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

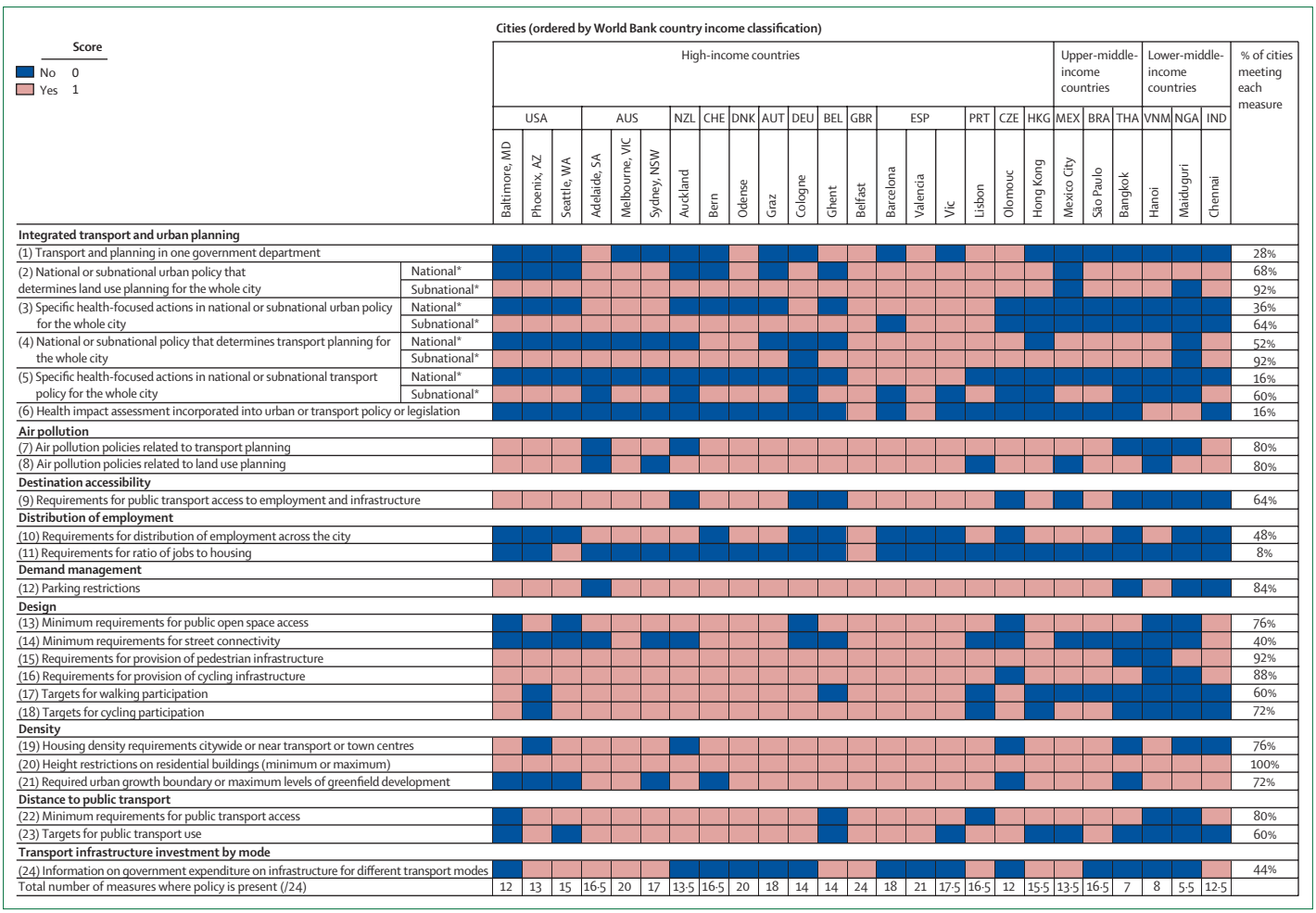

Figure 1: **Presence of key city planning policies associated with health**
AUS=Australia. NZL=New Zealand. CHE=Switzerland. DNK=Denmark. AUT=Austria. DEU=Germany. BEL=Belgium. GBR=United Kingdom. ESP=Spain. PRT=Portugal. CZE=Czech Republic. HKG=Hong Kong. MEX=Mexico. BRA=Brazil. THA=Thailand. VNM=Vietnam. 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

