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Liveable for whom? Prospects of urban liveability to address health inequities

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ABSTRACT

The aspiration of liveable cities, underpinned by the New Urban Agenda, is gaining popularity as a mechanism to enhance population health and wellbeing. However, less attention has been given to understanding how urban liveability may provide an opportunity for redress health inequities. Using an environmental justice lens, this paper investigates whether urban liveability poses an opportunity or threat to reducing health inequities and outlines a future research agenda. Selected urban liveability attributes, being: education; employment; food, alcohol, and tobacco; green space; housing; transport; and walkability, were investigated to understand how they can serve to widen or narrow inequities.

Some domains showed consistent evidence, others suggested context-specific associations that made it difficult to draw general conclusions, and some showed a reverse patterning with the social gradient, but with poorer outcomes. This suggests urban liveability attributes have equigenic potential, but operate within a complex system. We conclude more disadvantaged neighbourhoods and their residents likely have additional policy and design considerations for optimising outcomes, especially as changes to the contextual environment may impact neighbourhood composition through displacement and / or pulling up effects. Future research needs to continue to explore downstream associations using longitudinal and natural experiments, and also seek to gain a deeper understanding of the urban liveability system, including interactions, feedback loops, and non-linear and linear responses. There is a need to monitor neighbourhood population changes over time to understand how liveability impacts the most vulnerable. Other areas worthy of further investigation

include applying a life course approach and understanding liveability within the context of other

adversities and contextual settings.

MAIN TEXT

Fashioning 'liveable' cities, and how best to measure and monitor this progress has become priorities for various actors, including those tasked with improving population health and reducing inequities [1]. Half of the world's population lives in cities, and predominantly through migration, two-thirds of people are projected to be living in urban settlements by 2050. This puts enormous pressure on government, private sector, and civil society to create cities and neighbourhoods that are resilient, adaptive, sustainable, inclusive, equitable, economically productive, and support good health and wellbeing [2]. Building on its many predecessors and global initiatives, such as the Healthy Cities Movement [3] and UN HABITAT [4], the New Urban Agenda was formally launched in 2016 by the United Nations. The New Urban Agenda is a global framework aimed at government, non-government, and private sector that establishes key commitments for sustainable and equitable urban development over the next two decades [5]. Internationally, the aspiration of liveable cities and neighbourhoods, underpinned by the New Urban Agenda, is gaining popularity, and is increasingly viewed as a mechanism to enhance population health and wellbeing [6]. Moreover, the urban liveability agenda provides a timely mechanism for re-establishing the interdependence of urban planning, place, and population health that was evident in the 19th century [7]. By holistically connecting health and place under the umbrella of urban liveability it allows for better appreciation and understanding of the 'system as a whole'. This includes identifying points of intervention for effective integrated policy making, while potentially minimising any unintended or negative consequences.

Liveability is gaining traction in policy circles, alongside the rise of multiple liveability indices [8]. Others have pointed out that creating urban policies that promote liveability, health, and sustainability require effective intersectoral partnerships [9, 10]. However, these assertions have typically lacked an empirical foundation and little is known about the delivery of 'critical' elements, such as 'what, where, and how much' is required to provide structural urban planning solutions that

support a range of good outcomes [8, 11]. Coupled with the increasing availability of fine-grained spatial data and software, a body of interdisciplinary research has since rapidly emerged over the last decade that purposively seeks to capture and measure components of liveability within cities and investigate and establish associations with health and wellbeing [12-14].

Using a social determinants of health lens, our earlier work has conceptualized liveable cities and neighbourhoods as being *'safe, attractive, socially cohesive and inclusive, and environmentally sustainable with affordable and diverse housing linked via public transport, walking, and cycling to employment, education, public open space, local shops, health and community services, and leisure and cultural opportunities'* [8]. Such a definition echoes the guiding principles of the New Urban Agenda, which through the Sustainable Development Goals, seeks to equitably deliver sustainable urban development through economic prosperity, enhanced well-being, and environmental protection [5]. While the magnitude of association varies by built environment exposure and health outcome considered [15], this body of evidence has led to major public health organisations advocating the importance of the built environment and urban liveability for shaping population health outcomes [7, 16, 17].

Health inequalities and inequities remain major global public health priorities [16, 18]; yet, less attention has been given to understanding the extent urban liveability impacts these. The World Health Organization defines health inequalities as differences in health status or in the distribution of health determinants between different population groups. Health inequities are a subset of health inequalities, where they are attributable to the external environment primarily outside the control of the individual (i.e. the social conditions) [19]. Health inequities have been described as *'systematic differences in the health status of different population groups, arising from the social conditions in which people are born, grow, live, work, and age'*. These social conditions can include, but are not limited to, civic decision-making processes, and availability of financial resources, environmental dis/amenities, and opportunity structures [12, 13].

As socioeconomic position declines, health outcomes progressively worsen [20]. This social gradient disparity is recognised by many as unfair and unjust, largely because the social conditions determine an individual's risk of illness, the opportunities and actions available to prevent illness, and accessible treatment options [21]. Furthermore, a large evidence base (for example [21, 22]) demonstrates that across multiple outcomes, as health declines for those of the lowest socio-economic status, health outcomes for those of higher socioeconomic status are also compromised. The income-wealth gap between rich and poor (socioeconomic inequalities) has declined in some countries, and some countries have smaller gaps than others [22]. This suggests that reducing inequalities, and thus health inequities, is possible. Yet, in many contexts the social and spatial gradients in health are increasing [18, 23].

Health inequities are usually interpreted using a social determinants of health model that the World Health Organization defines as *'the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life'* [18]. Landmark reports [12, 13] establishing the drivers of health inequalities and inequities demonstrate the importance of the social determinants of health as a vehicle for reducing health inequities, and therefore flattening the social gradient. Of relevance, urban form attributes, such as housing affordability, employment opportunity, and public transport access – common components of urban liveability - are regarded as important urban planning policy health equity levers [6, 23]. Therefore, the notion of urban liveability is important within the context of the social determinants of health, largely through contextual exposures that can amplify or dampen opportunities for good health, wellbeing, and civic participation [8].

Urban liveability presents policymakers with opportunities for improving population health, yet the implications for health equity remain unclear. On one hand, it is feasible that if the concepts are adopted using a pro-equity lens then urban liveability will benefit multiple social determinants of health and reduce the social gradient of health. On the other hand, there are legitimate concerns that uneven implementation of liveability interventions may exacerbate socio-spatial circumstances

and eventually further widen health inequities. Yet, there has been little work examining whether the urban liveability agenda poses an opportunity or threat to reducing health inequities.

