne, par la destruction des milieux vitaux de la biosphère, des risques pour la santé à long

terme. A ce phénomène s'ajoute celui de la mondialisation observé sur la plus grande surface du globe dans les domaines social, politique et économique et qui, à son tour, crée de nouvelles dépendances dans les pays pauvres qui s'efforcent de faire face à la concurrence sur le marché mondial. Il s'ensuit que les normes environnementales sur le lieu de travail et la protection de l'environnement sont insuffisantes et que les écarts de revenu se creusent, autant de facteurs qui influent sur la santé des populations.

Les consommateurs devenant de plus en plus nombreux et exigeants, les villes contribuent dans une très large mesure aux agressions que subit la biosphère et notamment aux changements climatiques. Les villes des pays développés, qui abritent un cinquième de la population mondiale, émettent les trois quarts environ des gaz à effet de serre générés par l'activité humaine. Bien que généralement plus faibles au départ, les émissions imputables aux populations urbaines des pays en développement augmentent rapidement.

L'évolution du climat de la planète aura toutes sortes de répercussions sur la santé humaine, pour la plupart néfastes. D'une manière générale, les plus vulnérables seront les populations pauvres des zones urbaines.

Pour résoudre ces problèmes écologiques de grande ampleur, il faut des stratégies avantageuses pour tous qui visent aussi à réduire les inégalités et les risques pour la santé auxquels sont exposés nombre de citoyens au niveau local. La solution passe par des changements sociaux et technologiques radicaux, notamment une ferme volonté, au niveau international, de mettre en commun les ressources de la planète, telles que l'atmosphère et les pêcheries en mer.

Il y a tout à parier que notre conception et l'usage que nous faisons de la ville changeront au XXI<sup>e</sup> siècle. Les urbanistes imagineront probablement des solutions nous permettant de vivre dans des « villages urbains » à forte densité de population, séparés par des espaces boisés, des aires de loisir et des jardins, et reliés entre eux par un réseau de transports ferroviaires légers. On réintroduira ainsi les espaces verts, les jardins et l'horticulture ; les infrastructures collectives seront de taille humaine ; les modes de transport et les sources d'énergie seront sans danger pour l'environnement. Mais surtout, on tendra vers l'équité sociale et un mode de vie écologiquement viable.

## Resumen

### La salud y el entorno urbano en un mundo cada vez más globalizado: problemas para los países en desarrollo

El modo de vida urbano es la piedra angular de la ecología humana moderna. En todo el mundo, las ciudades se han multiplicado y extendido rápidamente a lo largo de los dos últimos siglos. Las ciudades son fuente

de creatividad y tecnología y motores del crecimiento económico. Sin embargo, también son fuente de pobreza, desigualdades y peligros medioambientales para la salud. Durante mucho tiempo, las poblaciones



urbanas han servido de incubadora y vía de entrada para las enfermedades infecciosas. Y en particular las poblaciones urbanas de los países en desarrollo corren en general un doble peligro, pues están expuestas tanto a los riesgos tradicionales, desde las enfermedades diarreicas a las infecciones respiratorias, como a los peligros modernos, físicos y químicos, que traen consigo una industrialización mal regulada, unas viviendas en malas condiciones, el tráfico y la violencia social.

La primera fase de la industrialización, caracterizada por un crecimiento no planificado de las ciudades y por la economía del *laissez-faire*, ha dado paso a la gestión colectiva del entorno urbano. Esto ha sucedido como respuesta al deterioro del entorno, paralelamente al aumento de la alfabetización, el desarrollo de gobiernos democráticos y el crecimiento de la riqueza. En muchos países de ingresos bajos este proceso es más lento debido a las presiones y las prioridades anticorporativas de la globalización económica.

