

Health Indicators of **sustainable cities**

in the Context of the Rio+20 UN Conference on Sustainable Development

Initial findings from a WHO Expert Consultation: 17-18 May 2012

Key messages:

More than two-thirds of the global population will be living in cities by 2050. The rapid rate of urban growth has created enormous challenges. Global growth in the number of slum-dwellers, now more than 800 million people, attests to the need for stronger urban governance. So while cities concentrate opportunities, jobs, and services, they also concentrate health hazards and risks. Health is an important benchmark of sustainability of urban policies. Health indicators proposed here also reflect progress on social equity, environment, and development dimensions of sustainable cities. Core indicators include:

- **Slum housing improvements that benefit health** – as assessed by well-defined measures for safe, resilient, and climate-adapted structures that also have access to clean energy and basic utilities;
- **Urban air quality in terms of particulate pollution** – with respect to WHO air quality guidelines;
- **Healthy, efficient transport** – in terms of safety and use of sustainable modes, including walking, cycling, and public transport;
- **Urban violence** - in terms of intentional homicides.

Governance indicators assess how cities account for health in urban planning and building codes, and in monitoring of air/water quality and sanitation risks. Indicators of **access to urban services** essential to public health and sustainable cities also are suggested for: health care services, green spaces, fresh food markets, and waste management.

1. Linkages between sustainable cities and better public health

More than half of the world's population now lives in cities and by 2050 that will increase to 70%, including most of the population in developing countries.¹ Yet, far too much of the world's urban growth is poorly managed. About one-third of the urban population lives in slums; numbers are growing in absolute terms.^{2,3} So while cities concentrate opportunities, jobs, and services, they also concentrate health hazards and risks – to which more people are being exposed.

In wealthy and poor cities, unsustainable and unplanned development of urban housing, transport, and food systems, along with social and lifestyle factors, are drivers in the epidemic of noncommunicable diseases, which are linked to risks and hazards such as air pollution, poor diet, physical inactivity, traffic injury and domestic injury. For instance:

- Outdoor urban air pollution is responsible for 1.3 million deaths annually.

¹ *World Urbanization Prospects, the 2007 revision. Executive Summary.* New York, United Nations, 2008 (http://www.un.org/esa/population/publications/wup2007/2007WUP_ExecSum_web.pdf).

² *Hidden cities: unmasking and overcoming health inequities in urban settings.* Kobe, World Health Organization/WHO Centre for Health Development & United Nations Human Settlements Programme, 2010.

³ *The energy access situation in developing countries. A review focusing on the least developed countries and Sub-Saharan Africa.* New York, United Nations Development Programme /World Health Organization, 2009.

- Physical inactivity is responsible for 3.2 million deaths annually.⁴
- Traffic injuries cause some 1.3 million deaths annually.⁵
- Violence causes some 1.6 million deaths annually,⁶ which is often linked to harmful use of alcohol.

Even in more affluent cities, access to healthy environments, products and services may vary widely across the metropolitan region, in terms of visible aspects of development, such as:

- **Built environment** – neighborhood form (sprawl/compact; homes and services/businesses in close proximity, or not); housing quality and access to energy and utilities; air quality and transport services;
- **Green environment** – availability, accessibility, quality, and security of public green spaces;
- **Social and economic environment** –street safety and security, access to jobs and schools, social welfare systems, and communal institutions that support social cohesion and gender equality;
- **Food security and quality** –accessibility and affordability of fresh food markets; and on the other extreme, excessive concentrations of fast-food outlets – contributing to a shift towards diets high in sugar and salt, processed carbohydrates/oils, and animal products;
- **Health services:** accessible, quality services, ranging from primary care clinics to hospitals and emergency response.

2. Core health indicators to monitor progress and identify success

Urban sustainability and health linkages have been discussed in diverse settings. These include the WHO *Health in the Green Economy* series (urban transport and housing),⁷ WHO regional office initiatives on housing, transport and healthy cities,⁸ and frameworks for environmental health linkages (e.g. DPSEEA);^{9,10} environmental health indicators;¹¹ and indicators for urban health equity (e.g. Urban HEART).¹² Indicators suggested here are informed by this work, as well as research by international, national, and regional institutions and by academia and civil society:¹³

Urban air quality and premature mortality from cardiorespiratory disease

- Annual average PM_{10/2.5} concentrations in relation to WHO air-quality guidelines;

⁴ *Global health risks: mortality and burden of disease attributable to selected major risks*. Geneva, World Health Organization, 2009.