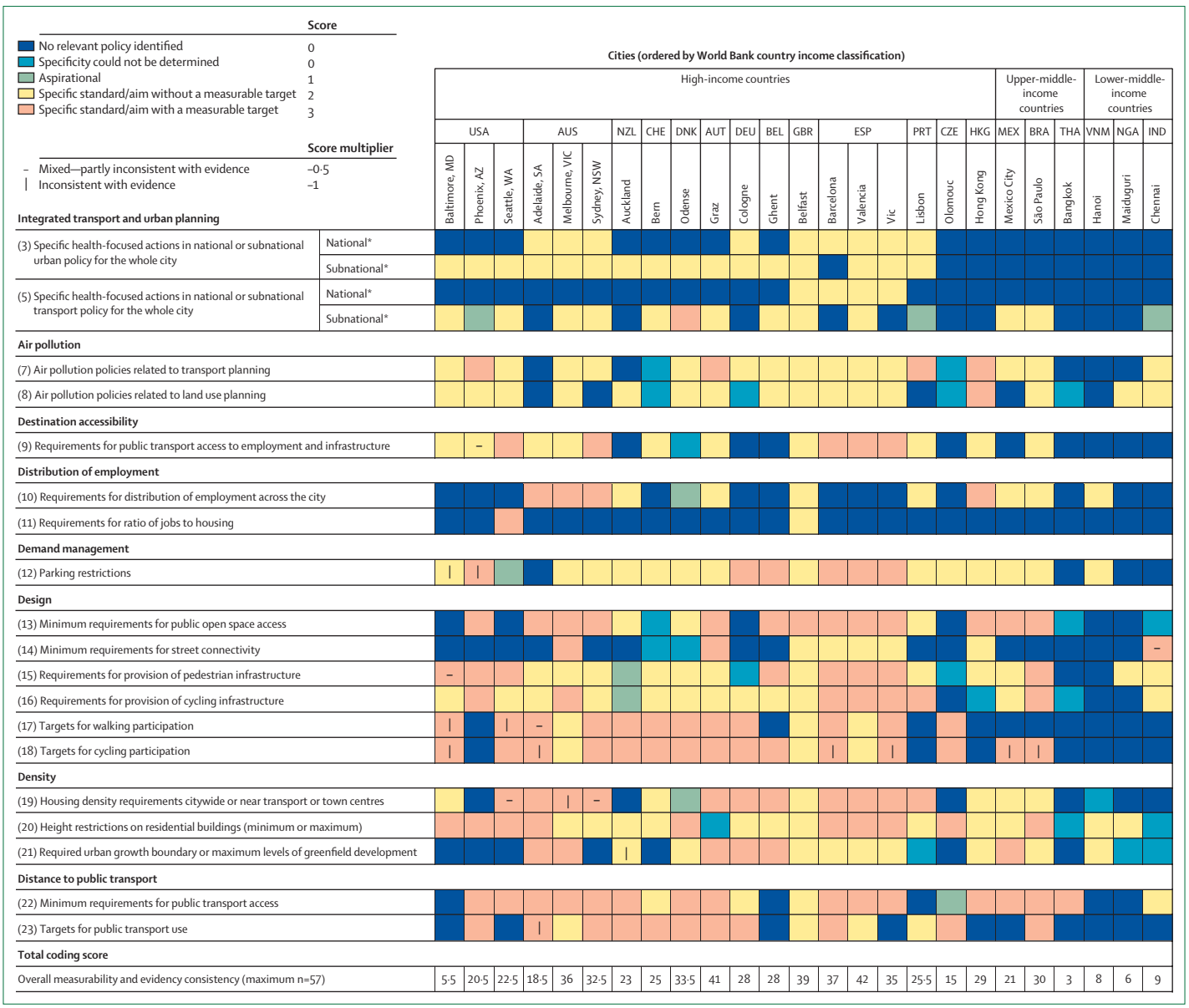

Figure 2: **Presence of measurable and evidence-consistent city planning policies associated with health**
Separate measures are listed in the table. AUS=Australia. NZL=New Zealand. CHE=Switzerland. DNK=Denmark. AUT=Austria. DEU=Germany. BEL=Belgium. GBR=United Kingdom. ESP=Spain. PRT=Portugal. CZE=Czech 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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References

1 UN General Assembly. Resolution adopted by the General Assembly: transforming our world: the 2030 agenda for sustainable development A/RES/70/1. New York, NY: United Nations, 2015.

2 UN. Resolution adopted by the General Assembly on 23 December 2016: New Urban Agenda. New York, NY: United Nations, 2016.

3 WHO. Health as the pulse of the New Urban Agenda. Geneva: World Health Organization, 2016.

4 Giles-Corti B, Moudon AV, Lowe M, et al. Creating healthy and sustainable cities: what gets measured gets done. *Lancet Glob Health* 2022; **10:** e782–84.

5 Giles-Corti B, Vernez-Moudon A, Reis R, et al. City planning and population health: a global challenge. *Lancet* 2016; **388:** 2912–24.

6 Münzel T, Sørensen M, Lelieveld J, et al. Heart healthy cities: genetics loads the gun but the environment pulls the trigger. *Eur Heart J* 2021; **42:** 2422–38.

7 Adlakha D, Sallis JF. Activity-friendly neighbourhoods can benefit non-communicable and infectious diseases. *Cities Health* 2020; published online June 9. https://doi.org/10.1080/23748834.2020.1783479.

8 Frank LD, Wali B. Treating two pandemics for the price of one: chronic and infectious disease impacts of the built and natural environment. *Sustain Cities Soc* 2021; **73:** 103089.

