Urban design, transport, and health 1

City planning policies to support health and sustainability: an international comparison of policy indicators for 25 cities

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City planning policies influence urban lifestyles, health, and sustainability. We assessed policy frameworks for city planning for 25 cities across 19 lower-middle-income countries, upper-middle-income countries, and high-income countries to identify whether these policies supported the creation of healthy and sustainable cities. We systematically collected policy data for evidence-informed indicators related to integrated city planning, air pollution, destination accessibility, distribution of employment, demand management, design, density, distance to public transport, and transport infrastructure investment. Content analysis identified strengths, limitations, and gaps in policies, allowing us to draw comparisons between cities. We found that despite common policy rhetoric endorsing healthy and sustainable cities, there was a paucity of measurable policy targets in place to achieve these aspirations. Some policies were inconsistent with public health evidence, which sets up barriers to achieving healthy and sustainable urban environments. There is an urgent need to build capacity for health-enhancing city planning policy and governance, particularly in low-income and middle-income countries.

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This is the first in a **Series** of four papers about urban design, transport, and health

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Introduction

Cities are confronting urgent health, social, and environmental challenges, as reflected in the UN's Sustainable Development Goals (SDGs).[1] The UN New Urban Agenda[2] emphasises the crucial role of city-level governance and planning in reaching the SDGs.[3] City planning decisions (see glossary in the introductory Comment on this Series)[4] shape land uses and travel patterns, which in turn influence urban lifestyles and environmental exposures, and thus human health and environmental sustainability.[5,6] Government city planning policies specify land uses and related taxation; fund and provide transport infrastructure and other public services; regulate housing, industry, car use, and transport fares; and foster economic development. Given the challenges of the 21st century, it is essential that city planning produces cobenefits for prevention of communicable and non-communicable diseases[7–10] and climate action.[11,12]

Much of the urban growth anticipated by 2050 is expected to occur in low-income and middle-income countries (LMICs),[13] which are disproportionately affected by the global burden of disease and face the harshest consequences of climate change.[14,15] LMICs often have fewer resources than high-income countries (HICs) for delivering infrastructure and services to meet the needs of rapidly growing urban populations. Reducing urban health inequities between HICs and LMICs should be a priority for governments.[16] However, most research on health-enhancing city planning originates from cities in HICs, so there is a need for more studies on the urban planning challenges faced by cities in LMICs and ways to support capacity building.[4,17–19]

To create healthy and sustainable cities, integrated planning is needed: vertically between levels of government, and horizontally across all sectors involved in city governance—especially land use, transport, housing, parks, and infrastructure.[20,21] Integrated planning prevents fragmented urban governance and supports coherent policy frameworks (see Series glossary).[4,22,23] Policy also needs to be informed by evidence.[24,25] Yet city planning policy is often inconsistent with public health evidence and contributes to urban design and transport features that foster car dependence and suburban sprawl, with inadequate access to jobs, shops, parks, and schools by walking, cycling, and public transport.[26] Best-practice policy incorporates clear, specific, measurable, and budgeted actions and targets.[23,27] To be measurable and support accountability for implementation,[28] policy targets must have a quantitative reference point or threshold, and ideally a timeframe for delivery.[27]

Key messages

- We assessed and compared healthy city planning policy indicators for 25 cities across 19 countries
- Many cities did not have specific and measurable policy targets to achieve their general aspirations for health and sustainability
- Some policies were inconsistent with the evidence on health-enhancing city planning, risking cities committing to unhealthy and unsustainable urban systems
- There is an urgent need to strengthen policy frameworks for health-enhancing city planning, particularly in low-income and middle-income countries

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City planning indicators can be used to monitor the quality and consequences of policies.[29] Various indicator frameworks and policy analysis methods have been developed to assess aspects of healthy and sustainable city planning policies.[24,27–32] However, most of these frameworks, including the SDG indicators,[1,33] focus on measuring the effects of policies (eg, air quality or physical activity),[27,33,34] rather than the presence or quality of upstream urban systems policies (eg, transport policy) or government investment, which establishes the likelihood of achieving downstream health and sustainability outcomes. Despite widespread calls for healthy, sustainable cities,[3] there appear to be no comprehensive international studies assessing or comparing the availability and quality of city-level planning policies associated with health. Thus, to support the creation of healthy and sustainable cities, we assessed the content of the city planning policies for diverse cities internationally, using health-related policy indicators.

In response to the limitations of other indicator frameworks, the 2016 *Lancet* Series on Urban Design, Transport, and Health[5] recommended a comprehensive set of upstream city planning policy indicators (see glossary),[4] on the basis of a conceptual framework of the pathways through which city planning affects health. The proposed policy indicators, which we measure in this paper, reflect the best available evidence on policies for urban design and transport features associated with health: integrated transport and urban planning; air pollution; destination accessibility; distribution of employment; demand management; design; density; distance to public transport; diversity; desirability; and transport infrastructure investment.[5]

In this first paper in the second Series on urban design, transport, and health, we develop and test a method for measuring the policy indicators proposed in the 2016 *Lancet* Series[5] using a sample of cities in high-income and middle-income countries, and assess whether these cities had policy frameworks that support healthy and sustainable urban environments. We make recommendations for policy and research and issue a call for policy action to build healthy and sustainable cities.

Measuring evidence-informed indicators of city planning policies

Selection of cities and policy indicators

We assessed city planning policies for 25 cities in 19 lower-middle-income, upper-middle-income, and high-income countries. We selected cities via convenience sampling through collaborators invited to join the Global Healthy and Sustainable City-Indicators Collaboration at international conferences and International Physical Activity and Environment Network meetings. Because we were testing the feasibility of assessing city planning policies, we aimed for a wide and diverse representation of cities internationally. However, our sampling approach did not aim to recruit equal numbers of cities in each world region or country-income category.

We developed one or more measures for the evidence-informed policy indicators proposed in the 2016 *Lancet* Series (24 measures in total).[5] We did not separately measure the diversity indicator from the 2016 *Lancet* Series[5] because policy requirements for the mix of housing types and land uses were difficult to consistently measure across the 25 cities. However, aspects of land use diversity were captured with our measures of destination accessibility, distribution of employment, design, density, and distance to public transport. Although the recommended desirability indicator was also not measured separately, some aspects of neighbourhood desirability were captured within the demand management, design, and air pollution indicators.

Identifying policy coverage and quality

Local English-speaking researchers with expertise in healthy cities collected policy data for each city, in some cases partnering with policy makers who helped to identify relevant policy documents. This approach helped to overcome language barriers and ensured an understanding of local policy contexts. Collaborators were trained via a webinar on how to identify relevant policy content. We included formal government policy documents (including strategic policy, design codes, guidelines, regulations, and legislation) that were current and publicly available during the data collection period (Jan 1 to Aug 31, 2019). We collected policy data for the levels of government responsible for the whole or majority of the metropolitan area, for consistency of policy assessment across cities of diverse population sizes, geographical extents, and governance arrangements. Collaborators provided English translations of policy content where relevant.

To collect policy data, collaborators completed an online questionnaire (appendix pp 1–8). The questionnaire asked about each city's governance context, and details about available policies for each measure. The presence or absence of policies for the indicators of city planning policies was recorded, and a content analysis coding protocol (appendix pp 9–10) assessed relevant policies' qualitative strengths and limitations. Qualitative coding focused on whether policies were aligned with current evidence on healthy cities derived from high-quality empirical studies and reviews[5,35] and were specific and measurable, to reflect the best-practice principles for health-supportive city planning.[23,28]

Policy data were analysed by two coders (ML, DA), and inter-rater reliability was calculated for the first three cities. Before commencing, the coders were trained in applying the coding rules and theoretical concepts.[36] Cohen's κ coefficients assessed the overall agreement between coders and ranged from 0·83 (95% CI 0·69–0·98) to 0·91 (95% CI 0·83–0·98), which is considered almost perfect agreement.[37] Instances of

	Country data				City data		
	GNI per capita, US$ (2019)[39]	Gini index, income inequality (year)[40]	Life expectancy at birth, years (2019)[41]	Proportion of deaths caused by NCDs (2019)[42]	Urban area, km²*	Population estimate (2015)[43]	Population estimate per km² (2015)
Lower-middle-income countries							
Maiduguri, Nigeria	2030	35·1 (2018)	55	27%	125	1 092 447	8722
Chennai, India	2120	35·7 (2011)	70	66%	425	6 602 769	15 549
Hanoi, Vietnam	2590	35·7 (2018)	75	81%	1220	5 938 818	4866
Upper-middle-income countries							
Mexico City, Mexico	9480	45·4 (2018)	75	80%	2312	20 216 501	8744
São Paulo, Brazil	9130	53·4 (2019)	76	75%	1018	11 718 034	11 512
Bangkok, Thailand	7260	34·9 (2019)	77	77%	1190	9 337 076	7844
High-income countries							
Baltimore, MD, USA	65 850	41·4 (2018)	79	88%	741	1 381 445	1865
Phoenix, AZ, USA	65 850	41·4 (2018)	79	88%	772	1 320 016	1710
Seattle, WA, USA	65 850	41·4 (2018)	79	88%	1885	2 199 327	1167
Hong Kong	50 800	..	85	55%[44]†	373	7 325 576	19 665
Adelaide, SA, Australia	55 100	34·4 (2014)	83	89%	541	985 647	1822
Melbourne, VIC, Australia	55 100	34·4 (2014)	83	89%	1657	3 741 467	2258
Sydney, NSW, Australia	55 100	34·4 (2014)	83	89%	1334	4 082 229	3061
Auckland, New Zealand	42 760	..	82	90%	468	1 234 554	2638
Graz, Austria	51 460	30·8 (2018)	82	91%	69	283 101	4121
Ghent, Belgium	48 030	27·2 (2018)	82	86%	75	174 411	2339
Olomouc, Czech Republic	21 940	25·0 (2018)	79	89%	27	88 044	3275
Odense, Denmark	63 950	28·2 (2019)	81	90%	56	157 018	2791
Cologne, Germany	48 580	31·9 (2016)	81	91%	348	1 118 442	3218
Lisbon, Portugal	23 200	33·5 (2018)	81	87%	85	583 347	6867
Barcelona, Spain	30 390	34·7 (2018)	83	91%	359	3 259 527	9068
Valencia, Spain	30 390	34·7 (2018)	83	91%	86	682 752	7937
Vic, Spain	30 390	34·7 (2018)	83	91%	31	43 813	1433
Bern, Switzerland	85 500	33·1 (2018)	84	90%	32	158 179	4898
Belfast, UK	42 220	35·1 (2017)	81	88%	98	400 731	4084

Countries grouped according to 2021 GNI per capita classification.[45] GNI=gross national income. NCDs=non-communicable diseases. *City boundary definitions, data sources, and methods are detailed in the appendix of paper 3 in this Series.[46] †Includes only deaths from cancer, cardiovascular diseases (including heart disease and stroke), diabetes, and chronic respiratory diseases.