Existen tres vías principales a través de las cuales el entorno urbano afecta a la salud humana. La primera son los cambios sociales que entraña la urbanización y el modo en que dichos cambios inciden en los riesgos comportamentales para la salud. Estos cambios afectan a los hábitos de alimentación, a la actividad física, los comportamientos adictivos, la conducta sexual y diferentes tipos de compromisos sociales. También varían los riesgos de padecer enfermedades cardiovasculares, diabetes mellitus, algunos cánceres, infecciones de transmisión sexual y problemas de salud mental.

La segunda vía tiene que ver con el entorno físico urbano y sus diversos riesgos microbiológicos y de toxicidad. Además del riesgo tradicional que suponen las enfermedades infecciosas para los pobres de las zonas urbanas, el entorno urbano también esconde diversos peligros fisicoquímicos, como por ejemplo la exposición al plomo (a través del aire, la tierra y el agua), la contaminación del aire, los peligros del tráfico y la amplificación que de las olas de calor provoca la bóveda térmica urbana.

La tercera vía guarda relación con el impacto medioambiental a gran escala de las poblaciones urbanas modernas; la perturbación de los sistemas de la biosfera necesarios para la vida provoca riesgos para la salud a más largo plazo. Esto coincide con la globalización social, política y económica general

imperante en la mayor parte del mundo, que a su vez crea nuevas dependencias para los países más pobres, los cuales están luchando por competir en el mercado mundial. Las deficiencias resultantes en lo tocante a la calidad del entorno laboral y a la protección medioambiental, así como el recrudescimiento de las disparidades en materia de ingresos, tienen consecuencias para la salud de la población.

Debido al aumento del número de consumidores y de sus expectativas, las ciudades contribuyen enormemente a las presiones a gran escala que sufre la biosfera, en particular al cambio climático. El mundo desarrollado urbanizado, que cuenta con una quinta parte de la población mundial, produce unas tres cuartas partes de todas las emisiones de gases termoactivos de origen humano. La contribución de las poblaciones urbanas de los países en desarrollo a ese fenómeno está aumentando rápidamente, aunque en la mayoría de los casos el punto de partida es más bajo.

Las alteraciones del clima mundial ocasionarán muchos cambios en la salud humana, la mayoría de ellos adversos. En general, la población pobre que vive en zonas urbanas será particularmente vulnerable.

Debería ponerse remedio a estos problemas medioambientales en gran escala mediante estrategias que beneficien a todas las partes, y que además reduzcan las desigualdades existentes y los peligros locales para la salud a que están expuestos muchos habitantes de las zonas urbanas. Las soluciones exigirán transformaciones sociales y tecnológicas radicales, incluido un verdadero compromiso internacional de compartir los recursos mundiales de propiedad común, tales como la atmósfera y la pesca del océano.

En el siglo XXI modificaremos sin duda el diseño de las ciudades y las usaremos de otro modo. Los urbanistas probablemente desarrollarán criterios que nos permitirán vivir en «aldeas urbanas» de alta densidad separadas por parques, instalaciones recreativas y zonas verdes, y comunicadas mediante formas de transporte ferroviario ligero. Reaparecerán la vegetación urbana, los jardines y la horticultura. Se volverán a crear estructuras y servicios comunitarios urbanos a escala humana. Se adoptarán tecnologías electrógenas y de transporte respetuosas del medioambiente. Y lo que es más importante, se procurará fomentar tanto la equidad social como la adopción de modos de vida ecológicamente sostenibles.