The urban liveability agenda as an environmental justice concern

The urban liveability agenda has evolved over time. It emerged in Canada in the 1960s as a collective approach to urban development and planning that focused on people rather than economy. Different conceptions of liveability materialized from this time onwards, dependent on context and purpose. Urban social movements have used liveability to stimulate active citizen engagement and challenge pro-growth urban agendas; governments and housing corporations have applied urban liveability concepts to advocate for and influence the social composition of neighbourhoods [24]; and in other cases, the urban liveability agenda has served to support entrepreneurs and protect privilege [25], or advocate for those more vulnerable [26]. More recently, urban liveability has been applied as a popular economic and global marketing tool [27]. This application provides city-level assessments that mask inequitable resource and opportunity distribution throughout a region and the potential impact this may have on those who are more vulnerable. We contend assuming homogeneity across a city has limited utility for guiding policies to reduce inequities [8].

These arguments are consistent with 'environmental (in)justice' literature, which has shown a clear and consistent relationship between social and environmental disadvantage. International studies are regularly finding that socially disadvantaged and disempowered groups disproportionately bear the burden of environmental disamenities (e.g. poor quality housing), as well as having worse access to opportunity structures (e.g. high quality greenspaces or public transport). It is increasingly recognised that this uneven distribution of environmental risk has implications for health inequities, with some groups suffering from the 'triple jeopardy' effects of social, environmental, and health disadvantage [28, 29]. Epidemiological studies demonstrate that the social gradient is often partially accounted for by the unequal distribution of good-quality

environments. This is not only due to uneven environmental exposure, but also because those faced with socioeconomic adversity are more susceptible to disadvantageous environmental circumstances [30]. Further, other strands of environmental justice research are uncovering the processes that lead to this the socio-spatial patterning of environmental resources.

It is increasingly apparent that socially disadvantaged populations are less able to influence decision making related to the investment of resources in public and private infrastructure [31]. At the governance level, equity, when converging with democracy and diversity, shape urban justice. For example, greater variety of participation in (diversity) and wider discussion (democracy) on urban planning processes is thought to produce fairer outcomes (equity) [32][146]. This body of work has largely emerged through observing systematic injustices and power differentials occurring within cities, primarily encountered by those living in poor neighbourhoods [32].

Together, many historical and contemporary processes are at play in shaping local environments including the structure of labour markets, residential segregation, political empowerment, historical patterns of industrial changes, as well as many other concerns [31, 33]. It is helpful to consider the distribution of urban liveability attributes using an environmental justice framework. Such thinking offers the potential to understand geographic inequities of urban liveability, and interrogate how this relates to social disadvantage and implications for health inequities.

Aim of the paper

Using an environmental justice lens, this paper seeks to identify if urban liveability is an appropriate lever for responding to the major public health challenge of reducing health inequities. We briefly review and discuss the: 1) evidence examining how the delivery of urban liveability-related attributes can dampen or amplify inequities; 2) potential attribute-specific strategies for reducing inequities within a developed country context; and 3) outline a future research agenda for urban

liveability within the context of flattening health inequities. Given the wide range of domains and

disciplines included in the scope of this paper, it was unfeasible to conduct a systematic review.

Contextualising disadvantage within the neighbourhood setting

A large body of epidemiological research has demonstrated those experiencing concentrated

poverty (i.e. being of a lower socioeconomic position and living in poor neighbourhoods) experience

'double disadvantage', which results in high rates of mortality and morbidity [23]. One pathway

through which this operates is deprivation amplification, whereby access (or lack of access) to

environmental resources compounds individual-level advantage or disadvantage [34]. Living in

concentrated poverty increases inequities by reducing local exposure to 'liveable' neighbourhoods,

which in turn limits social and economic participation, and produces poorer health outcomes [35]. A

mechanism for reducing concentrated poverty is through optimising urban liveability exposures (i.e.

the social determinants of health), such as local opportunities for meaningful employment and

education, walkable communities, and healthy food purchasing. Yet if these 'opportunity structures'

are not available locally, the potential to live a health promoting life in one's neighbourhood is

limited [34, 36].

Those who are more vulnerable, such as older adults, people with disabilities, families with

young children, the economically disadvantaged, the infirm, and children, are most likely to

experience geographic mobility restrictions as they may have limited resources to leave the

neighbourhood for discretionary purposes. In turn, these groups are more reliant on the opportunity

structures available locally and are at risk of concentrated poverty [36]. Yet, there is evidence that

residing in areas with greater amenity (i.e. neighbourhoods that are more liveable) can have the

opposite effect by 'pulling-up' those who are of lower socioeconomic position. This can mitigate the

effects of the social gradient of health and concentrated poverty [23, 37]. For example, in the

Australian context, adults who were in the lowest socioeconomic position but lived in the most

advantaged neighbourhoods reported comparable levels of self-rated health to those in the highest

socioeconomic position but living in the least advantaged neighbourhoods. Unsurprisingly, those

who reported the poorest self-rated health overall experienced the highest levels of concentrated

poverty [37]. If neighbourhood attributes that disrupt the usual conversion of socioeconomic

disadvantage into health disadvantage can be identified, then these 'equigenic' properties of places

offer significant policy opportunities for ameliorating health inequities [38].

Liveability attributes as a mechanism for impacting inequity

Returning to the earlier definition of liveability, the following section discusses how selected urban

liveability attributes, being: education; employment; geographic access to food, alcohol, and

tobacco; green space; housing; transport; and walkability, can serve to widen or narrow inequities.

The domain selection occurred as part of a major research program, including extensive reviews of

the urban liveability literature and indicators [6, 8]. For each domain, we developed and tested a

conceptual framework against plausible associations with health and social behaviours and

outcomes [11, 39-45].

This paper builds on two earlier review papers that examined associations between

liveability and health and wellbeing [6, 8], by explicitly and critically appraising domains of urban

liveability through an equity perspective. Several of the domains identified in the previous reviews

are examined, alongside geographic access to alcohol and tobacco. While crime and safety, health

and social services, leisure and culture, and social cohesion and local democracy were included in

the earlier reviews, they are excluded from this paper. Health and social services and leisure and

culture were shown through our work to be less strongly associated with health and wellbeing [46],

and we now regard crime and safety, and social cohesion and local democracy as being more distal

determinants of urban liveability. The domains presented in this paper focus on the 'causes of the

causes', which through various pathways (such as exposure to air and traffic pollution, crime and

safety) impact health and wellbeing. For example, walkability captures the street network, local destinations, and density; this impacts travel mode opportunity and choice, which in turn influences exposure to air and traffic pollution, and subsequently health and wellbeing.

