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Can the neighborhood built environment make a difference to children's development?

Building the research agenda to create evidence for place-based children's policy

Running title:

Neighborhood built environment and child development

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Abstract

Healthy child development is determined by a combination of physical, social, family, individual, and environmental factors. Thus far, the majority of child development research has focused on the influence of individual, family and school environments, and largely ignored the neighborhood context despite the increasing policy interest. Yet given that neighborhoods are the locations where children spend large periods of time outside of home and school, it is plausible the physical design of neighborhoods (built environment), including access to local amenities, can impact on child development. The relatively few studies exploring this relationship support associations between child development and neighborhood destinations, green spaces, interaction with nature, traffic exposure, and housing density. These studies emphasise the need to more deeply understand how child development outcomes might be influenced by the neighborhood built environment. Pursuing this research space is well aligned with the current global movements on ‘livable’ and ‘child-friendly’ cities. It has direct public policy impact by informing planning policies across a range of sectors (urban design and planning, transport, public health, and pediatrics) to implement place-based interventions and initiatives that target children’s health and livable development at the community-level. This paper argues the importance of exploring the effect of the neighborhood built environment on child development as a crucial first step towards informing urban design principle to help reduce developmental vulnerability in children, and set optimal child development trajectories early.

Main text

Where children live influences their health and wellbeing

Healthy development in the early years lays the foundations and sets the trajectories for children’s ongoing physical, social, emotional, and cognitive development ¹. From birth, the

brain rapidly develops through ongoing processes where important neural pathways supporting complex skills are built on simpler ones developed early in life. With age, brain plasticity solidifies, making it more difficult for the brain to ‘rewire’ and learn new skills ². When children are exposed to stimulating and positive environments early in life, they develop foundational skills in learning, communicating, problem-solving, and decision-making ³. Healthy development consists of salient but interrelated aspects such as physical development, social competence, emotional maturity, language and cognitive development (e.g., academic learning), and general knowledge and communication ⁴. These exposures are essential not only for children’s lives in the present, but for their ongoing full healthy and productive participation into adulthood ^{5,6}. To set optimal child development trajectories, we need to understand the various contexts in which children grow and develop.

The science supporting the ecology of childhood suggests that children develop in multiple contexts including the family, peer group, and broader social and physical environments ⁷⁻⁹. The majority of child development research has focused on the influence of family and school environments, and has largely ignored the neighbourhood. The neighborhood setting is consistently recognised as an important level of influence in socioecological frameworks of child development ⁷⁻⁹. Neighborhoods may provide important exposures and resources that impact child development, with rich sources of stimulation and opportunities to explore, learn, and interact with others and their surroundings ^{3,10}. The built environment is one important facet of the neighborhood setting, yet understanding its potential impact on children’s development has been mostly overlooked. The built environment, as used here, is defined as “part of the physical environment that is constructed by human activity” ¹¹.

Meanwhile, emerging evidence in the built environment and health literature, suggests that the way we design and build neighborhoods can facilitate healthier lifestyles, and contribute to reducing the risk of non-communicable disease ¹²⁻¹⁴. Recently, Australian public health and urban design and planning disciplines have reconnected to advocate for building ‘livable’ cities to support urban populations, promote healthier and more sustainable lifestyles, and enhance quality of life and equity across the life course ¹⁵. From a built environment perspective, a ‘livable’ neighborhood viewed through a health and wellbeing lens, is conceived as one with access to affordable housing, with facilities, services and social (e.g., schools, and child care) infrastructure accessible by public transport, walking and cycling ¹⁶. On the other hand, a poorly designed neighborhood has less connected street networks, and limited access to shops and services ¹⁷, making it more convenient to choose driving as the primary mode of transport ^{18,19}.

Neighborhoods that are livable and pedestrian-friendly may also be considered ‘child-friendly’. Designing neighborhoods for children is gaining attention worldwide, and is exemplified by the Australian and global movements towards creating ‘child-friendly cities’ ²⁰. Such advocacy and interventions reflect children’s rights in policies and programs designed to enhance child health and wellbeing ^{21,22}. The discourse surrounding the creation of livable and child-friendly cities is not surprising given over half of the global population live in urban environments, and 70% of the world’s population will live in cities by 2050 ²³. As populations continue to grow and cities rapidly urbanize, the way neighborhoods are designed have significant implications for its residents, including the health and wellbeing of children and their families.

The evidence connecting children's health to the built environment tends to be focussed on the way children play, walk or cycle, and move independently through the neighborhood²⁴⁻²⁶. For example, children living in more 'walkable' neighborhoods (e.g., well-connected streets with safe crossing points, footpaths, local destinations present, and low traffic volumes and speeds) are more likely to be physically active when compared with those living in less walkable communities^{27,28}. While the majority of built environment and health literature have focused on child physical activity behaviors^{26,29} and obesity^{30,31}, the role of the neighborhood built environment specifically on child development is less well understood. Combined with evidence suggesting that children's regular physical activity benefits their cognitive and psychosocial development³²⁻³⁴, it is plausible that certain neighborhood built environment features not only benefit children's physical development, but is also associated with their broader development (e.g. social, emotional and cognitive)^{35,36}. Given early childhood is a time when one's environment can determine how the brain develops³⁷, it is important to identify potential key neighborhood built environment features, and more importantly, the combination of these features, required to give children the best start to life.