Table 1: **Population and spatial characteristics of the included cities, and national-level economic and health indicators**

coding ambiguity or disagreement were discussed, and a consensus reached,[38] before proceeding to code the remaining cities independently. Frequent spot checks for consistency ensured that high coding agreement was maintained.

Summary scores quantified the overall presence of city planning policies associated with health, and the quality of these policies. For quality scores, each city's highest score for specific and measurable policy content was recorded for each measure (score of 3 for specific standard or aim with a measurable target; 2 for specific standard or aim without a measurable target; 1 for aspirational; and 0 for specificity could not be determined). These scores were multiplied by –1 if the policy text was inconsistent with healthy cities evidence, and by –0·5 if it was partly inconsistent with the evidence. The scores for all indicators were summed for each city.

Cities' performance on indicators for healthy city planning policies

Included cities

The cities included were diverse in terms of gross national income per capita, population size, official language, and geographical spread (all continents except Antarctica; table 1). Three cities were in lower-middle-income countries, three in upper-middle-income countries, and 19 in HICs.[45] Representation of LMICs was low with no cities in low-income countries, which resulted from our convenience sampling approach that used an established network of healthy cities researchers, most of whom were based in HICs. This under-representation is reflective of many research capacity inequities, as previously described.[5,17–19,34] Estimates of income inequality (measured with the Gini index) ranged from 25·0 for the Czech Republic (most equal), to 53·4 for Brazil (most unequal).[40] Life expectancy

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See **Online** for appendix

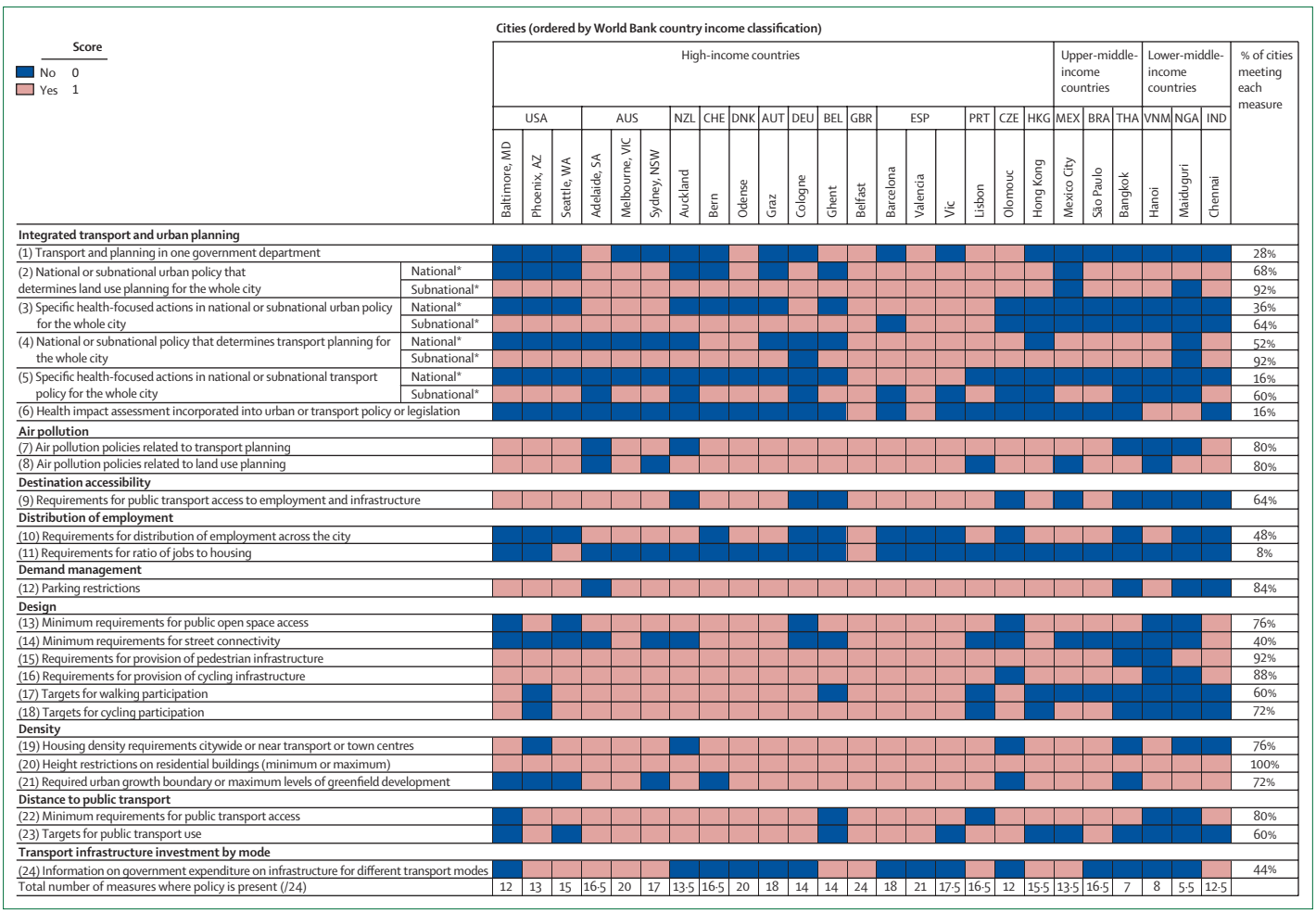

Figure 1: **Presence of key city planning policies associated with health**
AUS=Australia. NZL=New Zealand. CHE=Switzerland. DNK=Denmark. AUT=Austria. DEU=Germany. BEL=Belgium. GBR=United Kingdom. ESP=Spain. PRT=Portugal. CZE=Czech Republic. HKG=Hong Kong. MEX=Mexico. BRA=Brazil. THA=Thailand. VNM=Vietnam. NGA=Nigeria. IND=India. *National and subnational policies were treated as separate components of these measures, so were each scored out of 0·5.

at birth was higher in the studied HICs (79–85 years) than in the upper-middle-income countries (75–77 years) and lower-middle-income countries (55–75 years).[41] Non-communicable diseases accounted for most deaths in all countries, except for Nigeria.[42] Urban area size varied widely, as did population, from 20 216 501 people in Mexico City (Mexico) to 43 813 in Vic (Spain).[43]

Overall policy indicator scores

Policy frameworks across the cities varied substantially, in both policy presence (figure 1) and quality (figure 2). Belfast (UK) had a perfect score (24/24) for policy coverage across the indicator categories, with the second highest being Valencia (Spain; 21/24), then Odense (Denmark; 20/24), and Melbourne (VIC, Australia; 20/24; figure 1). Although São Paulo (Brazil) did better for policy presence (16·5/24) than many cities in HICs, other middle-income country cities—Maiduguri (Nigeria; 5·5/24), Bangkok (Thailand; 7/24), and Hanoi (Vietnam; 8/24)—had the largest policy gaps. Greater absence of policies for healthy and sustainable cities in some middle-income countries could indicate competing development priorities, governance limitations, or less transparency (ie, fewer publicly available policy documents) relative to HICs.

For policy quality, Valencia (42/57), Graz (Austria; 41/57), and Belfast (39/57) scored highest for being specific, measurable, and consistent with international evidence on planning healthy cities (figure 2). Baltimore (MD, USA), had a much lower score (5·5/57) than other cities in HICs. Other cities that had low scores for policy quality were in middle-income countries: Bangkok (3/57), Maiduguri (6/57), and Hanoi (8/57). Although most policies were consistent with public-health evidence (figure 2; appendix pp 11–12), most were stated as aspirations or aims, without measurable targets to guide implementation. Despite Belfast's high score overall, it had only one measurable policy target (public open space access). Except for São Paulo (30/57), cities in