9 Global Road Safety Facility, The World Bank, Institute for Health Metrics and Evaluation. Transport for health: the global burden of disease from motorized road transport. Seattle, WA: Institute for Health Metrics and Evaluation, 2014

10 WHO. World health statistics 2021: monitoring health for the SDGs. Geneva: World Health Organization, 2021.

11 WHO. WHO global strategy on health, environment and climate change: the transformation needed to improve lives and wellbeing sustainably through healthy environments. Geneva: World Health Organization, 2020.

12 Watts N, Amann M, Arnell N, et al. The 2020 report of The *Lancet* Countdown on health and climate change: responding to converging crises. *Lancet* 2021; **397:** 129–70.

13 UN. World urbanization prospects: the 2018 revision. New York, NY: United Nations, Department of Economic and Social Affairs, Population Division, 2018.

14 GBD 2017 SDG Collaborators. Measuring progress from 1990 to 2017 and projecting attainment to 2030 of the health-related Sustainable Development Goals for 195 countries and territories: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018; **392:** 2091–138.

15 GBD 2019 Disease and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020; **396:** 1204–22.

16 WHO, UN-Habitat. Hidden cities: unmasking and overcoming health inequities in urban settings. Kobe: World Health Organization and United Nations Human Settlements Programme, 2010.

17 Beran D, Byass P, Gbakima A, et al. Research capacity building—obligations for global health partners. *Lancet Glob Health* 2017; **5:** e567–68.

18 Malekzadeh A, Michels K, Wolfman C, Anand N, Sturke R. Strengthening research capacity in LMICs to address the global NCD burden. *Glob Health Action* 2020; **13:** 1846904.