The neighborhood and child health and development

Research exploring the relationship between neighborhood attributes and child development is not new, and there are numerous existing reviews on this topic^{8,9,35,36}. However, most of these studies have explored the neighborhood setting in relation to factors seemingly unrelated to the built environment. These studies have traditionally focused on socio-demographic measures and include aggregated neighborhood-level measures, such as income, employment, occupation status, family structure, exposure to affluent neighbours, racial/ethnic diversity, and residential stability³⁸⁻⁴¹. These markers appear to reflect neighborhood structure or composition, and often serve as measures of

advantage/disadvantage of neighborhood residents⁴². Substantial evidence suggests that disadvantage appears to be geographically concentrated; disadvantaged people tend to live with other disadvantaged people, and that neighborhood disadvantage (or neighborhood deprivation;⁴³) is associated with a number of factors (e.g., socioeconomic resources) that differentiate people who live in more or less affluent neighborhoods^{38,44,45}. Neighborhood disadvantage has been associated with children's learning, academic performance, and social, emotional and behavioral outcomes, even after controlling for personal and family socioeconomic characteristics^{40,41}.

Child development research postulates that other social aspects of the neighborhood such as neighborhood stressors (e.g., crime, incivilities) and social organisation processes among residents (e.g., social capital, collective efficacy) may influence children's developmental outcomes^{45,46}. High levels of neighborhood social capital and collective efficacy (i.e., shared expectations, residential 'monitoring' of children's behaviour and intervention if necessary)⁹ have been linked to healthy child development and behavioral outcomes, even in deprived communities with fewer financial and educational resources available^{47,48}. These social aspects are further supported by some built environment and health evidence connecting neighborhood design with social interactions which, in turn, facilitate social capital⁴⁹⁻⁵¹. For instance, more walkable neighborhoods that are characterized by more connected streets, higher number of residential dwellings, and a greater mix of local destinations, have been found to increase social interactions as people are more likely to walk, cycle, and linger locally⁵⁰. While this evidence suggests a strong theoretical platform for expecting the neighborhood built environment to influence child development, there is a lack of studies examining relationships between the built environment and child development outcomes. Recently, Goldfeld and colleagues proposed a framework that comprised five interconnected

neighborhood domains, including the physical, social, socio-economic, service, and governance domains⁵². While we acknowledge that the built environment is only one aspect of the neighborhood, and shares considerable overlap with other neighborhood factors (e.g., socio-economic and social processes), this paper argues the importance of the built environment for healthy child development⁵². We necessarily draw heavily on research related to the built environment and other health and social outcomes in urban environments. This literature underpins our proposition that the built environment provides a mutable point of intervention for children's development through the design of health-promoting environments in which young children live, grow and develop.

What is known about built environment effects on child health and development?

To date most of the available evidence related to the built environment and child health and development points to physical features such as housing density, neighborhood destinations, green space and nature, and traffic exposure. These are further detailed below.

Housing density

There is a global push towards building higher densities to accommodate our rapidly growing urban populations⁵³. Policy makers are viewing increased density as a practical strategy for managing urban population growth, and mitigating related problems such as urban sprawl, traffic congestion, and socially isolated communities⁵⁴.

Urban sprawl, characterized by low residential density neighborhoods with poorly connected streets, and limited access to services and facilities, has been linked with more vehicle miles travelled and lower levels of walking for recreation and transport^{13,55,56}. In contrast, more

compact environments generally have higher densities and mixed use, well-connected streets, and focus on transit-oriented development that promote non-vehicle transport modes ⁵⁷.

While more walkable and compact cities are important for health ^{28,58,59}, higher density living may negatively impact children's development outcomes; manifesting as behavioral problems, social withdrawal, and poor academic performance ⁶⁰. However, the evidence of whether higher density impacts health is indicative rather than conclusive ^{61,62}. The potential mechanisms between density and child development are complex, and likely to be affected by socio-economic disadvantage, and mediated by the influence density has on parent mental health, neighborhood satisfaction and perceptions of the environment ⁶³. For example, regardless of socio-economic status, high-rise living (being buildings ≥ 4 storeys) has been associated with poorer adult mental health outcomes and neighborhood dissatisfaction ^{54,64-66}.