Relevant papers were initially sourced through reviewing references identified through a major urban liveability work program that investigated these domains in relation to health and wellbeing (for example, [15, 41-43, 47-51]. Additional sources were recommended by the authors and guided by key reports focussed on the social determinants and social gradient of health [12, 13]. Sources spanned qualitative and quantitative studies, peer-reviewed and grey literature, with no country or date exclusion applied. Documents needed to be available in English and in full text. We briefly summarise the evidence for each domain in relation to the benefit of the attribute, how geographic access may differ by socioeconomic status, and opportunity for intervention to reduce health inequities. A summary diagram showing the associations between domains of liveability with health and wellbeing, and inequity is presented in Figure 1. We acknowledge that a range of marginalised or vulnerable groups (e.g. older adults, children, people with disabilities) could be considered within the scope of this paper, alongside different geographic or country contexts; however, in the interests of presenting a focussed argument we concentrate on associations with socioeconomic status in developed countries.

[INSERT FIGURE 1 ABOUT HERE]

Education

Education attainment is a key predictor of mortality and morbidity across the life span [23]. Gaining a formal education, especially in childhood, is strongly associated with enhanced health and economic trajectories over the life course [23], as well as reduced likelihood of committing crimes and deviant behaviour [52]. Provision of universal education at primary and secondary school levels improves socio-economic position by reducing family size [53], and through gaining literacy and

numeracy skills that improve employment opportunities [23, 52]. Importantly, these associations hold across the social gradient [52, 54].

Local, good quality education appears to have a disproportionate positive effect for those who are more socioeconomically disadvantaged [52, 55, 56]. The socioeconomic profile of a school is a better predictor of learning achievements than students' individual socioeconomic position [54, 56, 57], and has also been shown to reduce the effect of students' socioeconomic background by approximately 25%, though this varies considerably depending on country [58]. An earlier meta-analysis drawing on international data showed that after accounting for covariates such as family socioeconomic status and prior education, between-school socioeconomic variation accounted for 8% of students' academic achievement [59]. While this is the case, use of education facilities can be socio-economically patterned. For example, the UK's Sure Start initiative identified that less disadvantaged families (when compared with the most disadvantaged families) were more likely to benefit from preschool programs located in disadvantaged areas. As such, provision of education facilities alone is unlikely to be a sufficient intervention to reduce inequity [60].

In this way, the education sector may be further contributing to inequities by privileging less able students from less disadvantaged backgrounds. This creates location-based barriers for more talented students who are more disadvantaged [58]. For example, an Australian study showed fewer absolute and relative numbers of early child care centres were available in more disadvantaged neighbourhoods, and where available, were of lower quality when compared with centres located in less disadvantaged neighbourhoods [55]. Moreover, the study showed that each quintile increase in neighbourhood socioeconomic status yielded a higher number of local centres available that provided long-day care services (n=468 (most disadvantaged neighbourhoods) versus n=624 (least disadvantaged neighbourhoods) [55]. This shapes the range of employment that caregivers can undertake. A similar patterning of school quality and location has also been shown in many countries [57, 58, 61].

Similar to others [58, 61] and as shown by the overwhelming impact education attainment has on immediate and long-term outcomes, consistent social gradient evidence across multiple countries, and demonstrated socio-spatial patterning of education facilities, we argue the need for investment to support the increased availability and quality of education services located in disadvantaged areas. Evidence suggests applying such an approach will go some way to mitigating the effects of socioeconomic position related to educational performance, and potentially has a major role in flattening health inequities both in the short- and long-term.

Employment

Being in meaningful employment is important, not only for economic productivity and financial security, but also for civic participation, personal development, and long-term health [23]. Yet, employment patterning mirrors the social gradient, where those most likely to be under- or unemployed are the poorest, from minority groups, people with disabilities, and single parents [62]. Those who are under- or unemployed, or working in poor employment conditions, such as within a casualised labour force, tend to have worse physical and mental health when compared with those in full-time employment [23]. To compound this, declines in physical functioning occur approximately 12 years earlier in those with lower, compared with higher, employment grades [62].

Evidence suggests a socio-spatial patterning of employment, whereby in many settings higher-skilled workers tend to live more centrally and those with lower-skill levels live towards the city fringes [63]. This trend likely occurs in part because more affordable housing tends to be located on the urban fringe [64]. It also reflects where job opportunities are located. Higher-skilled jobs tend to be concentrated in the more desirable inner city areas, whereas lower-skilled jobs are more dispersed through suburbs and urban fringe areas [65]. Travel survey data from the US provides further evidence that in cases where employment is centrally concentrated, average commuting distances and times are positively and proportionally related to urban sprawl [66]. Other US research shows that relocating to the urban fringe generally decreases access to local employment

opportunities; however, this decrease is inequitably distributed. Those who are most disadvantaged experience a ~17% reduction in local job opportunity versus ~6% decrease for those least disadvantaged on the urban fringe [67]. Hence, those living and working on the urban fringe likely need to engage in longer commutes to access jobs, and this is most evident for those who are most disadvantaged [43, 68].

For those more disadvantaged, having jobs available in the local region is important. This group may be constrained by the cost of housing, and therefore, where they can afford to live [63]. They may be further disadvantaged if they need to rely on private automobiles for commuting, and therefore have to purchase and maintain at least one, and often numerous, vehicles per household [69]. This may be because existing public transport infrastructure is insufficient to employment hubs (particularly evident in the urban fringe), working hours do not match public transport timetables, or there is a need to travel to multiple places of work (e.g. tradespeople) [47]. These create the conditions for 'transport disadvantage', which disproportionately affect those of low socioeconomic status [42, 48]. Conversely, higher income and skilled workers are more able to absorb car ownership and commuting costs, alongside greater choice in where they work, live, and potentially how they commute [67].

For dual-income households living in an unbalanced jobs-housing environment (i.e. having limited opportunity for employment in a region), options are for at least one income earner having a longer commute, or seeking sub-optimal employment closer to home to maintain an established time budget commute [70]. As such, women are more under-utilised in the labour force than men [71], largely because they are more likely to alter their career ambitions to fulfil household and carers duties [72]. This is an important social and economic issue, whereby employment aspirations are not being met, skillsets are not maximised to their full potential, and there may be long-term gendered financial implications through lower wage accumulation and superannuation contributions [73]. Although unknown, it may be this phenomenon impacts those most who live on the urban fringes where local employment opportunities are fewer.