19 Salvo D, Parra DC, Jáuregui A, et al. Capacity for childhood obesity research in Latin American and US Latino populations: state of the field, challenges, opportunities, and future directions. *Obes Rev* 2021; **22** (suppl 3): e13244.

20 WHO. UN-Habitat. Global report on urban health: equitable healthier cities for sustainable development. Kobe: World Health Organization, 2016.

21 Valencia SC, Simon D, Croese S, et al. Adapting the Sustainable Development Goals and the New Urban Agenda to the city level: initial reflections from a comparative research project. *Int J Urban Sustain Dev* 2019; **11:** 4–23.

22 Quilling E, Kruse S, Kuchler M, Leimann J, Walter U. Models of intersectoral cooperation in municipal health promotion and prevention: findings from a scoping review. *Sustainability* 2020; **12:** 6544.

23 Lowe M, Whitzman C, Giles-Corti B. Health-promoting spatial planning: approaches for strengthening urban policy integration. *Plann Theory Pract* 2018; **19:** 180–97.

24 Lozzi G, Monachino MS. Health considerations in active travel policies: a policy analysis at the EU level and of four member countries. *Res Transp Econ* 2021; **86:** 101006.

25 Sallis JF, Bull F, Burdett R, et al. Use of science to guide city planning policy and practice: how to achieve healthy and sustainable future cities. *Lancet* 2016; **388:** 2936–47.

26 Lowe M, Hooper P, Jordan H, Bowen K, Butterworth I, Giles-Corti B. Evidence-informed planning for healthy liveable cities: how can policy frameworks be used to strengthen research translation? *Curr Environ Health Rep* 2019; **6:** 127–36.

27 Klepac Pogrmilovic B, Ramirez Varela A, Pratt M, et al. National physical activity and sedentary behaviour policies in 76 countries: availability, comprehensiveness, implementation, and effectiveness. *Int J Behav Nutr Phys Act* 2020; **17:** 116.

28 Lowe M, Arundel J, Hooper P, et al. Liveability aspirations and realities: implementation of urban policies designed to create healthy cities in Australia. *Soc Sci Med* 2020; **245:** 112713.

29 Pineo H, Zimmermann N, Cosgrave E, Aldridge RW, Acuto M, Rutter H. Promoting a healthy cities agenda through indicators: development of a global urban environment and health index. *Cities Health* 2018; **2:** 27–45.

30 Arundel J, Lowe M, Hooper P, et al. Creating liveable cities in Australia: mapping urban policy implementation and evidence-based national liveability indicators. Melbourne, VIC: Healthy Liveable Cities Group RMIT University, 2017.

31 UN-Habitat. Action framework for implementation of the New Urban Agenda. Nairobi: United Nations Human Settlements Programme, 2017.

32 WHO Centre for Health Development. Urban HEART: urban health equity assessment and response tool. Kobe: World Health Organization, 2010.

33 Giles-Corti B, Lowe M, Arundel J. Achieving the SDGs: evaluating indicators to be used to benchmark and monitor progress towards creating healthy and sustainable cities. *Health Policy* 2020; **124:** 581–90.

34 Salvo D, Garcia L, Reis RS, et al. Physical activity promotion and the United Nations Sustainable Development Goals: building synergies to maximize impact. *J Phys Act Health* 2021; **18:** 1163–80.

35 Sallis JF, Cerin E, Conway TL, et al. Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study. *Lancet* 2016; **387:** 2207–17.

36 Castorr AH, Thompson KO, Ryan JW, Phillips CY, Prescott PA, Soeken KL. The process of rater training for observational instruments: implications for interrater reliability. *Res Nurs Health* 1990; **13:** 311–18.

37 Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics* 1977; **33:** 159–74.

38 Zade H, Drouhard M, Chinh B, Gan L, Aragon C. Conceptualizing disagreement in qualitative coding. *Proc 2018 CHI Conf Hum Factor Comput Syst* 2018; published online April. https://doi.org/10.1145/3173574.3173733.