## References

1. Brennan EM. Population, urbanization, environment and security: a summary of the issues. *Environmental Change and Security Project Report*, 1999, 5: 4-14.
2. Szreter S. Economic growth, disruption, deprivation and death: on the importance of the politics of public health for development. *Population and Development Review*, 1997, 23: 702-703.
3. Chadwick E. *Report on the sanitary condition of the labouring population of Great Britain*. Edinburgh, Edinburgh University Press, 1965 (first published in 1842).
4. Chaplin SE. Cities, sewers and poverty: India's politics of sanitation. *Environment and Urbanization*, 1999, 11: 145-158.
5. McKeown T. *The modern rise of population*. New York, Academic Press, 1976.
6. Szreter S. The importance of social intervention in Britain's mortality decline c. 1850-1914: a re-interpretation of the role of public health. *Social History of Medicine*, 1988, 1: 1-37.
7. *World development report 1992. Development and the environment*. Oxford, Oxford University Press for The World Bank, 1992.
8. Rothman DS, De Bruyn SM. Probing into the environmental Kuznets curve hypothesis. *Ecological Economics*, 1998, 25: 143-145.
9. Hardoy JE, Mitlin D, Satterthwaite DE. *Environmental problems in third world cities*. London, Earthscan, 1992.
10. *World resources report: 1998-99*. Washington, DC, World Resources Institute, 1998.