Improving the jobs-housing balance across a region, especially across middle and outer suburbs, is one strategy to encourage economic participation and reduce inequity. Such an approach includes not only considering the number of jobs available, but also occupation type, employment security, and remuneration, and whether regional labour markets can be readily accessed by high quality and affordable public and active transport modes [47]. Having an appropriate jobs-housing balance across a region is becoming increasingly important as household structures are increasingly becoming dual-income earners [71], and governments are identifying ways to decentralise labour forces [74].

In summary, a longstanding body of work points to the established social gradient for types of employment and its outcomes, while more emergent evidence demonstrates the socio-spatial patterning by employment opportunity and social gradient. Those who are more disadvantaged potentially have reduced employment opportunity and are exposed to higher levels of transport disadvantage. A potential solution that is gaining political popularity is to create more equitable employment opportunities by dispersing jobs throughout regions (including into middle and outer urban areas) through the creation of employment hubs that require a range of skill sets and offer fair and decent working conditions. However, for such an approach to reduce inequities, regions of concentrated employment need to be adequately serviced by high quality and affordable active and public transport infrastructure and services [75].

Geographic access to food, alcohol, and tobacco

Access to affordable and high quality food provides the foundation for good health and development through the pathway of diet [76], yet globally at least 2.6 million deaths a year are attributable to insufficient fruit and vegetable intake [77]. There has been a large body of research in the last decade demonstrating access to, availability of, and a variety of healthy food are associated with better diets [76, 78]. Conversely, fast food outlet availability has been associated with fast food purchasing and consumption, with associations strongest for those most disadvantaged [79].

Although the strength of association differs by country and challenges in study reproducibility remain [76]; generally, those living in less disadvantaged neighbourhoods appear to have greater access to fresh food providers, while more disadvantaged areas have a higher concentration of fast food outlets [80, 81]. A recent Australian study showed the delivery of supermarkets (major providers of fresh food) across a city was inadequate to meet population demand, and perhaps more importantly, having a supermarket available locally (< 1km) was protective of body size for those who were more disadvantaged [82]. Notably, the study examined those who were 'doubly disadvantaged', being residents who did not have access to a supermarket within 1km, lived in neighbourhoods of high disadvantage, and had low public transport availability and car ownership. Twelve per cent of the study population experienced this double disadvantage; however, this increased to 19% when the urban fringes were considered in isolation, suggesting multiple disadvantages at play [82]. Conversely, other research from New Zealand has shown those living in the least disadvantaged neighbourhoods have an 80% longer travel time to access a supermarket relative to those living in the most disadvantaged neighbourhoods [80]. These food environment findings, when taken together, suggest differences in access exist by country-context, and further work is needed to understand the contributors to these differences.

Minimising access to alcohol remains an important global public health strategy for reducing alcohol consumption and associated harm [83]. There is clear international evidence that a greater concentration of alcohol outlets, particularly off-license outlets, exist in more disadvantaged areas [84-87]. To compound this, research has shown that living close to an off-license outlet (< 800m) in disadvantaged areas was significantly associated with poorer self-rated health, but no significant effect existed for alcohol outlet proximity in less disadvantaged neighbourhoods [41]. Other research has shown, despite evidence of socio-spatial patterning of alcohol outlets in Scotland, no differences in alcohol consumption existed by socioeconomic status except for low income 'problem' drinkers who lived in higher residential density neighbourhoods [87]. This suggests that alcohol outlets tend to cluster in areas of low socioeconomic status, and may have a disproportionately

deleterious effect for these residents.

Tobacco use is a major public health concern; compounding this, a social gradient exists for tobacco-related harm that persists across the life course [88]. Furthermore, international smoking rates show steeper declines for those in higher socioeconomic position compared with lower socioeconomic positions [89], and tobacco cessation programs have the lowest success rates in the most disadvantaged [90]. Similar to alcohol outlets, access to tobacco retailers is socio-spatially patterned with the most disadvantaged neighbourhoods having the highest densities of outlets [91], and availability of tobacco outlets has been positively associated with smoking rates [92]. A recent Finnish natural experiment study showed that moving into more disadvantaged neighbourhoods was associated with higher odds of smoking overall and lower odds of quitting smoking [93]. The study authors [93], as well as others [91], suggest mechanisms explaining these relationships include exposure to neighbourhood norms, and of relevance here, greater access to tobacco outlets.

To our knowledge only a few studies have examined the accumulation of multiple types of 'pathogenic' outlets by area-level disadvantage. A German study capturing 92,000 residents, showed positive relationships between increased neighbourhood disadvantage and the number of local outlets supplying fast food, alcohol, or tobacco products [94]. Another study identified co-location of alcohol and tobacco retail outlets in Scotland [91]. Other evidence points to correlations between demand for, and exposure to, alcohol and tobacco [95, 96], but no studies have examined causation between the food and alcohol environment by neighbourhood socioeconomic status.

Taken together, the (largely cross-sectional) evidence base for this domain is strongest for the social gradient and spatial patterning of alcohol and tobacco outlets, and remains mixed when considering fast food and healthy food outlet distribution. However, we contend the existing body of research supports a need for a greater governance and regulation for the geographic distribution of food, alcohol, and tobacco. On one hand, supermarkets (and other fresh food suppliers) need to be equitably located across a region and accessible by public or active transport modes. On the other hand, the availability of alcohol and tobacco outlets (and fast food outlets depending on the country

context) needs to be restricted through more effective policy regulation, especially in more disadvantaged neighbourhoods. In this way, exposure to pathogenic environments can be minimised, especially for residents living in more disadvantaged neighbourhoods.

Green Space

Access to and availability of green spaces are independently important for a range of health and wellbeing behaviours and outcomes across the life course, including prenatal development and birth outcomes, child development and behavioural outcomes, physical activity, mental health, social development and cohesion, and reductions in blood pressure, risk of chronic conditions, and stress levels [97, 98]. Consequently, green space provision has received much attention in the built environment and public health fields, see for example [49-51, 98].