39 The World Bank. GNI per capita, Atlas method (current US$). 2021. https://data.worldbank.org/indicator/NY.GNP.PCAP.CD (accessed May 20, 2021).

40 The World Bank. Gini index (World Bank estimate). 2021. https://data.worldbank.org/indicator/SI.POV.GINI (accessed June 10, 2021).

41 The World Bank. Life expectancy at birth, total (years). 2021. https://data.worldbank.org/indicator/SP.DYN.LE00.IN (accessed June 10, 2021).

42 The World Bank. Cause of death, by non-communicable diseases (% of total). 2020. https://data.worldbank.org/indicator/SH.DTH.NCOM.ZS (accessed June 10, 2021).

43 Schiavina M, Freire S, MacManus K. GHS-POP R2019A—GHS population grid multitemporal (1975–1990–2000–2015). 2019. http://data.europa.eu/89h/0c6b9751-a71f-4062-830b-43c9f432370f (accessed April 20, 2021).

44 Centre for Health Protection. Non-communicable diseases watch 2020—co-occurrence of health risk behaviours: an overview. 2020. https://www.chp.gov.hk/en/resources/29/100073.html (accessed March 24, 2022).

45 The World Bank. World Bank country and lending groups. June 2020. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (accessed April 26, 2021).

46 Boeing G, Higgs C, Liu S, et al. Using open data and open-source software to develop spatial indicators of urban design and transport features for achieving healthy and sustainable cities: a 25-city study. *Lancet Glob Health* 2022; **10:** e907–18.

47 Backholer K, Baum F, Finlay SM, et al. Australia in 2030: what is our path to health for all? *Med J Aust* 2021; **214** (suppl 8)**:** S5–40.

48 UN-Habitat. OECD. Global state of National Urban Policy. Nairobi: United Nations Human Settlements Programme, 2018.

49 Samet J. Community design and air quality. In: Dannenberg A, Frumkin H, Jackson R, eds. Making healthy places: designing and building for health, well-being, and sustainability. Washington, DC: Island Press, 2011.

50 Frank LD, Sallis JF, Conway TL, Chapman JE, Saelens BE, Bachman W. Many pathways from land use to health: associations between neighborhood walkability and active transportation, body mass index, and air quality. *J Am Plann Assoc* 2006; **72:** 75–87.

51 Transport for New South Wales. Future transport strategy 2056. Sydney, NSW: NSW Government, 2018.

52 Ewing R, Cervero R. Travel and the built environment: a meta-analysis. *J Am Plann Assoc* 2010; **76:** 265–94.

53 Office of Planning and Community Development. Seattle 2035 comprehensive plan. Seattle, WA: Office of Planning and Community Development, City of Seattle, 2016.

54 Buehler R. Determinants of automobile use: comparison of Germany and the United States. *Transp Res Rec* 2009; **2139:** 161–71.

55 Zlatkovic M, Zlatkovic S, Sullivan T, Bjornstad J, Kiavash Fayyaz Shahandashti S. Assessment of effects of street connectivity on traffic performance and sustainability within communities and neighborhoods through traffic simulation. *Sustain Cities Soc* 2019; **46:** 101409.

56 Baltimore Regional Transportation Board. Maximise 2040: a performance-based transportation plan for a greater Baltimore region. Baltimore, MD: Baltimore Regional Transportation Board, 2016.

57 Odense Kommune. Kommuneplan for Odense, 2016–2028. Odense: Odense Kommune, 2016.

58 Corporation of Chennai. Non-motorised transport (NMT) policy. Chennai: Corporation of Chennai, 2014.

59 Cerin E, Sallis JF, Salvo D, et al. Determining thresholds for spatial urban design and transport features to create healthy and sustainable cities through walking: findings from the IPEN adult study. *Lancet Glob Health* 2022; **10:** e895–906.

60 Planning Department. Hong Kong planning standards and guidelines (HKPSG). Hong Kong: Planning Department, The Government of the Hong Kong Special Administrative Region, 2019.