⁵ *Global status report on road safety*. Geneva, World Health Organization, 2009.

⁶ *World report on violence prevention*. Geneva, World Health Organization, 2002.

⁷ Health in the green economy (http://www.who.int/hia/green_economy/en/index.html).

⁸ See: http://www.who.int/topics/environmental_health/en/ for links to relevant WHO initiatives on housing, transport, health and environment linkages and sustainable health and development in all regions of the world.

⁹ Corvalan C, Briggs D & Zielhuis G, eds. *Decision-making in environmental health: from evidence to action*. Geneva, World Health Organization, 2000. Note: DPSEEA model: driving forces, pressures, states of hazard/pollution, and exposures to risks, health effects as well as actions.

¹⁰ *Health and environment, managing the linkages for sustainable development: a toolkit for decision-makers*. WHO/United Nations Environment Programme (UNEP) synthesis report. Health and Environment Linkages Initiative (HELI), Geneva, World Health Organization, 2008.

¹¹ Corvalan C, Briggs DJ, and Kjellstrom T. Development of environmental health indicators. In: Briggs D, Corvalan C, and Nurminen M, eds. *Linkages and methods for environmental and health analysis. General guidelines*, Geneva, United Nations Environment Programme, United States Environmental Protection Agency and World Health Organization, 1996.

¹² *Urban HEART*. Kobe, World Health Organization Centre for Health Development, 2011 (http://www.who.int/kobe_centre/measuring/urbanheart/en/).

¹³ *Environmental health indicators for the Rio+20 UN Conference on Sustainable Development. Background paper for WHO/NIEHS Expert consultation*, Geneva, National Institute of Environmental Health Sciences, 17-18 May, 2012.

Urban housing and health

- Proportion of "improved" urban slum homes, as defined by measures for structural resilience, heat/cold resilience, access to safe drinking water and improved sanitation, electric lights, low-emissions, and efficient modes of heating/cooking with adequate ventilation;

Safe, equitable, energy-efficient transport including opportunities for physical activity

- Percent of person trips/passenger kilometres travelled by urban public transport/transit and cycling/walking;
- Pedestrian and bicyclist deaths as a proportion of total traffic mortality; and pedestrian and bicyclist deaths/1000 kilometres of pedestrian/bicycle travel;¹⁴

Violence and security

- Intentional homicides per 100 000 residents city-wide and in slum neighborhoods.

3. Expanded indicators

Governance indicators

- Number/proportion of cities implementing standards for and reporting on water quality and air quality, in line with WHO guidelines; as well as number of smoke-free business and public places;
- Proportion of new housing city-wide, and by socioeconomic area, complying with planning and building codes that incorporate standards for safety, water/sanitation, disaster resilience,¹⁵ and energy efficiency;
- Proportion of new and existing commercial/industrial and public buildings complying with building codes that incorporate standards for energy efficiency, adequate employee day lighting/ventilation,¹⁶ and safety/disaster resistance;
- Number/proportion of cities implementing health impact assessment and monitoring of urban development strategies.

Access to health and sanitation services, food markets, and urban infrastructure for social/recreation/livelihoods

- Proportion of urban hospitals served by rapid transit; proportion of urban and urban slum population living within ready access of a health clinic and emergency health services;
- Proportion of urban population and urban slum population living within 500 meters of an urban transit stop;
- Proportion of urban streets with sidewalks; kilometres/year of urban cycle lanes constructed or renovated;
- Square meters of green space per capita (urban-wide area and in slums);
- Number of fresh food markets per square kilometre within the urban boundary and in slums;
- Volumes of urban municipal waste and municipal wastewater collected and treated as a proportion of waste/wastewater generation.

¹⁴ NMT deaths/total traffic deaths (and NMT deaths/100 000 population) are more commonly measured. However, low proportions of walking and cycling in some cities are a confounding factor in using from these indicators. Alternative measures of injury and fatality per unit of pedestrian/cycle travel thus deserve further development as an indicator of the safety of the pedestrian/bicyclist environment. The traditional measure available is NMT deaths/total traffic deaths. However, in countries with low proportions of walking and cycling, this may not provide a real reflection of the safety of the pedestrian/cycle environment. Therefore, measuring injury and fatality per unit of pedestrian/cycle travel is a more sensitive indicator of environmental safety, which deserves further development.

¹⁵ Earthquake, flood, storm depending on local vulnerability.

¹⁶ Note: ventilation is typically measured in terms of the number of air exchanges per hour.