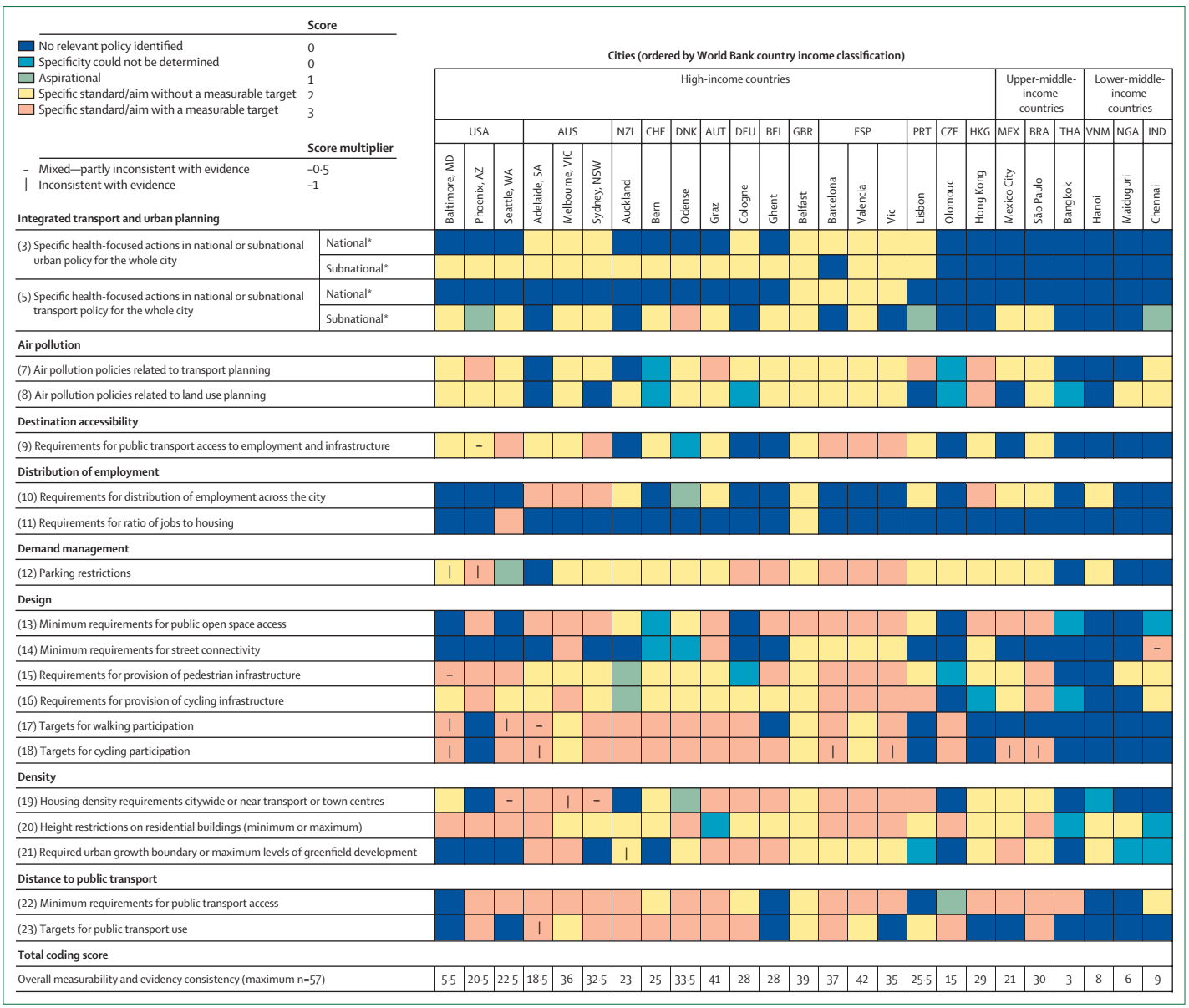

Figure 2: **Presence of measurable and evidence-consistent city planning policies associated with health**
Separate measures are listed in the table. AUS=Australia. NZL=New Zealand. CHE=Switzerland. DNK=Denmark. AUT=Austria. DEU=Germany. BEL=Belgium. GBR=United Kingdom. ESP=Spain. PRT=Portugal. CZE=Czech Republic. HKG=Hong Kong. MEX=Mexico. BRA=Brazil. THA=Thailand. VNM=Vietnam. NGA=Nigeria. IND=India. *National and subnational policies were treated as separate components of these measures, so scores are divided by two (out of -1·5 or 1·5 each).

middle-income countries had few measurable policy targets. Bangkok was found to have only one specific policy target (public transport access requirements).

Integrated transport and urban planning

The 25 cities had diverse and often multilayered governance contexts. In three-quarters of the cities, two or more levels of government (national, state or regional, metropolitan, and local) were involved in city planning, highlighting the importance of vertical policy integration (figure 1). 18 cities (72%) had separate land use planning and transport planning departments in the level of government responsible for most of the metropolitan area. Although separate departments are not necessarily a barrier to integrated planning, this pattern showed the importance of creating an authorising environment for horizontally integrated planning.[21,23,47] Metropolitan-wide integrated planning is crucial, regardless of any administrative subregions within a city. Cologne (Germany), and Maiduguri were the only two cities that appeared not to have a metropolitan-wide transport planning policy, and Mexico City did not have a

whole-city land use planning policy. As advocated in the New Urban Agenda, national urban policy has a crucial coordinating role "to support the alignment of different sectoral policies and ensure all the policies that affect urban areas are coherent in support of cities and the people that live in them."[48] Only 13 of the 19 countries studied had national urban policies (figure 1).

Stating health as an explicit city planning goal can highlight its importance.[23] Notably, only the UK (Belfast)and Spain (Barcelona, Valencia, and Vic) had explicit health-focused actions in national transport policy. Of the 25 cities, health-focused actions were included in 15 cities' (60%) subnational transport policies and in 16 cities' (64%) subnational urban policies. None of the studied cities in middle-income countries had explicit health goals or rationales when outlining actions in metropolitan-wide urban policy. Only four cities (16%) had requirements for health impact assessments, a decision-support tool that models the probable effects of city planning policy on health determinants (figure 1).[24]

Air pollution

Our air pollution indicators focused on pollution from land use and transport rather than other sources (eg, industry).[5] Because land use and transport planning have different consequences for air pollution,[49,50] we assessed these policy aspects separately. Although most cities (80%) had broad policy aims to limit air pollution via land use and transport planning (figure 1), only one city (Hong Kong) reported a measurable target for air pollution from land use (figure 2). Four cities in HICs (Phoenix, AZ, USA; Graz; Lisbon, Portugal; and Hong Kong) had targets for transport controls against air pollution (figure 2; eg, Graz had a policy of prohibiting old trucks and 80 km/h speed limits on highways with polluted air).

Destination accessibility

Destination accessibility requires integrated planning at the regional scale,[5] and helps to establish whether urban residents can equitably reach employment and essential services by public transport. It is shaped by a range of urban design and transport features. Although 16 cities (64%) had policy requirements for public transport access to employment and essential infrastructure, only five (Seattle, WA, USA; Sydney, NSW, Australia; and Barcelona, Valencia, and Vic) had measurable targets (figure 2), which were focused mainly on jobs or infrastructure being within a specified travel time or distance from a public transport stop. For example, Sydney had a target for being a 30-min city, "where people can conveniently access jobs and services within 30 minutes by public or active transport, 7 days a week."[51] Phoenix's destination accessibility policy included an emphasis on freeway access, which is inconsistent with healthy city planning evidence.

Distribution of employment

The spatial distribution of employment influences commuting distances and the potential to use active transport modes.[5] 12 cities (48%) had policies requiring employment distribution across the city, but only four (Melbourne, Sydney, and Adelaide, SA, Australia; and Hong Kong) were measurable (figure 2). The ratio of jobs to housing is a specific way of measuring employment distribution, and is associated with active travel.[52] Only two cities had a specified jobs to housing ratio and only Seattle had measurable targets (eg, 50 jobs and 15 households per acre in urban centres).[53] Given our focus on formal government policy, the indicators did not address the informal employment sector, which makes up a substantial proportion of jobs in LMICs.[20]

Demand management

Managing the demand for car travel influences the appeal of driving relative to other transport modes, with consequences for health.[5] We focused on one important aspect of demand management: car parking controls. Although 21 cities (84%) had policies for car parking restrictions, only six (Phoenix; Cologne; Ghent, Belgium; and Barcelona, Valencia, and Vic) included measurable targets (figure 2). Policies for Baltimore and Phoenix were inconsistent with healthy cities evidence, as they supported plentiful parking availability. Car driving demand is also influenced by determinants of active and public transport measured by our other indicators, and factors not measured in this study, such as road pricing, traffic controls, and tree canopy cover.[54]

Design

Urban design strategies can create walking-friendly and cycling-friendly neighbourhoods with accessible public open spaces,[5,55] which are associated with reduced non-communicable disease risk.[7,8] Making environments convenient and safe for walking and cycling is a crucial equity consideration in LMICs where poverty, socio-economic inequalities, and the cost of car ownership make active or multimodal transport a necessity.[34] Design measures included policy requirements for street connectivity, pedestrian and cycling infrastructure, access to public open spaces (including parks), and participation targets for walking and cycling (eg, percentage mode share). For this indicator, Bangkok, Hanoi, and Maiduguri had the most substantial policy gaps. Although most studied cities had requirements for pedestrian (92%) and cycling infrastructure (88%), only eight (32%) cities had measurable targets for pedestrian infrastructure, and seven (28%) had cycling infrastructure targets (figure 2). Baltimore's target for provision of two-way footpaths on state-owned roadways was too low for encouraging walking. Due to low policy ambition, six cities (24%) had cycling participation targets that were inconsistent with healthy cities

evidence, as did three cities (12%) for walking targets. For example, Baltimore's targets for both walking and cycling were inconsistent with evidence, with the aim to "increase bicycle/walk-to-work mode share to 5·0% by 2040".[56] By contrast, Odense was an exemplar of cycling targets (45% of work trips by 2028).[57] Street connectivity is a key element of walkability. Ten cities (40%) had specific street connectivity requirements, but only three (12%) had measurable targets. Chennai's (India) target[58] of at least 80 intersections per km² fell short of the 100 intersections per km² threshold to optimise walking outcomes, identified in the second paper in this Series by Cerin and colleagues.[59] Melbourne had connectivity targets for street block sizes and Graz for footpath grid sizes.

Most studied cities (76%) had minimum requirements for access to public open space (figure 1). 13 (52%) had measurable policy targets with diverse requirements based on the amount of open space per unit of population, net increases in the number of parks, or distances to open space from residences (table 2). The most common distance benchmark was 400 m from dwellings to public open space. This threshold is broadly consistent with evidence on encouraging walking,[71,72] although access to larger parks could also be important,[73] and different walking speeds and abilities should be considered.

Density

Sufficient density of dwellings and population is crucial for walkability because it determines the viability of local destinations and adequate public transport services.[74] However, as examined by Cerin and colleagues[59] in the second paper in this Series, and supported by other research,[75–77] densities in some cities in LMICs exceed optimal thresholds for walking. Our density policy measures included dwelling density requirements, building height restrictions, and urban growth boundaries or maximum levels of greenfield development. Most cities (76%) had citywide dwelling density requirements or requirements near transport or town centres (table 2), but these varied widely in ambition, which might partly reflect differences in baseline population densities. Measurable density targets for Seattle, Melbourne, and Sydney were inconsistent with evidence, as they were too low to support walkability.[78] For example, Melbourne's target was to increase density in growth areas to more than 20 dwellings per hectare.[79] At least 25 dwellings per hectare are needed to generate population densities that support walking[59] and the creation of sustainable 15 min or 20 min cities.[80]

All cities had building height aims, with specifications often varying across land use zones. Without detailed knowledge of the application of land use zoning, it was difficult to assess the potential effects of building height restrictions on local walking. Although 18 cities (72%) aimed to contain urban growth, only six (24%) had measurable limits on new greenfield housing developments (figure 2).