61 Stad Gent. Ruimte voor alle Gentenaars—Structuurvisie 2030. Gent: Stad Gent, 2018.

62 Jefatura de Gobierno. Programa sectorial de desarrollo urbano y espacio público 2013–2018. Gaceta Oficial Distito Federal 197, 24–66. Mexico City: Jefatura de Gobierno, 2015.

63 Department of Environment, Land, Water and Planning. Victorian planning provisions. 2019. https://www.planning.vic.gov.au/schemes-and-amendments/browse-planning-scheme/planning-scheme?f.Scheme%7CplanningSchemeName=vpps (accessed Jan 17, 2019).

64 Agència d'Ecologia Urbana de Barcelona y Red de Redes de Desarrollo Local Sostenible. Sistema de indicadores y condicionantes para ciudades grandes y medianas: Ministerio de Medio Ambiente y Medio Rural y Marino. Barcelona: Gobierno de España, 2009.

65 Department of Planning Transport and Infrastructure. The 30-year plan for Greater Adelaide—2017 update. Adelaide, SA: Government of South Australia, 2017.

66 Department for Regional Development. Regional development strategy 2035. Belfast: Department for Regional Development, 2010.

67 Auckland Transport. Regional public transport plan 2018–2028. Auckland: Auckland Transport, Auckland Council, 2019.

68 Transport for New South Wales. Integrated public transport service planning guidelines: Sydney metropolitan area. Sydney, NSW: Transport for New South Wales, NSW Government, 2013.

69 Prefeitura do Município de São Paulo. Secretaria de Transportes, São Paulo Transporte - SPTRANS, Companhia de Engenharia de Tráfego - CET. Plano de mobilidade urbana do município de São Paulo. Sao Paulo: Prefeitura do Município de São Paulo, 2015.

70 Centrum dopravního výzkumu. Plán udržitelné městské mobility Olomouc (PMMO). Brno: Centrum dopravního výzkumu, 2017.

71 WHO. Urban green spaces: a brief for action. Copenhagen: World Health Organization, Regional Office for Europe, 2017.

72 Hooper P, Boruff B, Beesley B, Badland H, Giles-Corti B. Testing spatial measures of public open space planning standards with walking and physical activity health outcomes: findings from the Australian national liveability study. *Landsc Urban Plan* 2018; **171:** 57–67.

73 Koohsari MJ, Badland H, Mavoa S, et al. Are public open space attributes associated with walking and depression? *Cities* 2018; **74:** 119–25.

74 Giles-Corti B, Gunn L, Hooper P, et al. Built environment and physical activity. In: Nieuwenhuijsen M, Khreis H, eds. Integrating human health into urban and transport planning: a framework. Cham: Springer, 2019.

75 Adlakha D, Hipp JA, Brownson RC. Neighborhood-based differences in walkability, physical activity, and weight status in India. *J Transp Health* 2016; **3:** 485–99.

76 Eom H-J, Cho G-H. Exploring thresholds of built environment characteristics for walkable communities: empirical evidence from the Seoul Metropolitan area. *Transp Res Part D Transp Environ* 2015; **40:** 76–86.

77 Salvo D, Reis RS, Stein AD, Rivera J, Martorell R, Pratt M. Characteristics of the built environment in relation to objectively measured physical activity among Mexican adults, 2011. *Prev Chronic Dis* 2014; **11:** E147.

78 Giles-Corti B, Hooper P, Foster S, Koohsari M, Francis J. Low density development: impacts on physical activity and associated health outcomes. Melbourne, VIC: National Heart Foundation (Victorian Division), 2014.

79 Department of Environment, Land, Water and Planning. Plan Melbourne 2017–2050. Melbourne, VIC: Department of Environment, Land, Water and Planning, Victorian Government, 2017.

80 C40 Cities, Arup. Green and thriving neighbourhoods: a pathway to net zero, featuring the '15-minute city'. New York, NY: C40 Cities and Arup, 2021.