4. Added value of these health indicators

Cities are complex entities. Still, healthy cities indicators can report, in simple and neutral terms, the impacts of urban policies on health while also helping policymakers and residents to understand "how are we doing" – whether the setting is Rio, Rome, Delhi, Seoul, Cairo, or Cape Town.

Monitoring urban indicators of health can help report on progress at global, regional or city level, as well as identifying barriers and social and environmental inequities that need to be addressed. Progress over time can be measured both within cities as well as between cities. Added value of specific health indicators is described for the following:

Air pollution exposures

Urban (PM_{10/2.5}) air pollution is an indicator of premature mortality from cardiopulmonary disease in cities that is widely used. Progress in improving air quality can be readily measured and translated into quantifiable health and economic benefits. However, current average particulate air pollution levels in many developing cities can be up to 12 times higher than those proposed by the *WHO Air Quality Guidelines*, and recent reports indicate mortality from urban air pollution – now 1.3 million annually – may increase significantly without strong action.¹⁷

Housing and health

Improving the lives of at least 100 million slum dwellers was a Millennium Development Goal target relevant to sustainable cities. Slums are defined as residential neighbourhoods that "lack one or more of the following: improved sanitation, safe drinking-water, security of tenure, durable housing, and sufficient living area (no more than 3 people sharing the same room)".¹⁸

However, a revised target for reporting on slum improvement is now widely acknowledged as necessary to facilitate country-level measurement of progress indicators against a better defined baseline.¹⁹ It is now apparent that the number of slum dwellers is far higher than originally estimated in 2000 and that number has grown in the intervening decade – although slum dwellers as a proportion of the urban population have indeed declined since 2000.²⁰

The indicator suggested here, in the context of Rio+20 Sustainable Cities theme, defines urban slum improvements in terms of simple, concrete physical features that capture synergistic aspects of health, equity and sustainability. For instance, in developing countries one quarter of the urban population uses coal, wood, or biomass for household cooking and heating – a large contribution to not only indoor but also outdoor air pollution.²¹ Thus improving aspects of a slum home's energy system helps health and environment.

¹⁷ *OECD Environmental outlook to 2050: The consequences of inaction*. Organization for Economic Co-operation and Development (OECD) Publishing, 2012 (<http://dx.doi.org/10.1787/9789264122246-en>). The baseline scenario projects that unless the global energy mix changes, fossil fuels will supply 85% of energy demand in 2050, implying a 50% increase in GHG emissions and worsening urban air pollution, including 3.6 million premature deaths annually from particulate pollution exposures.

¹⁸ Kinyanjui M et al. Development context and the millennium agenda. In: *The challenge of slums: global report on human settlements 2003, revised and updated version (April 2010)*. New York, United Nations Human Settlement Programme, 2010.

¹⁹ *Millennium Development Goals Report 2010*. New York, United Nations, 2010.

²⁰ Numbers of slum dwellers rose in absolute terms 2000-2010 from 767-828 million. Proportion of people living in urban slums in developing regions declined from 39%- 33%,

²¹ *The energy access situation in developing countries*. Geneva, United Nations Development Programme and World Health Organization, 2009.

More structurally sound, safe, and energy-efficient housing design, including good use of natural ventilation, can also help reduce domestic injuries and vulnerability to extreme weather/disasters. In addition, improving housing quality can reduce exposures to conditions of excessive heat, cold, and dampness, which are risk factors for a range of cardiopulmonary diseases (both infectious and noncommunicable).

Commercial and public buildings – if beset by poor ventilation/daylighting – and indoor air pollution can contribute to infectious disease transmission and chronic diseases as well as reduced morale and productivity. In some settings, commercial and public building energy use may not only be a large proportion of a city's total pollution and climate footprint, but also more rapidly amenable to policy interventions due to built-in market incentives for efficiencies.

Transport

Transport is deeply intertwined with both urban activities and structure. Transport indicators thus reflect powerful aspects of a cities' overall "energy, health, and safety" scorecard. Compact urban neighbourhoods served by transit and dedicated walking/cycling networks are more energy efficient and safer for pedestrians/cyclists and here, more residents will tend to use active travel with attendant health benefits.^{22,23} Long-term studies in cities as diverse as Shanghai and Copenhagen found a 30% lower annual mortality risk among cycle commuters,^{24,25} with similar results in meta-analysis of walking.²⁶ Cities built around transit and active transport offer efficient and equitable access to jobs, health facilities, and other health-promoting urban services, making such transportation infrastructure particularly important to youths, elderly, and disabled, and the poor.