A smaller body of work has looked at the association between disadvantage and green space access. Mitchell and Popham [99] showed income-related health inequity gradients were flatter in English populations with higher levels of green space exposure. Despite this benefit, analysis of green space availability across Australia's five most populous cities identified the most disadvantaged neighbourhoods had the least amount of green space provision [14]. Similar associations have been shown in other countries [100]. UK research has provided evidence that larger, rather than smaller, green spaces were most strongly associated with health outcomes, yet larger green spaces were less likely to be located in more disadvantaged neighbourhoods [101].

A recent review applying an environmental justice lens investigated how green space may contribute to neighbourhood gentrification. The review identified a range of examples drawn from different cities and countries that received new or retrofitted green spaces showing increased neighbourhood property values and subsequent displacement of low income earners [100]. The authors suggest employing 'just green enough' interventions that are based on the residents' needs, desires, thereby potentially minimising opportunity for speculative development and neighbourhood gentrification. However, while novel, caution should be applied as this strategy remains untested

and likely requires substantial support from a range of local stakeholders [100].

Together, a consistent body of evidence demonstrates green space is an important exposure for supporting a range of good health and wellbeing outcomes across the life course, and a potentially critical tool for reducing health inequities if delivered appropriately. Yet inequities in green space quality and quantity distribution persist that privilege the advantaged, and neighbourhood-specific interventions need to respond to local community needs. Indeed, Douglas et al call for greater engagement with disadvantaged and minority communities when planning green space [98].

Housing

Housing is widely recognised as a major social determinant of health [18, 102], and can impact health through pathways of housing condition and toxicant exposure, residential neighbourhood, affordability, and housing tenure [103]. This paper focuses on the residential neighbourhood, affordability, and housing tenure attributes, and how these can impact health inequities.

A common strategy to accommodate population growth and provide more 'affordable' housing in many developed countries is the release of greenfield land on the urban fringe for residential development [64]. However, such developments often have high internalised and hidden ongoing costs, and while initially affordable, they may not be liveable as per the earlier definition. Urban fringe developments are typically located in sprawling, low residential density communities, with limited social infrastructure, and poor access to local employment, shops and services, and public transport infrastructure. This often generates longer, car-reliant commutes to work and education, and reduced opportunity for living locally [6]. Moreover, those living in the urban fringe are most sensitive to fuel prices [104]. Urban fringe housing developments typically attract young families who are seeking a certain type and size of house and land, which may be less affordable in the inner and middle suburbs [68]. This can manifest as multiple disadvantages, whereby those who have lower household incomes (i.e. younger families) and are time poor are pushed to the urban

fringes where employment opportunities and infrastructure are lacking, and there becomes a forced reliance on private car use for commuting longer distances [43, 64, 68]. While it could be that those who live on the urban fringes prefer an auto-dependent lifestyle, research shows a major motivation for car ownership is when other transport modes are lacking [64].

Another approach to accommodate population growth is building apartments in high density environments, typically within or close to the central business district. Largely because of their proximity to the city, these neighbourhoods tend to be more liveable and less reliant on automobiles than those located on the urban fringe. By itself, a certain threshold of residential density lays the foundations for destinations and services to be commercially viable, and creates a lively and diverse social fabric [105]. However, a range of problems can occur if high density developments are of low quality and poorly integrated. Negative outcomes include poorer mental health and social isolation for residents [106], as well as poor ventilation, exposure to noise and air pollution, and lack of natural light [107]. Furthermore, because of the small size of many inner-city apartments, they are unable to healthfully and socially support diverse family compositions and ageing-in-place [105].

While urban fringe developments and inner-city densities are common housing policy levers, another housing consideration is affordability. Indeed, housing affordability remains a major concern for many developing and developed countries, especially in urban areas [108]. It is estimated that 34% of European households are facing housing affordability stress, and this is disproportionately distributed. Those at risk of poverty (classified as the lowest 60% of median equivalised income) spend 41% of their income on housing, compared with 10% of all European households [109]. Living in unaffordable housing has implications beyond financial burden. In a sample of over 10,000 Australian adults, entering unaffordable housing (as defined by weekly housing expenditure > 30% of income) was associated with declining mental health for those in low-to-moderate income households, but not for those in higher income households [110].

One contributor to housing affordability is gentrification, which is evident in many inner and middle suburbs. Gentrification can occur in three ways, and often in combination, being: increases in house prices, upgrades of housing stock, and social upgrading (displacement of certain population groups). As a consequence these actions stimulate changes to the local population, employment opportunities, housing types, and commercial activities and amenities [111], many of the attributes that contribute to the liveability of a neighbourhood. Causes of gentrification are wide-ranging and multilayered, and include the: rising economic value of land; high mobility of high income earners; desire for architecture and design evident in older traditionally working class suburbs; and, aspiration to live closer to the central business district and / or close to amenity [112]. It has been argued that a small amount of gentrification can help break the cycle of concentrated poverty [113]. However, pronounced gentrification, predominantly experienced through substantial and sudden rises in house and rental prices as often seen in the inner and middle suburbs, can have enormous deleterious effects for those who are most marginalised with the end result being displacement. As a result, those who are more disadvantaged may be forced to move away from their neighbourhood, social networks, and place of employment [111, 113]. Conversely, there is evidence showing that moving individuals from high to low poverty neighbourhoods or improving the neighbourhood can stimulate better health outcomes [103]. However, caution should be applied to interventions focused on relocation (or displacement) as this can serve to deepen concentrated poverty for the remaining residents, potentially causing further harm.

Clear evidence drawn from a range of countries shows associations between the social gradient and housing for tenure, affordability, concentrated poverty, and health. Strategies to overcome these challenges and reduce inequities lie in the provision of an adequate supply of diverse housing types across a region that can be accessed by those on a range of incomes. Where possible, social and private housing should be co-located and positioned next to public transport services and close to employment and education hubs; this will provide levers to minimise the negative effects of gentrification and maximise employment and education opportunities [43].

Pricing structures have use, such as rent controls, and regulatory strategies such as security of tenure should be in place to minimise displacement as neighbourhoods gentrify [111].

Transport

Provision of accessible and affordable transport that is regular and reliably available has an important role in supporting access to employment, education, recreation, food, health and social services, and to socialise with family and friends [6, 23]. Furthermore, access to public transport influences the economic capacity of cities through traffic congestion pathways [114]. However, not all transport modes are equal in terms of producing good health, environment, and social benefits. On one hand, having public transport stops located near homes not only supports active transport commuting (i.e. walking or cycling to and from the public transport stops), but also extends the reach of regional labour markets and the range of destinations that can be accessed outside of the neighbourhood via the public transport network. This reduces social inequities by increasing productivity, earning potential, social engagement and inclusion [115], as well as promoting good health and wellbeing and sustainability across the population [15]. In the face of a rapidly growing and ageing population and swift urbanisation, providing access to public and active transport infrastructure are seen as a critical factors in good urban planning [15, 108].