81 Kjellstrom T, Hinde S. Car culture, transport policy, and public health. In: Kawachi I, Wamala S, eds. Globalisation and health. New York, NY: Oxford University Press, 2007.

82 Holden M. Is integrated planning any more than the sum of its parts? Considerations for planning sustainable cities. *J Plann Educ Res* 2012; **32:** 305–18.

83 Marmot M, Friel S, Bell R, Houweling TAJ, Taylor S, Commission on Social Determinants of Health. Closing the gap in a generation: health equity through action on the social determinants of health. *Lancet* 2008; **372:** 1661–69.

84 Barnett A, Cerin E, Zhang CJP, et al. Associations between the neighbourhood environment characteristics and physical activity in older adults with specific types of chronic conditions: the ALECS cross-sectional study. *Int J Behav Nutr Phys Act* 2016; **13:** 53.

85 Foley L, Panter J, Heinen E, Prins R, Ogilvie D. Changes in active commuting and changes in physical activity in adults: a cohort study. *Int J Behav Nutr Phys Act* 2015; **12:** 161.

86 Woodcock J, Edwards P, Tonne C, et al. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *Lancet* 2009; **374:** 1930–43.

87 UN Sustainable Development Group. Leaving no one behind: a UNSDG operational guide for UN country teams. Interim report. Geneva: United Nations, 2019.

88 Hunter RF, Cleland CL, Kee F, et al. Developing system-oriented interventions and policies to reduce car dependency for improved population health in Belfast: study protocol. *Systems* 2021; **9:** 62.

89 Pineo H, Zimmermann N, Davies M. Integrating health into the complex urban planning policy and decision-making context: a systems thinking analysis. *Palgrave Commun* 2020; **6:** 21.

90 Sallis JF, Spoon C, Cavill N, et al. Co-benefits of designing communities for active living: an exploration of literature. *Int J Behav Nutr Phys Act* 2015; **12:** 30.

91 Le Gouais A, Govia I, Guell C. Challenges for creating active living infrastructure in a middle-income country: a qualitative case study in Jamaica. *Cities Health* 2020; published online June 23. https://doi.org/10.1080/23748834.2020.1767950.

92 Gostin LO, Monahan JT, Kaldor J, et al. The legal determinants of health: harnessing the power of law for global health and sustainable development. *Lancet* 2019; **393:** 1857–910.

93 Giles-Corti B, Moudon AV, Lowe M, et al. What next? An expanded view of city planning and global health, and the need for evidence-informed policy to be implemented and monitored. *Lancet Glob Health* 2022; **10:** e919–26.

94 Boulange C, Gunn L, Giles-Corti B, Mavoa S, Pettit C, Badland H. Examining associations between urban design attributes and transport mode choice for walking, cycling, public transport and private motor vehicle trips. *J Transp Health* 2017; **6:** 155–66.

95 Pineo H, Glonti K, Rutter H, Zimmermann N, Wilkinson P, Davies M. Characteristics and use of urban health indicator tools by municipal built environment policy and decision-makers: a systematic review protocol. *Syst Rev* 2017; **6:** 2.

96 Bull FC, Milton K, Kahlmeier S. National policy on physical activity: the development of a policy audit tool. *J Phys Act Health* 2014; **11:** 233–40.

97 Lozano-Gracia N. COVID and cities – a new demon that points at old problems: how can research help? *Environ Plan B Urban Anal City Sci* 2020; **47:** 1128–32.

98 van Wee B, Witlox F. COVID-19 and its long-term effects on activity participation and travel behaviour: a multiperspective view. *J Transp Geogr* 2021; **95:** 103144.

99 Giles-Corti B, Sallis JF, Sugiyama T, Frank LD, Lowe M, Owen N. Translating active living research into policy and practice: one important pathway to chronic disease prevention. *J Public Health Policy* 2015; **36:** 231–43.