Violence and social coherence

Indicators of violence are an important reflection of social cohesion and equity. Violence also has very powerful far-reaching impacts on diverse dimensions of sustainability (e.g. urban socioeconomic flight; ability to engage in outdoor recreation or travel by public or non-motorized modes; opening windows to ventilate a home, etc.).

5. Feasibility of data reporting

With the exception of the indicator for slum improvements, most indicators proposed here are already collected by UN agencies, national governments, or broadly by cities. Data on PM_{10/2.5} air pollution concentrations are available for over 1 100 cities globally, and are maintained by the WHO Global Observatory. Data on slums are available for more than 60 countries (UN Habitat). Data on homicides are available through the WHO database on mortality by cause as well as from the UN Office on Drugs and Crime.²⁷ WHO also maintains data from multi-country studies on domestic violence and women's health, which can be disaggregated for cities.

²² Bournay E. *Urban and transport related energy consumption*. Norway, United Nations Environment Programme/Global Resource Information Database Arendal Maps and Graphics Library, 4 June 2012.

²³ Peden M et al. (Eds) . *World report on road traffic injury prevention*. Geneva, World Health Organization, 2004.

²⁴ Matthews CE et al. Influence of exercise, walking, cycling, and overall nonexercise physical activity on mortality in Chinese women. *American Journal of Epidemiology*, 2007,165(12):1343-50.

²⁵ Andersen LB et al. All-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work. *Archives of Internal Medicine*, 2000, 160(11):1621-8.

²⁶ Hamer M, Chida Y. Walking and primary prevention: a meta-analysis of prospective cohort studies. *British Journal of Sports Medicine*, 2008, 42:238–243.

²⁷ See <http://www.unodc.org/unodc/en/data-and-analysis/statistics/crime.html>.

For urban transport, data on the percent of pedestrian/cycle mortality as a proportion of total traffic mortality is available for 135 countries.²⁸ In some highly motorized countries, this proportion may not adequately reflect the "pedestrian-cycle" quality of the urban environment, but rather the sheer lack of travel by non-motorized transit (NMT) modes. For this reason, a more sensitive indicator would be the proportion of pedestrian/cycle deaths by kilometres of pedestrian/cycle travel – which is relatively easy to deduce once travel by NMT modes is routinely monitored and reported. Health sector support for the expanded use of this indicator would reinforce efforts by countries, cities, and civil society to focus on this all-important linkage between urban environment, health and safety.

6. Cross-cutting issues for further consideration

Equity

Within most large cities, there are large disparities in population health and access to health-enabling environments as well as social services among different socioeconomic groups, genders, and neighborhoods. Collection of data and reporting on all indicators proposed should thus be disaggregated by factors such as age, gender, and neighborhood/socioeconomic stratum. Trends in these data should be analysed in terms of these social groups to monitor progress towards greater health equity.

Governance

Strong urban institutions are needed to manage growth and to cope with new and emerging challenges to urban sustainability such as increasing heat waves and extreme weather.²⁹ Evidence about the economic savings in terms of health and health-care costs – offsetting investments made – can help provide a stronger impetus for action on sustainable urban policies once the dimensions of cost and benefit are well understood by policymakers.³⁰

Climate change

Along with direct health benefits of urban sustainability measures noted here, greener development of the physical environment can be an indirect driver of cities' long-term resilience to climate change and natural disasters. For instance, cities built compactly – with homes and essential businesses and services in close proximity of each other and major transit and walking/cycling routes – can maintain green belts in and around denser inner cities areas. This can help moderate urban heat waves – a factor in illness, particularly among the elderly.³¹ Urban green spaces also filter air pollution, and facilitate physical exercise, fresh food production and better mental health.³²

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²⁸ Peden M et al. *World report on road traffic injury and prevention*. Geneva, World Health Organization, 2004.

²⁹ Campbell-Lendrum D, Corvalan J. Climate change and developing-country cities: implications for environmental health and equity. *Journal of Urban Health*, 2007, 84(Suppl 1): 109–117 (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1891643/?tool=pubmed>).

³⁰ Chapman R et al. Retrofitting houses with insulation: a cost-benefit analysis of a randomized community trial. *Journal of Epidemiology and Community Health*, 2009. 63: 271-277.

³¹ Dousset et al. Satellite monitoring of summer heat waves in the Paris metropolitan area. *Int. J. Climatol.*, 31:313-323.

³² Rydin et al. Shaping cities for health: complexity and the planning of urban environments in the 21st century. *Lancet Commissions*. 30 May, 2012. doi:10.1016/S0140-6736(12)60435-8.