Distance to public transport

Easy access to frequent public transport is a key determinant of healthy and sustainable transport systems.[24] Accessible public transport near housing and employment increases the mode share of public transport trips, therefore encouraging transport-related walking; improving access to regional jobs and services;

	Measurable targets			Specific standards or aims without a measurable target	Aspirational or non-specific
	First example	Second example	Third example		
Measure 13: minimum requirements for public open space access	Hong Kong:[60] minimum of 20 hectares of open space (including 10 hectares of local open space and 10 hectares of district open space) for every 100 000 people.	Ghent, Belgium:[61] district parks should be closer than 400 m from each house and >1 hectare; minimum requirement of 10 m² public open green space per inhabitant	Mexico City, Mexico:[62] a minimum of 12 m² of public space per inhabitant	Melbourne, VIC, Australia:[63]* provide additional small local parks or public squares in activity centres and higher-density residential areas	..
Measure 19: housing density requirements citywide or near transport or town centres	Barcelona, Valencia, and Vic, Spain:[64] minimum housing density of >80 houses per hectare for new developments; desirable housing density of >100 houses per hectare	Adelaide, SA, Australia:[65] increase average gross density within activity centres and transit corridor catchments from 15–25 to 35 dwellings per hectare	Seattle, WA, USA:[53] an overall residential density of 15 households per acre in urban centres	Belfast, UK:[66] increase housing density without town cramming, higher-density housing developments should be promoted in town and city centres and in other locations that benefit from high accessibility to public transport facilities	Odense, Denmark:[57] the new transformation areas must be created with a specific identity and on a scale that suits the areas and the adjacent city
Measure 22: minimum requirements for public transport access	Auckland, New Zealand:[67] 95% of the population should be within 500 m of a public transport stop (within the serviced community) in 2021; 42% of the population should be within 500 m of rapid, frequent, or both rapid and frequent network stops in 2021	Sydney, NSW, Australia:[68] on weekdays, 90% of households should be within 400 m (as the crow flies) of a bus stop, ferry wharf, light rail station, or train station between 0600 h and 2200 h	São Paulo, Brazil:[69] implement 150 km of bus lanes every 4 years, with a total of 600 km by 2028, and 34 more bus terminals by 2024	Chennai, India:[58] provide bus shelters, rapid transit stations, or both at key destinations and at frequent intervals	Olomouc, Czech Republic:[70] increase the attractiveness and speed of public transport, ensuring its reliability

*City also has a measurable policy target.

Table 2: **Examples of policy statements that are consistent with the evidence, but with differing specificity and measurability**

***Panel*: Call to action**

We urge the UN and WHO to:
- Formally recommend that their affiliated countries use the present policy indicators and adopt a health-in-all-policies approach to city planning
- Provide frameworks and financial support, especially for low-income and middle-income countries (LMICs), to build capacity for integrated city planning across sectors and levels of government
- Lead the way in promoting policies that advance the New Urban Agenda to prevent cities and countries from committing to unhealthy and unsustainable urban systems
- Support development of policy briefs, checklists, scorecards, or an observatory of city planning indicators, to assess and monitor progress towards equitable, healthy, and sustainable cities

We urge governments responsible for city planning to:
- Use the present policy indicators to develop health-enhancing, actionable, and measurable city planning policies
- Close gaps in policy frameworks to ensure comprehensive and integrated planning for healthy and sustainable cities
- Revise policies that are contrary to the evidence on planning healthy and sustainable cities
- Include evidence-informed standards and targets in city planning policies, to aid both implementation and accountability

We urge governments of LMICs to:
- Urgently consider strategies to build capacity for health-enhancing city planning policies and governance
- Make all city planning policies publicly available for use by health, sustainability, and equity researchers and advocates

We urge researchers to:
- Collaborate closely with policy makers to codesign policy-relevant studies, including determining optimal policy thresholds for urban design and transport features, and testing how well city planning policies are being developed and implemented
- Collaborate with policy makers to evaluate the costs, consequences, and economic benefits of policies designed to support health and sustainability
- Further develop and evaluate the present policy analysis approach, paying special attention to adaptations needed for LMICs

delivering benefits for health, economic development, and social inclusiveness; and reducing pollution and carbon emissions.[52,81] 20 cities (80%) had minimum requirements for public transport access, with 15 (60%) having measurable targets (figure 2). Although the targets were diverse, they were typically stated in terms of public transport stop distances or active travel times from homes (table 2). Policy targets for Seattle, Adelaide, Sydney, Auckland (New Zealand), and São Paulo also mentioned transport speed or service frequency—stronger predictors of walking for transport than stop proximity alone.[30] Only 11 of the studied cities (44%) had measurable targets for public transport use (eg, percentage mode share). Adelaide's target (18% of work trips by public transport, walking, or cycling by 2045)[65] was too low to be consistent with evidence on healthy cities. None of the three studied cities in lower-middle income countries had measurable targets for public transport access or use.

Transport infrastructure investment by mode

Transport investment data can indicate the degree to which governments prioritise public and active transport relative to car-focused infrastructure.[5] Information on government expenditure for different transport modes was identified for only 11 cities (44%; figure 1), suggesting inadequate transparency in expenditure data. Policies promoting active and public transport were not reflected in transport investments. Only Mexico City and Seattle reported greater investment in public and active transport combined, than in road infrastructure. Four cities (Phoenix, Adelaide and Melbourne, and Hong Kong) prioritised investment in roads for cars. Data on all transport modes was unavailable for five cities.

Opportunities to strengthen policy for healthy, sustainable cities

Closing policy gaps to support integrated planning

Our findings show the need to transform policy frameworks to achieve the goal of healthy, sustainable, and equitable cities (panel).[2,25] Many cities did not have policies important for health and sustainability, especially policies related to street connectivity, employment distribution, health impact assessments, health-focused national transport policy, and investment in active and public transport (figure 1). Belfast was the only city that had complete policy coverage across the indicators, yet—like many other cities—had few measurable targets to achieve its ambitions. Absent or deficient policies could be symptomatic of insufficient integrated planning, impeding the delivery of the full suite of transport and urban design features needed for healthy and sustainable cities.[21,82] However, existing policies might have been overlooked, even though local experts aided in systematic and consistent data collection. Also, since our study was done, some policy gaps and limitations might have been addressed.

Evidence-informed policy targets

The studied cities were mainly united in their rhetoric to be healthy and sustainable, with most—although not all—policy statements aligned with evidence on health-promoting cities (figure 2; appendix pp 11–12). Justice and equity aims, which are essential for reducing health inequities,[83] were prominent in many city planning policies.

However, most cities did not have the policy detail needed to achieve their ambitions. Measurable policy targets for urban design and transport features were often absent (figure 2), which makes it difficult to monitor policy implementation and hold governments accountable.[27] Cities in middle-income countries generally had fewer specific and measurable policies than those in HICs (although Baltimore did have relatively deficient policies), pointing to a particular need to improve policies in middle-income countries. São Paulo was a positive outlier among studied cities in

middle-income countries, outperforming many cities in HICs on policy presence and quality, making it a positive example for other middle-income countries. Although policy implementation requires further study, in the third paper in this Series, Boeing and colleagues[46] show that São Paulo's policies might be translating into better real-world, spatial outcomes relative to some other cities in middle-income countries.

Where cities did have policy targets, thresholds were diverse, with little justification or explanation for their selection. Some cities had policy targets that were contrary to the evidence on health-enhancing city planning (eg, three for Adelaide and Baltimore, and two for Seattle), which sets up policy barriers to creating healthy, sustainable cities. Unambitious active transport targets, and targets supporting car use, undermine efforts to increase physical activity,[84,85] improve air quality, and reduce carbon emissions.[86] Consistent with our findings that some policies favoured car use in Australian and US cities, Boeing and colleagues[46] found that these cities had relatively poor walkability. These findings suggest that flawed policy might be more detrimental than an absence of policy supporting walkability.

Absence of policy targets could be due to insufficient research on the thresholds required for city planning to support health-enhancing behaviours. In the second paper in this Series, Cerin and colleagues[59] provide evidence-informed thresholds for several urban design and transport features to optimise walking and physical activity, which could inform future policy targets. Notably, few of the policy targets across the 25 cities were similar or consistent with these thresholds. The widespread adoption of evidence-informed thresholds could facilitate progress towards attaining the UN SDGs.

Strengthening and monitoring government policy

The policy indicators we measured in 25 cities are useful for benchmarking and monitoring progress towards the achievement of integrated city planning that prioritises and delivers health and sustainability outcomes. For example, comparisons between cities could help civil society to advocate for reform and give policy makers the evidence needed to target policy gaps. Policy insights could be shared with peers and through relevant research-practice networks (eg, the International Urban Development Association). This type of collaboration could accelerate the pace at which cities in regions, countries, and globally collectively reach urban health and sustainability targets. Our results underscore the urgent need to build urban policy capacity in LMICs, which is a crucial role of international organisations such as the UN and WHO.

Planning healthy and sustainable cities requires strong governance, intersectoral collaboration, systems thinking, and equity-driven practices.[20,87–89] Greater collaboration across public health and all city planning sectors and government departments could highlight the multisectoral cobenefits of healthy cities. For example, policies to encourage walking and cycling produce health, environmental, and economic benefits, due to increased physical activity, reduced air and noise pollution, and decreased carbon emissions.[90] Land use and zoning codes that favour mixed-use developments can also increase property values, reduce car dependency, foster a sense of community, and boost local economies.[91] Vertically and horizontally integrated planning should be championed by public health ministers and agencies.[47]

Policies are only as good as their implementation, so cities must implement policies that improve the upstream determinants of human and planetary health and monitor their progress.[33] Policy is often not mandatory, and political leadership changes can also result in incomplete or delayed implementation. Governments should, wherever possible, use the power of transport and planning law to strengthen the implementation of integrated planning, and support health equity.[87,92] In the third paper in this Series, Boeing and colleagues[46] show limitations and inequities in provision of urban design and transport features, indicating areas that require additional attention in policy development or implementation.

Policy-relevant research

We showed the feasibility of systematically assessing evidence-informed policy indicators for diverse cities. By using an international network of collaborators with expertise in healthy cities and local knowledge of policy contexts, we generated policy-relevant findings for 25 cities.