On the other hand, neighbourhoods that are auto-dependent (as often seen on the urban fringe) commonly have poor access to high quality public transport and active transport infrastructure [64]. When combined with largely residential land use, commute distances to access daily activities, such as employment, are lengthened and car-reliant [116]. One potential immediate consequence from living in an auto-dependent neighbourhood is forced car ownership; being the need for households to purchase and maintain one or more vehicles to maintain mobility for participation. Indeed, if a car (or driver) is unavailable in an auto-dependent neighbourhood, opportunities for economic and social participation are drastically reduced, which can stimulate a cycle of poverty and entrapment through reduced opportunities for meaningful employment and

skill development [117]. Indeed, earlier research from the UK reported 38% of job-seeking adults reported lack of transport opportunities as being a major barrier to finding employment [118].

Individuals who lack access to public transport are more likely to experience 'transport disadvantage', which is the inability to travel when and where one needs without difficulty [119]. Those who experience transport disadvantage are in turn more likely to experience social exclusion [64], and further socioeconomic disadvantage due to the forced ownership and maintenance of (often multiple) private motor vehicles [69]. They are also more vulnerable to increases in fuel prices and mortgage stress as they may receive lower incomes [117], and research has documented associations between risk of housing foreclosure and households with higher car ownership [120]. It has been estimated that 20% of those living in the urban fringes of Melbourne, Australia, have below median household income yet own and maintain at least two cars, compared with 6% of those living in the inner suburbs [64]. Minimising (with the aim of removing) transport disadvantage can also benefit the overall population by significantly reducing welfare and health expenditure, and increasing economic capacity [119].

A more distal consequence of car reliance is the impact on the quality of the local environment. This includes greater risk of traffic injuries [121], reduced sense of community [122], and higher levels of noise and air pollution [123]. The impact of exposure to poor quality air is not inconsequential; in 2010 mortality and morbidity costs from air pollution in OECD countries were estimated at US$1.7T [124], and emerging evidence suggests there is an interaction between pollution and non-communicable disease risk factors [125]. Low-income communities not only tend to face the burden of higher levels of pollution but are also more susceptible to the health effects of exposure [126]. Therefore, exposure to air pollution may have a more deleterious effect for those more disadvantaged as per the social gradient of health.

In order to be effective, transport planning needs to be integrated with urban planning and delivered to communities in a timely manner. The evidence clearly shows that transport infrastructure availability is related to travel mode choice [127]. Using residential mobility data, with

all other things equal, higher levels of suburbanisation was associated with higher levels of private car use, and lower levels of walking, cycling, and public transport. The opposite relationship existed for those who relocated to inner-city neighbourhoods with good public transport services [128].

In summary, the pathway for the social gradient and transport accessibility is informed by residential location in relation to other key destinations. Much evidence shows a spatial patterning of public and active transport, generally showing higher levels of infrastructure availability in inner city areas compared with middle, and to a greater extent, outer ring suburbs. In turn, these environmental exposures contribute to transport disadvantage and pollution exposure, of which have social gradient patterning. Therefore, residential densities need to be adequately distributed throughout a region to enable public transport services to be commercially viable, and the services need to travel to meaningful destinations. At least within North American and Australasian contexts, efforts should be put into urban fringe developments, which typically experience lower levels of public transport access, in an attempt to reduce the impacts of transport disadvantage.

Walkablity

The creation of walkable neighbourhoods are regarded as a laudable ambition by a range of perspectives, including public health, environmental justice, transport, and urban planning [48]. A walkable neighbourhood is generally described as one with diverse land uses and destinations, well-connected street networks, high residential density, and good pedestrian infrastructure and amenity [13]. Walkable neighbourhoods encourage active and public transport modes for commuting to a range of destinations [48], generate environmental benefits through reduced reliance on fossil fuels and reductions in greenhouse gases, stimulate more frequent social interactions [23], and provide opportunities to habitually engage in physical activity, which in turn protects against many non-communicable diseases and obesity [129].

A considerable evidence base demonstrates associations between higher levels of neighbourhood walkability and favourable health outcomes [13, 130-132]. When considering

walkability and inequity, the findings are mixed and may be country-context specific. Australian research has shown disadvantaged neighbourhoods (not located on the urban fringe) tend to be more walkable, with residents being more likely to walk for transport and have lower car ownership relative to those from less disadvantaged neighbourhoods [133]. Similarly, a New Zealand study showed more disadvantaged neighbourhoods were more walkable [80]. Alternatively research from the US has shown neighbourhoods at either end of the disadvantage spectrum being the most walkable; the least walkable neighbourhoods were those with high proportions of resident children and older adults [134]. Arguably, children and older adults are those who would most benefit from living in more walkable environments as they are more likely to rely on their local environment.

While the concept of walkable neighbourhoods is widely accepted, there is debate as to how and which components contribute to walkable neighbourhoods for different populations (e.g. children, older adults) [48], and recognition of the epistemological, methodological and thematic narrowness of the current walkability agenda [135]. Furthermore, the benefits realised from living in a walkable neighbourhood may be conditional on other factors, and this effect is greatest for those living in more disadvantaged neighbourhoods. For example, poorer neighbourhoods often have higher residential densities and land use diversity (that is, they are more walkable as per the general definition), but this may be counteracted by more strangers in the area and higher rates of crime [136]. These concerns may detrimentally affect local perceptions of safety and limit engagement with the local neighbourhood with implications for the social and health benefits a walkable neighbourhood may afford [137]. Gentrification and accelerated appreciation of housing values are also more likely to occur in more walkable neighbourhoods [48], and this is particularly evident for neighbourhoods located closer to the inner city or to public transport nodes [138]. Therefore, through the mechanism of gentrification, walkability has the potential to displace those who are more vulnerable.

More walkable neighbourhoods have higher levels of air and noise pollution and traffic exposure, largely because greater street connectivity facilitates stop-starting of vehicles and

increased densities contribute to concentration of activities and higher building heights, which

generate and / or trap pollutants [134]. While higher levels of walkability overall have been

associated with higher levels of $PM_{2.5}$, a social gradient exists whereby all other things being equal,

the association between intersection count and air pollution is stronger for more, when compared

with less, disadvantaged neighbourhoods [139]. In addition, traffic-related injuries are highest in the

most disadvantaged neighbourhoods, even after for controlling for walkability attributes [140].