11. **Obesity: preventing and managing the global epidemic. Report of a WHO Consultation on Obesity.** Geneva, World Health Organization, 1998 (unpublished document WHO/NUT/NCD/98.1).
12. **McKeigue PM.** Cardiovascular disease and diabetes in migrants — interactions between nutritional changes and genetic background. In: Shetty PS, McPherson K, eds. *Diet, nutrition and chronic disease: lessons from contrasting worlds.* Chichester, John Wiley & Sons, 1997: 59–70.
13. **Morse SS.** Factors in the emergence of infectious diseases. *Emerging Infectious Diseases*, 1995, **1**: 7–15.
14. **McMichael AJ.** Urbanisation and urbanism in industrialised nations, 1850–present: implications for human health. In: Schell L, Ulijasek S, eds. *Urbanism, health and human biology in industrialised countries.* Cambridge, Cambridge University Press, 1999, pp. 21–45.
15. *Health and environment in sustainable development: five years after the Earth Summit.* Geneva, World Health Organization, 1997.
16. **United Nations Center for Human Settlements (HABITAT).** *An urbanizing world: global report on human settlements, 1996.* Oxford, Oxford University Press, 1996: 559.
17. *The world health report 1995. Bridging the gaps.* Geneva, World Health Organization, 1995.
18. **Satterthwaite DE.** Environmental health and urban poverty and overcrowding. In: Munn T, ed. *Encyclopedia of global environmental change.* Chichester, John Wiley & Sons, 2000, in press.
19. **Wilson ME.** Infectious diseases: an ecological perspective. *British Medical Journal*, 1995, **311**: 1681–1684.
20. **Johnson CL, Appleton CC.** Urban schistosomiasis and rural-urban migration. Abstract presented at the Annual Conference of the Epidemiological Society of Southern Africa, East London, United Kingdom, February 23–25, 2000 (unpublished abstract).
21. **Maciel A et al.** Epidemiological study of bancroftian filariasis in Recife, northeastern Brazil. *Memórias do Instituto Oswaldo Cruz*, 1996, **91**: 449–455.
22. **Githeko A et al.** Climate change and vector-borne diseases: a regional analysis. *Bulletin of the World Health Organization*, 2000, **9**: 1136–1147.
23. **Epstein PR et al.** Biological and physical signs of climate change: focus on mosquito-borne diseases. *Bulletin of the American Meteorological Society*, 1998, **78**: 409–417.
24. **Schell LM.** Effects of pollutants on human prenatal and postnatal growth: noise, lead, polychlorobiphenyl compounds and toxic wastes. *Yearbook of Physical Anthropology*, 1991, **34**: 157–188.
25. **Listorti J.** Is environmental health really a part of economic development — or only an afterthought? *Environment and Urbanization*, 1999, **11**: 89–100.
26. **Tong S, Prapamontol T, von Schirmding Y.** Environmental lead exposure: a public health problem of global dimensions. *Bulletin of the World Health Organization*, 2000, **9**: 1068–1077.
27. **Nriagu JO, Blankson ML, Ocran K.** Childhood lead poisoning in Africa: a growing public health problem. *The Science of the Total Environment*, 1996, **181** (2): 93–100.
28. **Tong S et al.** Declining blood lead levels and cognitive function during childhood — the Port Pirie cohort study. *Journal of the American Medical Association*, 1998, **280**: 1915–1919.
29. **Newman P, Kenworthy G.** *Cities and sustainability: reducing auto dependency.* Washington, DC, Island Press, 1999.
30. **McMichael AJ.** Transport and health: assessing the risks. In: Fletcher T, McMichael AJ, eds. *Health at the crossroads: transport policy and urban health.* Chichester, John Wiley & Sons, 1996: 9–26.
31. **Maddison D.** *A meta-analysis of air pollution epidemiological studies.* London, Centre for Social and Economic Research on the Global Environment, University College London, 1997.
32. **Connolly P.** Mexico City: our common future? *Environment and Urbanization*, 1999, **11**: 53–78.
33. **Jacobi P, Segura DB, Kjellen M.** Governmental responses to air pollution: summary of a study of the implementation of *rodizio* in São Paulo. *Environment and Urbanization*, 1999, **11**: 79–88.
34. **Intergovernmental Panel on Climate Change.** *Second assessment report. climate change 1995.* Vol 1–3. New York, Cambridge University Press, 1996.
35. **Semenza JC et al.** Heat-related deaths during the July 1995 heat wave in Chicago. *New England Journal of Medicine*, 1996, **335**: 84–90.
36. **Rooney C et al.** Excess mortality in England and Wales, and in Greater London, during the 1995 heatwave. *Journal of Epidemiology and Community Health*, 1998, **52**: 482–486.
37. **Megens T, Kovats RS, McMichael AJ.** Mortality impact of heatwaves in the UK, 1976 and 1995. *The Globe*, 1998, **42**: 4–5.
38. **Lee K.** Globalisation and the need for a strong public health response. *European Journal of Public Health*, 1999, **9** (4): 249–250.
39. **McGranahan G et al.** Urbanisation and healthy living environments. In: *Environmental change and human health in countries of Africa, the Caribbean and the Pacific.* Stockholm, Stockholm Environment Institute, 1999: 166.
40. **Girardet H.** *The Gaia atlas of cities. New directions for sustainable urban living.* London, Gaia Books, 1992.
41. **Rees WE.** Revisiting carrying capacity: area-based indicators of sustainability. *Population and Environment*, 1996, **17**: 195–215.
42. **Folke C, Larsson J, Sweitzer J.** Renewable resource appropriation. In: Costanza R, Segura O, eds. *Getting down to earth.* Washington, DC, Island Press, 1996.
43. **Guidotti T.** Perspective on the health of urban ecosystems. *Ecosystem Health*, 1995, **1**: 141–149.
44. **McMichael AJ.** *Planetary overload: global environmental change and the health of the human species.* Cambridge, Cambridge University Press, 1993.
45. **McMichael AJ, Haines A.** Global climate change: the potential effects on health. *British Medical Journal*, 1997, **315**: 805–809.
46. **Patz JA et al.** Global climate change and emerging infectious diseases. *Journal of the American Medical Association*, 1996, **275**: 217–223.
47. **Hulme M, ed.** *Climate change and southern Africa: an exploration of some potential impacts and implications in the SADC region.* Norwich, Climate Research Unit, University of East Anglia, 1996.
48. **Working Group on Public Health and Fossil-Fuel Combustion.** Short term improvements in public health and global-climate policies on fossil-fuel combustion: an interim report. *Lancet*, 1997, **350**: 1341–1349.
49. **Wang X, Smith KR.** Near-term benefits of greenhouse gas reductions: health impacts in China. *Environmental Science and Technology*, 2000, **33** (18): 3056–3061 (available on the Internet via <http://pubs.acs.org/journals/esthag/index.html>).