Our findings point the way to further research. Building on the second paper in this Series,[59] optimal thresholds need to be established for all policy areas and interventions identified as important[93] to aid policy development and evaluation.[94] We did not examine policy implementation nor whether and how governments track performance against policy targets, so another crucial research area is to explore—through natural experiment studies—the extent,[26,95] timing, equity, monitoring, and costs of policy implementation. Expenditure on specific policy actions could be studied beyond our examination of transport infrastructure investments. Boeing and colleagues[46] show how spatial indicators can be used to monitor the delivery of urban design and transport features. Multisite prospective studies could evaluate whether the policy indicators assessed here are associated with outcomes, such as active transport use, health equity, air quality, and carbon emissions.

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A limitation of the present study was its focus on metropolitan-level policies. Comprehensive assessments of local, regional, state, national, and supranational policies are needed to better understand policy contexts and their variation within and between countries. Existing national-level policy assessments related to health, environment, and physical activity could be combined with city-level assessments.[27,96] Examining differences in

political structures, administration, and policymaking processes between cities, countries, and world regions, and their implications for integrated planning, would advance the recommended transformation of city governance.[31] Additional policy aspects important for health could be assessed in future research, including housing diversity and affordability, traffic controls, access to education and health services, accessibility of transport for people of different ages and abilities, and urban design for crime prevention.[5]

Our indicators were largely based on evidence derived from HICs, and our convenience sampling resulted in most of our included cities also being in HICs. Some issues that are pertinent to LMICs were not covered, such as particular forms of local transport (eg, private taxis and informal collective transport options),[5] overcrowded housing, public safety, and basic infrastructure provision. Nonetheless, the inclusion of six cities in middle-income countries, including two Latin American, one African, and three Asian cities, provides valuable insights. As a proof of concept, our methods can be expanded and used in more cities worldwide, especially in low-income countries. To achieve global research equity and understand the status of urban health and sustainability policies in LMICs, investment in building partnerships, developing data infrastructure, and supporting capacity building in LMICs is urgently needed.[17,34]

To aid the reproducibility of the study and future use of the indicators, full details of the data collection and coding method are provided in the appendix (pp 1–10). Differences in the suitability of the policy analysis methods between cities and countries should be explored and local adaptations made as needed. Periodically repeating assessments would help to monitor changes, including urban policy innovations in response to emergent threats such as the COVID-19 pandemic.[97,98]

To produce real-world benefits, researchers should work closely with policy makers to codesign policy-relevant studies. Presenting findings in user-friendly ways supports research translation[99] and civil society's advocacy towards improving city planning policy.[87] The authors of this Series are creating city-specific policy briefs, scorecards, and checklists, and are supporting collaborators in each city to present findings to local policy makers.

Conclusion

We analysed policies in 25 diverse cities, using evidence-informed policy indicators for planning healthy cities. Our approach enabled comparisons between cities and identified specific policy gaps and limitations that should be addressed in each city. City planning policies have a crucial role in preserving or damaging health and sustainability. Actions that result from policies can mitigate health inequities and decrease the number of premature deaths caused by traffic fatalities, inactive lifestyles, air pollution, and related environmental exposures.[5] Governments face the risk of committing to unhealthy and unsustainable urban systems if policy makers do not consider the health, social, and environmental consequences of their policies. Our findings complement the other papers in this Series,[46,59,93] which offer guidance on priority interventions and policy thresholds to assist evidence-informed city planning for health and sustainability. We encourage further application of the policy indicators used here, continued research to evaluate and refine the methods, and systematic policy assessments by organisations advocating for healthy and sustainable cities.

Contributors

ML and DA led the study design, data collection, data analysis, data verification and interpretation, data visualisation, writing of the original draft, and review and editing. ML, DA, JFS, DS, EC, AVM, CH, EH, JA, GB, and SL were part of the study executive team. ML, DA, JFS, DS, EC, AVM, CH, EH, JA, GB, SL, and BG-C contributed to conceptualisation. JFS, DS, EC, AVM, CH, EH, JA, GB, SL, and BC-G contributed to study design. JFS, DS, EC, EH, JA, and BC-G contributed to data collection. JFS, DS, EC, AVM, CH, EH, PM, and BG-C contributed to data interpretation. JFS, DS, EC, CH, EH, PM, and BG-C contributed to data visualisation. JFS, DS, EC, AVM, CH, and BG-C contributed to the writing of the original draft and reviewing and editing of the paper. KG, AP-R, PBM, TB, JC, JD, AAF, TPH, HH, RFH, P-CL, JM-G, KN, ALO, CDGR, ER, JT, and FW collected and verified data for one or more cities. EH, JA, GB, SL, PM, KG, AP-R, PBM, TB, JC, JD, AAF, TPH, HH, RFH, P-CL, JM-G, KN, ALO, CDGR, ER, JT, and FW reviewed and edited the paper. BG-C led the study executive team.

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PLANNING FOR HEALTHY COMMUNITIES POSITION STATEMENT

11 May 2016

NATIONAL POLICY POSITION STATEMENT

PIA POSITION

RATIONALE

The Planning Institute of Australia knows that planners play a key role in shaping the built environment. Given the evidence that clearly links the built environment to wellbeing, planners are in a position to positively influence the health of our communities.

The planning profession evolved from the need to improve the health and wellbeing of urban populations. At the turn of the 20th century, contagious disease was a major concern in overcrowded and unsanitary housing. Authorities installed sewerage systems, provided uncontaminated water supplies and collected rubbish. Concurrently with improved transport systems, town planners advocated for city design that separated housing from highly polluting industrial land uses. Together with the increasing availability of the motor car, this design philosophy has fundamentally shaped our cities. Suburban growth and long distances from home to the places we need to access everyday (work, school, shops, recreation and services), have ensured our reliance on the automobile.

Today our lives are largely sedentary which is a major risk factor for chronic disease. The World Health Organization (WHO) has advised that physical inactivity is the fourth leading risk factor for global mortality (6% of deaths globally) and is also a major contributor to the epidemic of overweight and obesity.[1]

Planners and urban designers need to creatively and collectively address the sedentary lifestyle of our communities. This is critical if we are to curb increasing rates of chronic health problems such as cardiovascular disease, diabetes and cancer. Planners and urban designers also need to consider measures to address social isolation that can contribute to depression and related mental ill-health.

ABOUT THE ISSUE

There is a growing body of evidence that clearly demonstrates the link between healthy communities and the planning, design and management of the built environment.

Through advocacy, legislation, policy, strategy, design, review and approval, planners can assist in creating health supportive places. These will reduce sedentary behaviours by supporting physical activity, improve access to healthy food, and create safe environments that prevent injury and encourage social activity, improving community belonging and integration.

[1] In 2011-12, 10.8 million Australian adults were either overweight or obese, and of these 4.7 million were obese: National Health Performance Authority, 2013

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PLANNING FOR HEALTHY COMMUNITIES POSITION STATEMENT

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Design changes to the built environment can result in increased levels of physical activity. Connected movement networks; efficient, convenient and safe public transport, cycling and walking opportunities; greater land use diversity; and access to a variety of quality public open spaces: all can have a measurable impact on activity levels which improve health.

Eating healthy food also has a significant impact on the health and wellbeing of individuals, society and the natural environment. Growing healthy food, in private or community gardens for local consumption has the potential to improve individual and public health outcomes and decrease health care costs.

Healthy communities enjoy a 'virtuous circle' marked by good nutrition, regular and enjoyable exercise, the use of active transport, health-conscious work places, affordable access to health care services and recreational opportunities in appropriate places, including easy-to-access green open space, and regular community interaction.

PIA members are keen to raise the bar in both new developments and redevelopment projects that create the physical spaces and opportunities that enable healthy communities to thrive.

PLANNING PRINCIPLES

In addition to PIA's Planning System principles,[2] the following principles should guide planning for healthy communities in new settlements and suburbs, and through the redesign and renewal of established communities:

- Provide long term leadership in advocating for the planning, design and adaptation of built environments that encourage and support active living;
- Adopt multi-disciplinary and collaborative practices working alongside other built environment and health professionals;
- Aim to reduce sedentary lifestyles to combat obesity by providing a variety of accessible, high quality and diverse open spaces including green natural areas;
- Facilitate an increased proportion of journeys by active transport (such as cycling and walking) to improve both physical activity levels and create a more sustainable environment;
- Better connect communities to ensure accessibility to health care and other community services, community groups and social networks;
- Improve the community's sense of belonging and reduce social isolation by designing spaces that enable day-to-day interaction with people and natural environments.
- Create shared places on local streets and in public spaces that are safe, accessible to all, respond to the local cultural and demographic context, and are aesthetically pleasing.

[2] See: www.planning.org.au/documents/item/5859

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PIA'S PREFERRED APPROACH

PIA SUPPORTS:

Leadership

- Planners contributing to improving community health and wellbeing by encouraging and supporting built and natural environments that promote physical activity, healthy eating, and social and mental wellbeing.
- Consideration of health perspectives throughout all phases of the planning process including policy and strategy formation, initial design, permit assessment, and approval.
- State and Territory Government planning legislation and policy frameworks including the health and wellbeing of the community as integral objectives and outcomes of the planning process.
- Planning Ministers across Australia being encouraged to take on a leadership role within government to advocate the economic, social and environmental benefits of planning for healthy communities.

Education

- Review university planning and urban design curricula to ensure students are being taught the benefits of shaping healthy communities via interdisciplinary planning and design processes informed by the health sector.
- Champion change in the development industry by educating the private sector on the benefits of healthy communities via National, State and locally based, PIA run or endorsed, professional development programs.
- Take a proactive role in the preparation of planning documentation that educates and informs planners, urban designers, state and local government agencies, political decision makers, and the community about the benefits of planning for healthy communities.

Collaboration and partnership

- Collaborations with health professionals (including burden-of-disease epidemiologists and health promotion officers), economists, community leaders, engineers, architects, landscape architects, property developers, and approval agencies to study, understand and promote the co-benefits of planning for healthy communities across multiple sectors. This collaboration should acknowledge the economic, environmental and social co-benefits of planning for health and wellbeing.
- Collaborations with state governments, service agencies, and aligned organisations, such as the National Heart Foundation, to educate the community about the importance of healthy community outcomes in planning processes and decisions.