In summary, countries and cities differ in terms of social gradient in access to walkable

neighbourhoods; however, there does seem to be a consistent social gradient patterning for the

effects of walkability. In order to harness the numerous benefits of living in walkable communities

and reduce inequities, additional consideration of design elements for creating walkable

neighbourhoods in disadvantaged communities may be required [141]. Factors to consider include

encouraging natural surveillance, integrating with housing and transport policies to mitigate any

gentrification effects, designing adequate ventilation and noise reducing strategies, and provision of

safe streets and crossing points for those more vulnerable.

A future research agenda for urban liveability

Liveability as a complex system

As demonstrated by the evidence presented, while the notion of 'urban liveability' is fairly new to

the public health discipline, there is, to varying degrees, a substantial body of research that has

examined the separate domains of urban liveability. Taken together, some domains show consistent

evidence internationally (e.g. housing), others suggest context-specific findings that make it difficult

to draw general conclusions (e.g. food), and some show a reverse patterning with the social

gradient, but with poorer outcomes (e.g. walkability). This points to considering liveability a complex

system; that is the combination of and interactions between the domains that determine the

liveability of an environment [15, 142]. Future work in this field needs to not only continue to

explore the downstream associations, but also seek to gain a deeper understanding of the urban liveability system and interactions beyond the sum of its parts, including feedback loops, and non-linear and linear responses [143]. For example, affordable housing not only has to be made readily available, but it needs to be located close to jobs, education, destinations and services, which in turn are able to be accessed via walkable streets or by public transport. Omitting one or more of these domains undermines the synergistic effect of liveability and potentially will result in poorer health and social outcomes and steeper social gradient of health. While all critical components, it is likely individual domains of urban liveability will require more or less attention for a given context or composition, and this will be informed by the governance structure, strategic priorities, demographics, and available infrastructure and resource within a region.

Urban planning policy typically delivered by local government is an important and well-established lever for modifying the social determinants at the neighbourhood level (e.g. employment opportunity, living conditions). These initiatives are commonly activated through targeted neighbourhood / community renewal interventions and investments that respond to the needs of the resident population, and are collectively described as area-based initiatives [144]. While not specifically targeting urban liveability, area-based initiatives provide emergent examples of harnessing this complexity by pursuing multiple social determinants of health simultaneously within an urban neighbourhood context. Area-based initiatives commonly seek to redress inequity through a range of interventions tailored to the community needs, and have largely been executed in the United Kingdom. Thus far the results have been modest, and in some cases mixed [103, 144], with criticisms aimed at unrealistic ambitions, too short time-scale, and the utility of a small-area intervention site to stimulate wider national change [144]. Also, as shown with the earlier Sure Start example [60], area-based approaches to addressing social and health inequities may not reach the target population. However, there is some evidence that area-based initiatives can improve the social determinants of health, and in turn, social and health outcomes and the social gradient in intervention sites. For example, a ten-year evaluation of the New Deal for Communities showed that

relative to those most disadvantaged in England, those living in the 39 New Deal for Communities

intervention neighbourhoods showed steeper improvements over time in qualification attainment

(p=0.04) and self-rated health (p=0.09). The authors concluded that area-based initiatives could

prevent, if not reduce, the widening of inequities over time [145].

There is now an opportunity to apply learnings from area-based initiatives to the broader

urban liveability context, as well as extending area-based initiatives to capture the 'liveability'

planning and policy levers that impact the social determinants of health. Similar to area-based

initiatives, it is likely that strategies that enhance urban liveability will require moving beyond a 'one

size fits all' approach to rely on different priorities, levers, and urban policies depending on

contextual and compositional needs [142]. This echoes the seminal work of Healey who called for

greater attention to be paid to the complexity and diversity of urban governance and public interest

in local contexts through collaborative planning [146]. Recent planning theory has since identified

the potential scalability and generalisability of collaborative planning for application at the city scale

in the face of multiple, and often competing, vested interests [147]. Such an approach and learnings

could be further incorporated into area-based initiatives.

The multiscale dimension of urban liveability

This paper, as well as others [15, 148], argue the need for urban liveability to be considered at

various scales. For example, the local residential neighbourhood environment may be critical for

domains such as housing and education, whereas the regional setting is likely more important when

considering employment opportunity. Furthermore, a recent study highlighted that geographic scale

applied (city, country, and macro-regional) differentially impacted urban mortality across multiple

European cities [148]. Urban liveability is also shaped by the governance and leadership that guides

planning policies, and can originate locally, regionally, nationally, and potentially globally [8]. So far,

the political economy of the urban liveability discourse has done little to address poverty and class

structures [31, 33]. Currently, there is an acknowledged exclusion of more disadvantaged people in

planning processes and outcomes [32, 146], and it remains rarely explicit as to which policies would produce a more just city [32]. The New Urban Agenda's principle commitment of 'leaving no one behind' provides a potential platform to bring these issues to the forefront through an explicit equity lens to urban planning and policies and the broader urban liveability agenda.

The dynamic nature of neighbourhoods and people

The contextual (place) and compositional (people) components of neighbourhoods constantly evolve, albeit at varying paces. These changes impact differently for the 'movers' and 'stayers' and is an important consideration within the context of urban liveability and inequity. In the face of gentrification, the consequences for long-term residents who are disadvantaged can be immense, largely through substantial and abrupt increases in localized rental prices. This can cause anxiety and financial stress, and if unable to afford the market rent, commonly results in displacement and alienation from society [113]. In contrast, the benefits of relocation to the individual can be vast in circumstances where people can afford upwards mobility. On one hand, US data showed those who moved from high to low poverty neighbourhoods improved their physical and mental health and subjective well-being, even though their economic capacity did not change [149]. On the other hand, those who are constrained from relocating 'upwards' from disadvantaged or declining neighbourhoods may experience increased levels of concentrated poverty [150]. Building on the emerging literature in this field and opportunity for natural experiments [151-153], a more rigorous understanding of drivers of and the subsequent impacts for movers and stayers will strengthen and deepen our understanding of urban liveability as a complex system. Returning to the urban justice argument put forward by Fainstein, better outcomes will be achieved if different viewpoints, especially from those who are disadvantaged, are incorporated into the planning process [32].

