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The development of policy-relevant transport indicators to monitor health behaviours and outcomes

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ABSTRACT

Evidence-based and replicable spatial indicators relevant to transport policy are needed to monitor pathways for health behaviours and outcomes and inform planning in this field. Yet, little is known about which indicators are most useful, what are meaningful geographic scales for applying spatial data, and how these relate to urban and transport planning policy. As such, we sought to: (1) develop a conceptual model from a public health perspective to demonstrate how multiple pathways of transport impact on health behaviours and outcomes; and (2) identify using the conceptual model the most useful spatial indicators policy-makers and planners could apply over a given region to determine how measures of transport support or hinder health behaviours and outcomes. Associations documented in the literature guided the development of the conceptual framework, relationships, and indicator selection. Twenty-three transport indicators were identified in the literature as being viable measures relevant to the Victorian (Australian) region. These were categorised into measures of public transport, car reliance, cycling, and traffic exposure. This work has the potential to facilitate the comparison of health behaviours and outcomes with area-level transport variations to explore how transport policy and planning decisions impact on population health and inequalities.

1. Introduction

It has long been recognised that urban form and associated travel behaviours (e.g., walking, cycling, public transport and private motor vehicle use) impact on health behaviours and outcomes (Cervero, 1988; Cervero and Kockelman, 1997). Accessibility to transport infrastructure is necessary for a functioning society, hence it is a social determinant of health that enables people to access employment, education, food, health and social services, and to recreate and socialise (Delbosc, 2012; Strategic Review of Health Inequalities in England post-2010, 2010). In this way, transport is a critical contributor to the liveability of a community (Badland et al., 2014b; Strategic Review of Health Inequalities in England post-2010, 2010). A growing body of literature links transport-related physical activity (i.e., walking and cycling as modes of active transport) (Badland and Schofield, 2005; Black et al., 2001; British Medical Association, 2012; Carlson et al., 2012; Dannenberg et al., 2003; World Health Organization Centre for Health Development, 2011), public transport use (Badland et al., 2014a; Daniels and Mulley, 2013; Department of Infrastructure and Transport, 2013), and driving (Badland et al., 2010a; Ewing and Cervero, 2001) with specific built environment attributes, such as the presence of transport-related infrastructure (e.g., footpaths, controlled crossings, proximal public transport stops, car parking availability), as well as street connectivity, land use mix, residential and employment densities, and access to local shops and services (Ewing and Cervero, 2001; Handy and Clifton, 2001; Handy, 2004; Kitamura et al., 1997).

For all these built environment attributes, the strongest health-related evidence exists for walking behaviours (particularly transport-related walking) and obesity (Badland and Schofield, 2005; Christian et al., 2011; Ewing, 2005). Thus, the role transport plays as a social determinant of health in modifying the risk of non-communicable disease outcomes (Beaglehole et al., 2011) is gaining attention in health (Heart Foundation, 2009; National Institute for Health and Clinical Excellence, 2008), as well as urban policy and liveability discourse (Badland et al., 2014b; Commission for Architecture and the Built Environment, 2008; Ewing, 2005; Koohsari et al., 2013; Major Cities Unit,

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2011). These built environment characteristics have broader relevance to regional and national policies, such as: traffic incidents, volume, congestion and pollution (Dumbaugh and Rae, 2009; Jacobsen et al., 2009; OECD, 2010); environmental sustainability (Woodcock et al., 2007); and social inclusion (Leyden, 2003; Witten et al., 2003; Wood et al., 2008). Moreover, it was estimated that death and illness attributable to air pollution in OECD countries was US$1.7 trillion in 2010. Accordingly, the report argued for investment into improved public transport (OECD, 2010).