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Evidence-Based

- Evidence based research that enables planners and urban designers to effectively demonstrate the value of healthy communities to a wide audience.

Community engagement

- Include community engagement in the planning and design process to ensure that planning initiatives and solutions are locally responsive, effective, and relevant to the end users.

REFERENCES AND RESOURCES

Links to other PIA policies

Planning System principles (07/13)
http://www.planning.org.au/policy/planning-systems-principles-0713

What is good planning? (09/13)
http://www.planning.org.au/policy/what is good planning-0913

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Healthy Active by Design (WA)

Healthy Spaces and Places- http://www.planning.org.au/policy/healthy-spaces-and-places-2

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New York City Active Design Guidelines – http://www1.nyc.gov/site/ddc/about/active-design.page

Victorian guidelines – https://www.betterhealth.vic.gov.au/health/healthyliving/gardens-for-all-a-health-activity

Healthy Built Environment Indicators – https://cityfutures.be.unsw.edu.au/research/city-wellbeing/

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Urban design, transport, and health 4

What next? Expanding our view of city planning and global health, and implementing and monitoring evidence-informed policy

Billie Giles-Corti, Anne Vernez Moudon, Melanie Lowe, Ester Cerin, Geoff Boeing, Howard Frumkin, Deborah Salvo, Sarah Foster, Alexandra Kleeman, Sarah Bekessy, Thiago Hérick de Sá, Mark Nieuwenhuijsen, Carl Higgs, Erica Hinckson, Deepti Adlakha, Jonathan Arundel, Shiqin Liu, Adewale L Oyeyemi, Kornsupha Nitvimol, James F Sallis

This Series on urban design, transport, and health aimed to facilitate development of a global system of health-related policy and spatial indicators to assess achievements and deficiencies in urban and transport policies and features. This final paper in the Series summarises key findings, considers what to do next, and outlines urgent key actions. Our study of 25 cities in 19 countries found that, despite many well intentioned policies, few cities had measurable standards and policy targets to achieve healthy and sustainable cities. Available standards and targets were often insufficient to promote health and wellbeing, and health-supportive urban design and transport features were often inadequate or inequitably distributed. City planning decisions affect human and planetary health and amplify city vulnerabilities, as the COVID-19 pandemic has highlighted. Hence, we offer an expanded framework of pathways through which city planning affects health, incorporating 11 integrated urban system policies and 11 integrated urban and transport interventions addressing current and emerging issues. Our call to action recommends widespread uptake and further development of our methods and open-source tools to create upstream policy and spatial indicators to benchmark and track progress; unmask spatial inequities; inform interventions and investments; and accelerate transitions to net zero, healthy, and sustainable cities.

Lancet Glob Health 2022; 10: e919–26

See **Comment** pages e782, e786, e788, and e790

This is the fourth in a **Series** of four papers about urban design, transport, and health

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Introduction

Cities are powerhouses of the economy, providing access to employment, opportunities, and resources. Yet when poorly planned, cities foster unhealthy and unsustainable lifestyles, expose residents to environmental stressors (such as traffic; air, noise, and nocturnal light pollution; and heat), and exacerbate inequities in access to infrastructure and resources.[1,2] By 2050, around 70% of the world's population is projected to live in cities.[1] Cities generate 75% of global energy-related greenhouse gas emissions, with 24% of global emissions coming from road transport,[2] and urbanisation is a major cause of biodiversity loss.[3] High-income and upper-middle-income countries emit 86% of global CO_2 emissions.[4]

In the coming decades, city planning decisions will profoundly affect human and planetary health. In the first *Lancet* Series (Series 1) on urban design, transport, and health, we argued that cities should prioritise urban and transport policies and interventions that enable walking, cycling, and public transport, and we proposed a set of city planning indicators that could be used to benchmark and monitor progress.[1] The principal aim of the second Series (Series 2) was to facilitate development of a global system of health-related policy and spatial indicators that could assess achievements and deficiencies in urban and transport policies and features.

This final paper in Series 2 summarises key findings, considers what to do next, and outlines urgent key actions. City planning issues are often considered in silos (eg, focused either on transportation or urban planning or biodiversity), rather than in one comprehensive framework to achieve better outcomes for cities through integrated city planning. Transport, land use, green space, and infrastructure research and planning are typically undertaken by different disciplines, policies are devised by different government departments, and interventions are implemented by different sectors. In this final paper, we argue that to transition to healthy and sustainable cities there is an urgent need to rethink this siloed approach in favour of interdisciplinary research and cross-sector, integrated policy and practice.

Key findings of Series 2

The selection of policies and spatial indicators studied in Series 2 was based on the eight regional and local urban design intervention foci (the 8Ds) identified in Series 1 (figure),[1] which combine to create compact, walkable cities that support sustainable mobility. Compact, walkable cities affect individual, social, and environmental risk exposures and reduce non-communicable diseases (NCDs) and road trauma. The 8Ds are: destination accessibility, distribution of employment, demand management, design of movement networks, density, distance to public transport, diversity of housing and land uses, and desirability of active modes.[1] In 25 case study cities across 19 countries, Series 2 assessed the presence and quality of city planning policies that support the 8Ds,[5] and developed spatial indicators to measure access to urban design and transport features that would support healthy and sustainable lifestyles.[6] Spatial indicators were

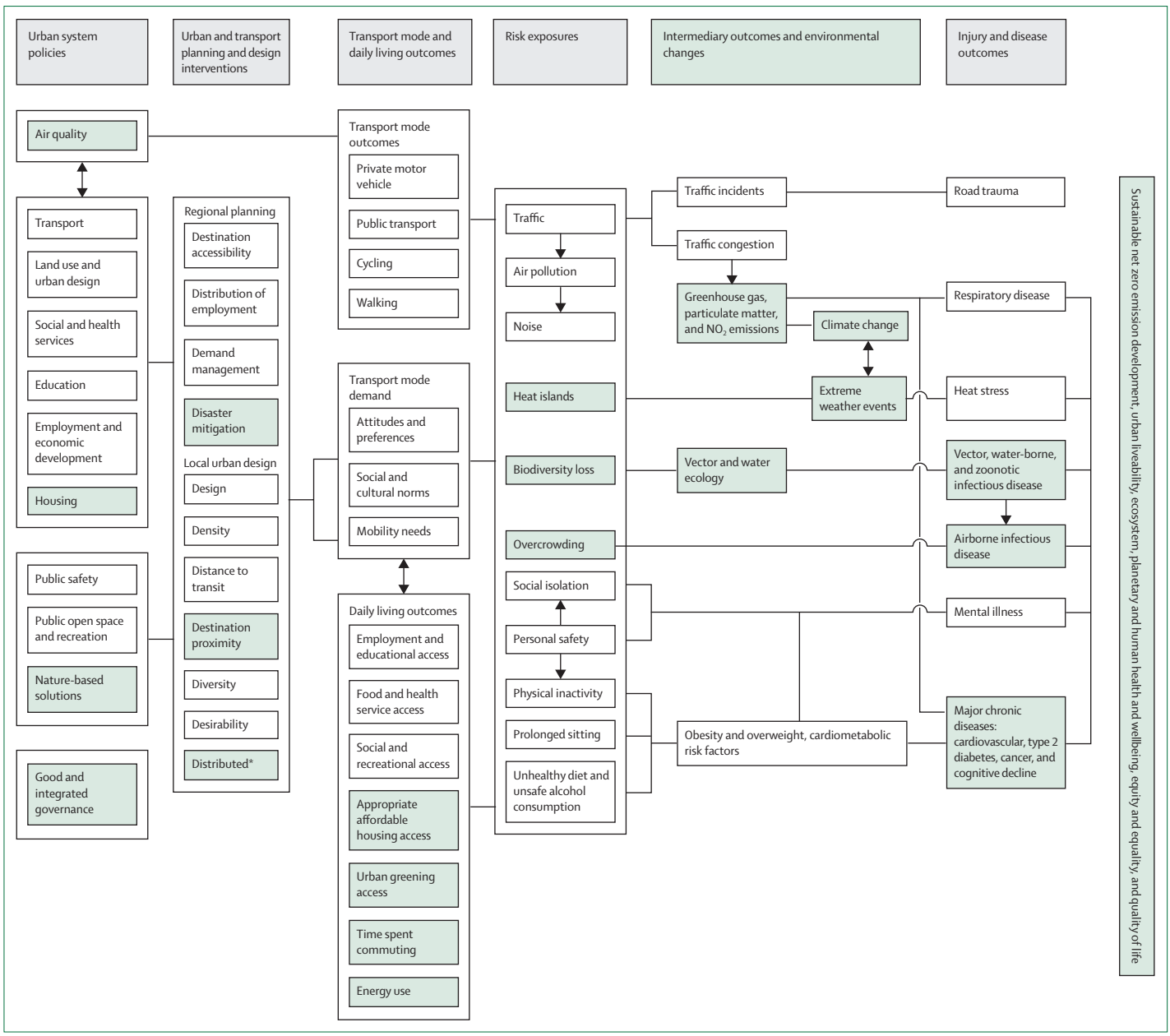

Figure: **The pathways through which urban and transport planning decisions affect health**
New and modified pathways, since 2016, are highlighted in green. *Interventions and resources accounting for age, gender, race, socioeconomic position, and area-level disadvantage.