Recent work arising from the health geography discipline has focused on neighbourhood 'shapes' based on the range and location of activity spaces accessed, such as home, work, or school [154, 155]. This further adds to the dynamic and complex nature of a person's 'neighbourhood',

which may change over time depending on place of employment or education, or the range of destinations required for his or her lifestyle and life stage. Exposure to different types of neighbourhoods and their impact across the life-course has received less attention. The life course approach recognises that health is affected by the accumulation of social and economic (dis)advantages over a lifetime but, importantly, there are critical periods where exposure effects can be greater. For example, pollutant exposure in-utero [156] or education opportunity during early childhood [23] can alter health, social, and economic trajectories independent of individual socioeconomic status. Yet, only a small amount of research has focussed on how built environment exposures accumulate over the lifetime to influence health [157]. To date, a life-course perspective to the study of health and place remains uncommon, which has resulted in limited understanding of how the dynamics of person-health-place relationships are embedded within a complex system and the subsequent causal inferences that can be made [158].

Liveable for whom?

This paper sought to bring a social equity perspective to the urban liveability agenda by synthesising the evidence base for the geographic inequities of urban liveability in relation to the social gradient and health inequities. It focussed on interrogating these relationships in terms of social disadvantage; however, we recognise there are numerous types of discriminations and inequities people are exposed to. Other population groups (e.g. people with disabilities, different age groups, race, or sexual orientation) may have different requirements from and associations with the urban liveability discourse, which in turn impact inequity trajectories. Future research needs to gain a more nuanced understanding of how urban liveability can support 'equigenic' environments for a range of different groups. This includes exploring the notion of urban liveability for a range of diverse demographic characteristics, including gender, disability, sexual orientation, and age profile. Equigenic environments have been described as those that seek to disrupt the usual conversion of adversity, socioeconomic or otherwise, to a greater risk of poor health [38]. This paper suggests

multiple urban liveability attributes have equigenic potential. Testing equigenic attributes, such as those highlighted in this paper, needs greater attention in the urban liveability research agenda in order to confirm their role in narrowing inequities.

Limitations

This paper sought to investigate the notion of liveability from an equity perspective, and how the delivery of domains of urban liveability may serve to flatten (or widen) inequity. In order to present a focussed piece, numerous parameters were placed. First, the paper was based on one definition of liveability and its associated domains. Another definition, say one that placed greater importance on environmental resilience and sustainability, may have yielded a different set of domains for consideration. Second, we focused on socioeconomic inequity within developed countries, rather than other types of injustices or multiple country contexts. Again, it is possible that examining the literature through a gender, age, disability, ethnic, or other type of disadvantage lens, or in a developing country context would have identified different associations and levels of importance across the domains. Third, this paper largely focused on access to selected domains of interest, and it is likely that quality and personal preferences also play important roles in shaping these relationships. Fourth, this paper focussed on urban, rather than rural contexts. While there may be some overlap between urban and rural liveability domains, it is likely that other considerations are relevant for rural settings and this requires further investigation. Last, methodological issues such as causality, neighbourhood self-selection, interactive effects, and lack of measurement comparability remain challenging, largely because the evidence base, while rapidly developing, is still in its infancy and there were few examples to draw on.

Conclusion

This paper has provided an alternative perspective on urban liveability by using an environmental justice framework to consider its potential for reducing health inequity. This paper sought to: 1) present the value of urban liveability as a tool for reducing inequities; 2) identify potential unintended consequences if liveability-related domains are not delivered in a way that is sensitive to the needs of the neighbourhood and its residents; and, 3) ascertain potential policy and planning mechanisms for delivering 'liveability' to enhance urban health and reduce inequities. As well as changes to the built environment, there is a need to monitor neighbourhood population changes over time to understand how liveability impacts the most vulnerable, especially in regard to displacement and pulling up effects. Understanding and modelling liveability as a complex system will provide much-needed information as to how different domains interact for different populations. Other areas worthy of further investigation include applying a life course approach, greater utilization of natural experiments, and investigating liveability within the context of other adversity and contextual settings. To conclude, we argue more disadvantaged neighbourhoods and / or residents likely need additional design (and potentially policy) and consultation considerations to protect and provide better outcomes, especially as changes to the contextual environment may impact the composition of the neighbourhood, through both displacement (negative outcome) and pulling up effects (positive outcome). As such, the urban liveability agenda, through regulation, urban planning mechanisms, urban justice, and the global New Urban Agenda, has substantial potential to narrow inequities.

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FIGURE CAPTION

Figure 1. Summary of the evidence for how domains of urban liveability are association with health, wellbeing, and inequity

FIGURE

EVIDENCE SUMMARY FOR HEALTH AND WELLBEING   **EVIDENCE SUMMARY FOR INEQUITY**

LIVEABILITY DOMAINS

EDUCATION
Education exposure is associated with lifelong economic, health, and social trajectories
- High quality education disproportionately benefits those more disadvantaged
- Higher quality educational facilities are located in less disadvantaged areas

EMPLOYMENT
Employment status and type are associated with financial security, economic productivity, civic participation, and health outcomes
- Those more disadvantaged have poorer working conditions
- Fewer local employment opportunities are available in middle and outer areas

FOOD, ALCOHOL, AND TOBACCO
Access to: healthy food outlets is associated with fruit and vegetable intake; fast food outlet access is related to fast food intake; and population-specific evidence exists for alcohol and tobacco outlet access and consumption
- Clustering of fast food, alcohol, and tobacco outlets exists in more disadvantaged areas
- Healthy food outlet and social gradient patterning is mixed

GREEN SPACE
Green space is associated with a range of health and wellbeing behaviours and outcomes
- Less green space provision in more disadvantaged areas
- Green space can reduce health inequities if delivered appropriately

HOUSING
Housing impacts health through pathways of housing condition, affordability, toxicant exposure, tenure, and location
- Housing stress has a social gradient
- Housing strategies that relocate or displace residents can deepen concentrated poverty

TRANSPORT
Specific transport modes are associated differentially with physical activity, body size, mental health, traffic congestion, traffic injuries, and air and traffic pollution
- Transport disadvantage and pollution exposure has a social gradient
- Access to public and active transport infrastructure extends the range of accessible destinations and reduces transport disadvantage and pollution exposure

WALKABILITY
Walkability is associated with physical activity, body size, some non-communicable diseases, and social cohesion
- Mixed associations for walkable areas and the social gradient
- Walkable areas in disadvantaged areas have higher pollution exposure and traffic exposure

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