Calculation of Policy-relevant Spatial Indicators of Urban Liveability: Experiences of Scaling a Research Programme from Local to Global

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Introduction

Urban liveability is a global priority, underpinning the creation of healthy, sustainable cities (United Nations, 2016), aligning strongly with the United Nations (UN) Sustainable Development Goals (SDGs; United Nations, 2015). Measurement of policy-relevant spatial indicators of built and natural environments supports city planning at all levels of government (United Nations, 2015, Giles-Corti et al., 2019, Lowe et al., 2020). Analysis of their spatial distribution within cities, and impacts on individuals and communities, can assist with implementation and evaluation of policy for effective and equitable planning decisions (Giles-Corti et al., 2019).

The Urban Liveability Index (2016-2021, Higgs et al., 2019) was underpinned by a detailed socio-ecological model of associations between the built environment and health (Lowe et al., 2013, Giles-Corti et al., 2014, Badland et al., 2015). Using this framework, we developed methods for calculating a high-resolution spatial urban liveability index, encompassing empirically-tested indicators across liveability domains, including walkability, access to community and health services, employment, food, housing, public open space, and transport. The resulting spatial indicators supported analysis and mapping of geographic access to health-supportive environments, providing evidence of within-city and between-city liveability inequities in Australia and internationally.

A pilot project, which focused on Melbourne in 2012, developed an initial workflow to calculate address-level liveability measures (Higgs et al., 2018, Davern et al., 2018, Higgs et al., 2019, Higgs et al., 2021). This workflow was extended to capital and regional cities, towns and local government areas around Australia (the Australian National Liveability Study, 2016-2021; Arundel et al., 2017, Davern et al., 2019b, Davern et al., 2019a, Davern et al., 2019c, Davern et al., 2020, Lowe et al., 2020), and to 25 cities located in diverse international contexts across two distinct projects (Bangkok Liveability, 2018-2021, Alderton et al., 2020, ; Global Healthy and Sustainable City-Indicators Collaboration study, 2018-2022, Liu et al., 2021). The results informed scorecard reports of urban liveability (Gunn et al., 2020a), interactive indicator map portals (Alderton et al., 2020, Davern et al., 2020), analysis of health outcomes (Alderton et al., 2019, Fortune et al., 2020a, Fortune et al., 2020b, Foster et al., 2019, VicHealth, 2020), and amenity provision in new urban developments (Gunn et al., 2020b).

This paper reviews methodological challenges encountered in the scaling up of this 5-year collaborative research program. It derives lessons-learned from these experiences that can further strengthen evidence and tools used by urban planners, policy makers and researchers for creating healthy, sustainable cities.

Case Studies

Study planning, definitions, and data sourcing

Measuring and evaluating spatial indicators across cities and over time requires detailed, comparable data, and clear, consistent study region definitions. However, data in general are more likely to be available, accurate and complete in higher-populated urban areas of high-income countries (Taylor et al., 2018). Measuring liveability indicators is challenging in peri-urban areas with dynamic growth, and in lower-income settings, with increased risk of data being inaccurate, incomplete or unavailable (Johnson et al., 2016, Fonte et al., 2017).

To support fairer comparisons between diverse cities we sourced established urban boundaries; for example, data from the Australian Bureau of Statistics (ABS, 2017) or the Global Human Settlements Urban Centres Database (Florczyk et al., 2019). The community contributed open map database, OpenStreetMap, provided a longitudinal resource of built and natural environment data with global scope, ostensibly up-to-date and coded according to consistent and transparent guidelines (OpenStreetMap contributors, 2021). These data were used in the Australian and international studies for determining residential access to specific services and amenities.

OpenStreetMap has advantages over routinely collected official data, in that new developments and pedestrian paths may be better represented (Barrington-Leigh and Millard-Ball, 2017, Boeing, 2017). However, all data are imperfect representations of real world phenomena and, thus, have limitations. Care must be taken to consider positional, temporal and semantic accuracy of urban features, as well as completeness of study region coverage (Guptill et al., 1995, Zhang and Pfoser, 2019). Seeking advice from experts on specific subject matter, local contexts and cultural nuances can ensure face validity.

Scale and units of analysis

The ability to produce indicators at different scales of aggregation for analysis, visualisation, and linkage according to the needs of diverse stakeholders and projects required high resolution measurement of built environment features. Our Australian studies measured local neighbourhood environments using address points in urban residential locations. Internationally, where address data were not always available, point locations were identified at regular intervals along a pedestrian accessible street network in populated regions of the city. These methods served to identify residential locations, whose local neighbourhood environments could be evaluated and aggregated to produce measures for larger geographical areas, in conjunction with additional data on dwelling and population distributions.

Relative or absolute comparisons?

The Urban Liveability Index workflow supported large scale comparative analyses of inequities. Composite measures such as the Walkability Index and Urban Liveability Index provide a score based on a relative comparison with the average residential exposure across study regions, rather than an absolute comparison with a fixed evidence-based or policy-relevant threshold. Relative scores such as these have two important limitations: 1) an average is a shifting standard, which cannot be meaningfully calculated for a single address point; 2) measures calculated for different study regions and/or time points cannot subsequently be meaningfully compared, as they do not share common reference standards. Methods for urban liveability scoring standardised against established, objective policy-relevant standards and thresholds are needed to support real time address queries as well as longitudinal and between-city comparisons.

Software development practices supporting urban environment research cycles

Meeting the evolving needs of expansive, multi-output projects requires on-going coding and collaboration between team members with different backgrounds and skills. Agile software development practices can support meeting project deadlines and keeping development on track with project aims (Rodriguez et al., 2021); for example, version control, stand-up meetings and task boards were used to support timely scaling-up. However, capacity for code review was limited in the Australian study, and lack of a clearly defined end-point contributed to scope-creep, delaying project documentation and dissemination to prioritise emerging requirements.

Documentation is essential for project posterity but is challenging to achieve after time allocations lapse. The Bangkok Liveability Project deliberately incorporated automated documentation of results, technical methods and metadata into the workflow from project commencement to support a continuous development approach (Alderton et al., 2020). On-going sharing of outputs with project partners ensured expectations were met, despite geographical distance, while supporting local capacity-building.

Conclusion

Spatial indicators of urban liveability developed through this work program have provided flexible tools for a broad range of uses: examining relationships of the built environment with child development, travel behaviours, high-density housing residents, and COVID-19 exposure; and measuring and mapping city indicator summaries supporting local, state and federal government planners and policy makers. Future research can build upon this work, learning from the challenges faced, to advance the accessibility, utility and meaningfulness of spatial indicators for urban liveability to support progress on achieving the SDGs, and building healthier, more sustainable cities worldwide.

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