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informed by Cerin and colleagues' study[7] of 14 cities in ten countries, identifying thresholds for reaching WHO's transport-related physical activity targets.[8]

Panel 1 summarises the main findings of Series 2. By working with local collaborators, we identified and assessed policies, and created corresponding policy and spatial indicators in cities worldwide. Data limitations were greater for cities in lower-income countries than cities in higher-income countries, which highlighted the importance of investing in partnerships and capacity building in low-income and middle-income countries (LMICs). Despite policy ambitions to create healthy and sustainable cities, we found that few cities had measurable standards and targets to achieve such aspirations.[5] This observation was reinforced by Cerin and colleagues' study,[7] which showed that, to reach WHO's physical activity targets by 2030,[8] population, transport, and intersection densities needed to be markedly different from those currently specified in many cities' policies.[5] Notably, Cerin and colleagues[7] also found upper limits for population density, beyond which the probability of walking appeared to decline. Boeing and colleagues'

***Panel 1:* Summary of the main findings from the second urban design, transport, and health Series**

- Working with a robust international network of local collaborators, we identified and measured city planning policies that lead to better health and wellbeing and developed comparable policy and spatial indicators to benchmark and monitor cities globally over time.
- Most cities did not have city planning policies to deliver healthy and sustainable cities, which was particularly evident in lower-middle-income countries.[5]
- Even when policies and standards existed, many did not have measurable targets, or fell short of thresholds for urban design and transport features that encourage healthy, active, and sustainable lifestyles.[5]
- Using comparable data from 14 cities in ten countries, we identified thresholds for urban design and transport features related to walking for achieving WHO targets for physical activity by 2030 that could inform standards and targets for city planning policies.[7]
- Compared with other neighbourhoods, urban neighbourhoods with more than 5700 people per km², approximately 100 street intersections per km², and about 25 public transport stops per km², and with proximate public parks, were associated with 80% or higher probability of walking for transport and 58% or higher probability of meeting physical activity guidelines via walking. However, unrestricted increases in population, street intersection, and public transport densities might not be desirable. We observed a decline in the probability of walking beyond about 14 000 people per km², approximately 230 street intersections per km², and about 45 public transport stops per km² in our sampled cities.[7]
- In many cities worldwide, free, editable open data sources (such as OpenStreetMap, built by volunteers) provide relatively consistent spatial data, making it feasible to create spatial indicators that can be used to benchmark, monitor, map, and compare urban design and transport features between and within cities. In some cities—particularly in low-income and middle-income countries (LMICs)—open data are not readily available. Nevertheless, momentum to create and use open data sources such as OpenStreetMap is likely to grow in the future. We created open-source tools to facilitate replication of our spatial indicators.[6] However, open data require validation by local experts.
- Both between and within cities, we found substantial inequities in access to urban design and transport features that enable healthy and sustainable lifestyles. For example, the percentage of the population with a healthy food market within a 500 m walk varied from 6% (Phoenix, AZ, USA) to 70% (Bern, Switzerland).[6]
- The percentages of the population living in local areas that meet the thresholds for population, street intersection, and public transport stop densities associated with increased physical activity through walking, and sufficient to reach WHO physical activity targets for 2030, varied substantially—both between and within cities.[6]
- Cities in LMICs tended to be more walkable than cities in the USA, Australasia, and some European countries, despite few of the cities in LMICs having policy frameworks to achieve healthy and sustainable cities. Conversely, many residents of cities in LMICs had very poor access to public open space.[6]
- Our spatial indicators and maps offer local planners insights about where and how to invest and target interventions to enable healthy and sustainable lifestyles and reduce inequities in access to health-supportive environments.
- To create healthy and sustainable cities, we recommend that cities implement comprehensive integrated policies with evidence-informed standards for implementation, to create urban and transport planning and design interventions that deliver an expanded set of 11 regional and local urban design intervention foci (11Ds).

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spatial indicators of urban design and transport features unmasked inequities within and between cities.[6] Among the cities studied, a substantial proportion of urban dwellers lived in neighbourhoods with urban design and transport features well below thresholds that support active and sustainable lifestyles, particularly in North America and Australia. Although many cities in lower-middle-income countries were walkable, many residents lacked access to public open space.

What to do next?

Since the 2016 *Lancet* urban design, transport, and health Series,[1] evidence about the effects of city planning on sustainable mobility and health has strengthened. Longitudinal evidence shows that proximate destinations and public transportation increase physical activity, and investments in active and public transport infrastructure can increase demand for walking and cycling.[9] Growing longitudinal evidence also shows that well connected, higher-density, walkable, mixed-use neighbourhoods might reduce the risk of obesity, type 2 diabetes, and hypertension. Conversely, urban sprawl might increase risk of obesity.[10] Simulation research predicts meaningful gains in road traffic safety, local air quality, and climate change mitigation resulting from increased and equitable access to active transportation and recreational opportunities in high-income, middle-income, and low-income cities, particularly when combined with bold policies to reduce car dependency.[11]

Given an ageing population globally, age-friendly city planning that reduces risk of dementia and ageing-related cognitive decline has also been called for.[12] With declining physical functionality, ageing populations rely more on their local neighbourhoods for daily living. Some evidence suggests that urban design and transport features are linked to several dementia

risk factors, including physical inactivity, depression, social isolation, obesity, diabetes, hypertension, and air pollution exposure.[13] However, the benefits of walkable neighbourhoods with mixed land uses might be offset by increases in air and noise pollution and traffic, if travel demand by car is not reduced.[14] Failure to consider traffic-related air and noise pollution might mask positive effects of proximate destinations on cognitive health, underlining the need for studies to include all inter-related environmental factors.[15]

WHO air-quality guidelines reflect the urgency for action on air pollution.[16] Cities are hotspots for air pollution, with 25% of $PM_{2·5}$ caused by vehicular transportation.[2] With no safe limit of exposure, air pollution is the fourth largest risk factor for global mortality.[17] Air pollution not only causes cardiovascular and respiratory disease and premature mortality, but might also contribute to diabetes, obesity, low birthweight, poor mental health, and impaired cognitive development.[18] Although the net health effect of walking and bicycling in polluted areas remains positive, active travel—particularly bicycling—can increase air pollution exposure.[19]

The findings of Series 2 show that there is still much to do, and cities must urgently move from evidence to action. Without comprehensive and integrated implementation of the 8Ds, human health will be harmed by car-centric planning.[1]

The urgency to act is now palpable.[20] In the face of dangers from climate change,[20] rapid urbanisation, and growing spatial, social, economic, and environmental problems, disparate sectors must work together to harness integrated city planning to protect human and planetary health.[1,2,20] Greater emphasis must be placed on anticipating and avoiding unintended consequences.[2,3] Moreover, as the COVID-19 pandemic has shown, cities must be designed to be resilient in preparation for future crises. The next section therefore considers several additional emerging issues that we recommend city planners prioritise to protect human health.

Optimising the compact city: the 11Ds

Compact cities are necessary for sustainable development—they reduce urban footprints while providing access to proximate destinations; reduce automobile dependence, travel distances, commute times, traffic congestion, and greenhouse gas emissions; and enable sustainable mobility.[1,20] However, the COVID-19 and climate crises highlight the importance of broader considerations to optimise compact city development to benefit health.

Hence, we have expanded our 2016 conceptual framework of how city planning affects health. The framework now includes 11 integrated urban systems policies that create 11 integrated urban and transport planning and design interventions. The revised framework reinforces earlier recommendations (ie, high-density housing and integrated governance) and adds two upstream urban system policies (ie, air quality and nature-based solutions) that enable downstream health-supportive interventions (figure). We have also expanded the foci of recommended urban and transport planning and design interventions from 8Ds to 11Ds. Destination proximity reflects the strengthened evidence for the importance of local destinations for walkable cities.[5–7] Disaster mitigation underscores the role played by city planning in adapting to, and mitigating, the effects of climate change. Distributed interventions and resources reinforce city planning's role in embedding equity in decision making.

COVID-19 and city planning

The COVID-19 pandemic had a rapid and catastrophic effect on cities, and spatial and socioeconomic inequities soon emerged.[21] Crowded conditions, poor air circulation, and ambient air pollution increased disease risk.[21] In some cities, the pandemic triggered migration to suburbs and rural areas, with the potential to intensify urban sprawl, encroach on natural habitats, and reduce biodiversity.[21] Other evidence suggested that amenity-rich urban density might protect residents by reducing travel distances and COVID-19 exposure and transmission,[21] although this protection is not equally shared, with less affluent populations unable to work from home.[21]

In some cities, the pandemic prompted rapid transformations that supported health. Air quality improved as teleworking reduced travel by private vehicle; road space was reallocated to enable physically distanced walking, cycling, commerce, and recreation;[21] and cycling infrastructure was fast-tracked.[21] Many city leaders have vowed to "build back better" through 15-min or car-free neighbourhoods or zero emission areas, with proximate destinations, public open space, and expanded walking and bicycle infrastructure. However, these vows will not create a healthier, fairer, and greener future unless they are maintained and expanded over time, and only if affordable and appropriate high-density housing are prioritised.

High-density housing

High-density housing underpins compact cities, making proximate destinations and high frequency public transport viable.[1] However, apartments with insufficient space, inflexible layouts, poor light, limited control over indoor air quality and temperature, and inadequate communal space might expose residents to environmental stressors (eg, insufficient daylight or natural ventilation, poor thermal comfort, and lack of visual and acoustic privacy), impede physical distancing within and between households, and reduce ease of home-based activities (eg, school, work, and exercise).[22]

The COVID-19 pandemic revealed and reinforced global inequities in housing. Densely populated low-income areas with underserviced housing were hotspots for disease spread.[23] Overcrowded dwellings—rather than housing density per se—increases disease transmission

risk,[24] highlighting the urgent need for affordable and appropriate housing.

Housing located along heavily trafficked roads or in areas with insufficient green space exposes residents to air pollution and noise,[1] and exacerbates urban heat islands. Yet, affordable, low-density housing, located on the urban fringe and poorly served by amenities and public transport, increases urban sprawl, motor vehicle dependence, and social segregation. Hence, there are calls for apartment standards based on health-supportive principles,[22] including design features that mitigate and adapt to climate change.

Mitigating and adapting to climate change in compact cities

Cities both contribute to greenhouse gas emissions and are vulnerable to the consequences of climate change, including more frequent and severe disasters (eg, floods, droughts, fire, and extreme heat), in-migration from drought-stricken rural areas, and infectious diseases.[25] Cities therefore exemplify the nexus between climate change and health, and need cross-sectoral, integrated governance and planning to reduce risks.

Although high-income countries are the primary contributors to greenhouse gas emissions, rapidly urbanising areas in LMICs are more vulnerable to disasters, with fewer resources and underdeveloped infrastructure. Low-income populations, particularly in LMICs, also suffer the harshest health, social, and economic consequences of climate-induced disasters.[26] Equity must therefore be at the forefront of urban climate mitigation and adaptation efforts, particularly given the concentrations of poverty in risk prone locations in many cities. Disaster mitigation should become an integral element of city planning, and a priority in LMICs.