Transport policy and land use planning shapes people's behaviours and can be used to reducing inequalities. For example, building 'walkable' pedestrian-friendly environments that support active and public transport modes not only enables access to destinations, but can enhance social inclusion and reduce inequalities by providing equitable access (Leyden, 2003), as well as promote health through physical activity engagement (Beaglehole et al., 2011; Christian et al., 2011; Frank et al., 2010; Witten et al., 2012). 'High' walkability in this context is defined as areas with well-connected street networks, higher residential densities, and good access to a diversity of land use mixes (Frank et al., 2010). Conversely, environments designed primarily for private motor vehicle use often assume people can afford to purchase a car and cover the running costs, as well as regularly maintaining the vehicle. Compared with more walkable neighbourhoods, auto-dependent settings tend to have poorer public transport access and longer commute distances between the residence and key destinations, such as employment, education, and goods and services (Ewing and Cervero, 2001). For those with limited access to a private vehicle, this can result in increased social isolation, reduced opportunities to access a distributed labour market, and hence, meaningful employment and skill development, leading to entrapment and a cycle of debt (Dodson and Sipe, 2008). The environmental benefits of using public and active transport modes extend to improved air quality, and reduced traffic congestion, vehicle miles travelled, and road infrastructure expenditure (Haines et al., 2009; Smith and Haigler, 2008).

Several frameworks arising from transport psychology have mapped transport pathways with selected wellbeing and life satisfaction outcomes (Delbosc, 2012; Ettema et al., 2011; Reardon and Abdallah, 2013). Together, they demonstrate that transport systems play an integral role in enabling or restricting access to destinations that, in turn, impact on a wide range of outcomes. Although these models have utility for understanding conceptual pathways of transport with selected outcomes, they have not been developed within a wider public health framework. They also do not provide direction for tangible policy and planning indicators that can be applied to measure and compare transport access and infrastructure within and across given regions. Using indicators for these purposes can assist in monitoring the success (or otherwise) of current policy, while more fully informing the development of future transport policy and land use planning (Greenwood, 2008; United Nations Development Program, 2011). This is now possible, given recent advancements in spatial data and software, and the increased capability of computers to objectively measure transport infrastructure and access, and other built environment attributes.

These spatial built environment attributes can be linked to behaviours and outcomes of interest in the resident population. However, when applying spatial measures across different regions it is critical the methods can be replicated, data are valid, reliable, and available, and the outcomes are relevant to the population being examined (Kerr et al., 2013). As such, there is now a growing consensus for tool and indicator selection, which are at least in part derived from spatial measures, to enable comparison across diverse neighbourhoods or regions. Examples of spatial built environment measures include walkability indices (Frank et al., 2010; Giles-Corti et al., 2013; Giles-Corti et al., 2011; Kerr et al., 2013), public open space measures (Badland et al., 2010b; Crawford et al., 2008; Giles-Corti et al., 2005), and streetscape audits (Badland et al., 2010c; Pikora et al., 2002), with these being applied across different settings and populations. Yet, many limitations exist when using spatial data to assess built environments. For example, little is known about the most useful and meaningful geographic scales for applying spatial data, and how these relate to urban and transport planning policy; the number and diversity of spatial indicators may be confusing to policy-makers and planners; and appropriate spatial data may be challenging to source and duplicate. Evidence-based and replicable spatial indicators relevant to transport policy are needed to monitor pathways for health behaviours and outcomes and inform future policy and planning.

As such, in this paper our objectives were to: (1) develop a conceptual framework from a public health perspective to hypothesise how multiple pathways of transport might impact upon health behaviours and outcomes; (2) use the conceptual framework to identify the potentially meaningful spatial indicators policy-makers and planners could use to assess how measures of transport support or hinder health behaviours and outcomes; and (3) propose indicators that could have utility for monitoring transport policy and land use planning progress over time. This work has been conceptualised from an international perspective, but uses Australian data as a case study to demonstrate how a series of transport policy-relevant indicators could be developed and applied in future.

2. Material and methods

This work was broadly informed by recent literature reviews that investigated indicators of urban liveability (Badland et al., 2014b; Lowe et al., 2013). The reviews yielded 11 distinct liveability domains regarded as important components of liveable cities and communities, and based on the current literature, were likely to contribute to health and wellbeing through social determinants of health pathways. The full report listing the databases searched and document references are available at: ⟨http://mccaugheycentre.unimelb.edu.au/research/health_and_liveability⟩

2.1. Causal framework development

The transport conceptual framework was developed by applying a social determinants of health lens, whereby the upstream (e.g., neighbourhood physical environment) and downstream (e.g., travel behaviours) transport determinants were identified in relation to selected health behaviours and outcomes collected in population health or routine surveys (Fig. 1). Well-established associations documented in the literature guided the framework and conceptual relationships. This framework was then used to identify the appropriateness of inclusion for the transport indicators as they related to selected health behaviours and outcomes.

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