Integrated city planning should prioritise mitigation strategies, including reducing direct and indirect greenhouse gas emissions by transitioning to sustainable mobility, clean renewable energy, and energy-efficient buildings. Adaptation is also essential, including reducing disaster risk through development controls in locations prone to floods and fires, improved stormwater management, urban greening (such as tree canopy cover and green roofs), and planning for large, abrupt in-migration following climate-related disasters.

Biodiversity and urban greening

Biodiversity underpins life on earth. Intact ecosystems provide services that are fundamental to human health, such as food production, clean air, quantity and quality of fresh water, and regulation of climate, pests, and disease.[27] Growing evidence suggests that more biodiverse urban greening provides greater health, wellbeing, and social benefits.[27]

Yet urban expansion—occurring at more than twice the rate of urban population growth—together with agriculture and resource mining, threatens biodiversity by polluting, degrading, and fragmenting habitat and displacing endemic species with introduced ones.[3] Nature-based solutions that harness nature's ability to regulate, restore, and regenerate resources are urgently needed. These solutions should include biodiversity-sensitive design that minimises harm from urban development, such as protecting wildlife corridors that connect green spaces, maintaining local plant populations, minimising pesticide use, and controlling non-native predators.[28]

Urban greening yields several human health benefits, such as longer life expectancy, better mental health, and improved birth outcomes and child development.[29] Well designed green spaces provide venues for social and physical activity, mitigate urban heat island effects, improve air quality, reduce noise, and sequester CO_2. WHO proposes that, for good health, green spaces of 0·5–1 hectare be located within 300 m of residences.[30] However, green space access and quality varies between and within cities. This Series' findings revealed poor access to large public open spaces in many cities in lower-middle-income countries.[6] This finding reinforces the need to prioritise equity of access within cities, particularly given that low-income neighbourhoods are commonly deprived of high-quality green space. To achieve health-supportive compact cities that mitigate and adapt to climate change, evidence-informed urban planning standards are needed for the size and proximity of biodiverse green spaces and minimum thresholds for tree canopy cover.

Call to action

In a rapidly urbanising world in which cities—particularly high-income cities—are the major contributor to greenhouse gas emissions, future human and planetary health will be determined by our ability to transform city planning to achieve healthy and sustainable development and lifestyles. Based on this Series' findings, we have summarised the key actions urgently required (panel 2).

The Series shows that few cities have measurable standards and targets to drive the necessary transition,[5] and that health-supportive urban design and transport features are inadequate and inequitably distributed in most cities.[6] Evidence-informed thresholds for standards for urban design and transport features—such as those estimated by Cerin and colleagues[7]—are urgently needed for all 11Ds (figure). To develop sustainably and promote health and wellbeing, cities need comprehensive integrated—rather than selective one-off—interventions for all 11Ds, with short-term, medium-term, and long-term targets for their implementation.

We have shown the feasibility of creating comparable policy and spatial indicators and recommended additional policy and spatial indicators aligned with the 11Ds (panel 2), including indicators measuring biodiversity, tree canopy, and heat islands.

Achieving integrated governance across sectors and between all levels of government is essential to

Panel 2: Actions for the transition to healthy and sustainable cities

We urge international governmental, non-governmental, and professional organisations to:

Encourage all cities to benchmark and monitor progress

- Provide guidance, tools, and technical support to incorporate health, sustainability, net zero emissions, and equity in all urban policies, including procurement and financing mechanisms
- Lead the way in expanding and disseminating the open-source tools we developed to enable cities across the globe to replicate and expand our evidence-informed indicators, and to benchmark and monitor progress every 5 years
- Commit to investing in cities in low-income and middle-income countries (LMICs) to support data infrastructure and technical capacity building
- Develop an expanded set of evidence-informed indicators that measure the consequences of city planning for human and planetary health; these should include changes in biodiversity, tree canopy, heat island, levels of low-income housing built in areas prone to floods and fires, distribution of urban infrastructure, levels of crime, traffic injuries, and resources that enable healthy and sustainable development
- Activate a worldwide citizen-science programme (we propose a 1000 cities challenge) and encourage collection of open data, such as OpenStreetMap, to improve the knowledge base and inform decision making, with a focus on the most data-scarce areas
- Create multidisciplinary teams with content and technical experts (including computer and geospatial scientists) to use big data and technology ethically, to create replicable, routinely collected indicators

We urge city mayors and leaders of regional and national governments to:

Transform urban governance

- Create an authorising environment that encourages and actively works towards integrated urban governance: horizontally across sectors, and vertically between levels of government and jurisdictions
- Make the transition to integrated, transparent, inclusive, accountable, and nimble urban governance, to respond to emerging urban problems and create net zero emission cities
- Encourage participatory planning, monitoring, and budgeting; listen to the voices of unheard groups, including children, youth, those living in poverty, Indigenous communities, and other marginalised people

Strengthen policy frameworks

- Develop city planning policy frameworks that are integrated across sectors and between levels of government; all such frameworks should:
- Enable sustainable mobility and create healthy and sustainable net zero emission cities
- Specify accountability and funding, with clear goals, measurable standards, and specific targets, using evidence-informed thresholds to achieve desired results
- Maximise co-benefits for human and planetary health by mitigating and adapting to climate change
- Provide equitable access to health-supportive resources, infrastructure, and environments
- Incorporate actions to achieve the 11 regional and local urban design intervention foci (or 11Ds)
- Create 15-min neighbourhoods
- Reduce residents' exposure to environmental stressors (such as air and noise pollution)
- Incorporate standards for the size and proximity of biodiverse green spaces and minimum thresholds for tree canopy cover
- Incorporate biodiversity-sensitive design guidelines that minimise harm from urban development
- Avoid residential development in risk-prone locations
- Incorporate health-supportive design principles into land use and high-density housing
- Implement national and regional urban policy that builds capacity and consistency in responding to health and sustainability problems

Benchmark and monitor progress

- Adopt (and expand) our evidence-informed spatial indicators, to create a consistent set of upstream policy and intervention indicators that enable the consequences of city planning decisions to be benchmarked, monitored, and tracked over time; these could include indicators of greenhouse gas emissions, air and noise pollution, biodiversity, tree canopy, and heat island effects
- Use spatial indicators to unmask within-city inequities and design interventions, to ensure equitable access to urban design and transport features that enable healthy and sustainable lifestyles and foster health and wellbeing
- Measure each city's transport use and health and wellbeing outcomes, so that the consequences of policies can be monitored over time, and any inequalities in each city can be identified and remedied

Monitor policy implementation

- Make city planning decision-making accountable, by conducting natural experiments of policy interventions in partnership with universities; such experiments should assess and track policy implementation and health, social, environmental, and equity outcomes
- Assess effects on chronic disease, sustainability, mobility, air pollution, greenhouse gas emissions, biodiversity, and heat island effects when developing, financing, or implementing urban policies and interventions
- Equip the health sector to develop, evaluate, and support the implementation of all decisions arising from these health and environmental impact assessments

(Continues on next page)

(Panel 2 continued from previous page)

We urge citizens and civil society to:

Create and use open data

- Become and encourage citizen scientists and support the growth of open data sources, like OpenStreetMap, which can be used for both research and local advocacy
- Advocate locally and nationally for governments to create healthy and sustainable cities and to use policy and spatial indicators to monitor progress
- Actively demand and become involved in participatory processes to plan, finance, build, and monitor urban environments

We urge teaching and research academics to:

- Co-design policy-relevant research with citizens and policy makers, including the interpretation and translation of findings
- Conduct natural experiments of policy initiatives designed to improve the healthfulness and sustainability of cities
- Study cities as a complex system
- Fill the gap in city planning research and help build capacity in LMICs and other disadvantaged places
- Conduct international studies with common protocols and measures to assess thresholds for built environment features that can inform measurable standards in city planning policies
- Develop, and evaluate the use of, policy and spatial indicators locally, nationally, and globally, and incorporate this work into degree programmes
- Provide interdisciplinary tertiary and professional education on the planning of healthy and sustainable cities for all relevant professions, including public health, city planning, urban design, transport, environmental studies, architecture, parks and recreation, geography, and public administration

We urge research funders to:

- Prioritise multisector, multi-outcome studies (including natural experiment study designs) that incorporate systems thinking and provide comprehensive evaluations of integrated governance approaches
- Prioritise research in LMICs and other disadvantaged settings, and research on under studied urban design and transport features and their links to health and sustainability

transform cities and enable nimble responses to emerging urban problems. Integrated governance ensures alignment of actions across government, and shared responsibility for, and funding of, transformation. Leadership is vital to create the authorising environment that will enable cross-sector integrated governance and policies to deliver all 11Ds needed for healthy and sustainable cities. To capitalise on the post-COVID-19 pandemic global aspirations to "build back better" governments must reduce traffic and prioritise sustainable transport through safe walking and cycling infrastructure by creating 15-min neighbourhoods with proximate amenities, building healthy and affordable housing, and improving and enlarging green spaces.

Closing statement

Given multiple challenges confronting cities worldwide—preventable chronic disease, infectious disease pandemics, deep social disparities, ageing populations, biodiversity loss, and climate change—there is an urgent need for evidence-informed city planning policies and standards aligned with our framework's 11Ds, which will lead to healthy and sustainable cities for all. We recommend widespread and rapid uptake and further development of our methods and open-source tools,[6] with high-income countries supporting adoption of our methods and tools in LMICs. Widespread adoption will enable city planning policy and spatial indicators to be used to benchmark and track progress, unmask spatial inequities in access to health-supportive built environments, inform interventions and investments, accelerate changes that could help solve multiple related problems, and hold governments to account, with cobenefits for human and planetary health.

Contributors

BG-C led the study executive team, conceptualisation, writing of the original draft, review, and editing. AVM, ML, EC, GB, DS, and JFS were part of the study executive team and contributed to the conceptualisation, writing of the original draft, review, and editing. HF, SF, AK, THdS, SB, and MN contributed to the conceptualisation, writing sections of the original draft, and reviewing and editing critically for important intellectual content. CH, DA, EH, JA, and SL were part of the study executive team and contributed to the conceptualisation, writing and review, and editing critically for important intellectual content. ALO and KN coordinated and contributed to collection of local data, conceptualisation, writing, and review, and editing critically for important intellectual content.

Declaration of interests

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