Satisfaction related to the built environment is often linked with perceptions of the neighborhood ⁶⁴, including safety ⁵⁴. Neighborhood safety concerns may influence family practices and parental restrictions thereby impacting children's opportunities to play outside ⁶⁷, and interact with others locally ⁶⁸. For example, Evans (2011) identified mothers of young children living in high-rise developments expressed difficulties in monitoring children's outdoor play because of crime and safety concerns ⁶⁰. Similarly, Whitzman and Mizrachi (2012) found children living in high-rise housing were similarly concerned about traffic volumes and lack of safe crossing points in their neighborhood ⁶⁹. This is unsurprising given higher density housing is frequently located along major arterial roads, which often attract more vehicular traffic and strangers into the local area ⁷⁰. Indeed, parent concerns about traffic and strangers are among the highly cited barriers to children's engagement with the outdoors ^{68,71}.

Families with young children often prefer to live in detached houses located in outer suburban neighborhoods ^{64,72} because of their relative affordability ⁷³ and provision of back/front yards ⁷⁴. Low-density suburban developments are also usually associated with desirable features such as good schools and low crime, whereas high density housing is less popular because of perceived crime, noise, and traffic, quality of schools, and neighborhood aesthetics ⁶⁴. However, in actuality families and children living in lower walkable areas typically have limited access to local essential services such as schools, childcare, and health services ²⁹. Consequently, these low-density, urban fringe neighborhoods often result in spending more time in cars commuting to destinations *away* from the local neighbourhood. This translates to more time spent indoors under adult supervision, and less time exploring and interacting with people and their environment, all of which can often isolate children and families ⁷⁵, and may potentially negatively impact early child health and development.

These complex (and sometimes conflicting) pathways highlight the need to ‘tease out’ the mechanisms in which housing density plays a more direct and indirect role in child health and development. For example, if high rise density living is often viewed as negative or undesirable for children, how should we design both high-rise dwellings, and its surrounding neighborhood, to increase its acceptability to families? If designed properly, high-density housing may be a favourable housing option for families. From a built environment perspective, this places increasing pressure on considering interior and exterior building design (e.g., natural surveillance opportunities such as windows facing the street), identifying optimal housing density levels, identifying elements that encourage neighborhood satisfaction, recognizing neighborhood features that promote and hinder children’s healthy development and wellbeing, and thus co-locating high-rise density housing in neighborhoods

with these features. This may challenge the current urban planning policy that enables the co-location of high-rise density housing on high traffic roads.

Traffic

Households and destinations located along streets with low traffic exposure is a key contributor to neighborhood safety²⁷. Traffic speed and volume, the availability and design of controlled crossings, illegal or dangerous parking, poor visibility, and poor supervision at pedestrian crossings are safety factors consistently associated with the extent to which children are allowed to play and interact with their neighborhood⁷⁶.

Notably, parent and children's concerns about traffic are well-grounded. Younger children appear to be more at risk of traffic injury than older children⁷⁷. Children aged below 10 years old may not have the cognitive (e.g., attention focus and interpreting traffic signs) and perceptual (e.g., locating sounds, judging speed, and peripheral vision) abilities to negotiate complex traffic situations⁷⁸. Cul-de-sac ('lollipop') networks have been found to encourage young children's play and generate informal social control by neighbours⁷⁹. Higher levels of traffic exposure have been associated with parents restricting children's outdoor activities⁸⁰, smaller social networks and poorer academic performance⁸¹, and diminished social and motor skills⁸².

As children age and become more mobile, well-connected streets are associated with greater mobility. In turn, this provides children the opportunity to acquire the basic skills to interact with and move through their neighborhood. Children have opportunities to problem-solve, manage risks and negotiate traffic situations (e.g., judge traffic speed, interpret traffic signs and cross roads), learn about their environment, and improve spatial and way-finding abilities

(e.g., distance estimation, locating north, identifying landmarks, spatial referencing skills)⁸³⁻
⁸⁵. These skills are vital for healthy cognitive development and required to build confidence and competence to safely interact with their environments⁸⁵⁻⁸⁷. However, well-connected streets are often characterized by high traffic exposure as cars and pedestrians may use the same routes. Thus, neighborhoods need to be designed in such a way that provides safe routes for children (e.g., separating children from high traffic main streets⁷⁰, yet also provides freedom and ease to safely move around the neighborhood independently (e.g., shorter distances to destinations). With increased reliance on cars, and ‘chauffeur’ children to and from places, it is important to explore whether objectively-measured and perceived traffic exposure directly influences child development outcomes, and how we can design neighborhoods to limit vehicular traffic.

Access to local destinations and nature

As urban density and the number of dwellings with no or small yards increases, providing local spaces and facilitating safe play within the local neighborhood is increasingly important⁸⁸. Designing neighborhoods that encourage children’s health and wellbeing includes access to local destinations, including green space and nature, and local infrastructure and services^{70,89}. We know that destinations such as schools, recreation venues, and child and health care services all have inherent functional roles, but they can also serve as physical places for social interaction and developing networks of support³⁵. These places may influence children’s development through providing opportunities to learn, explore, recreate, socialise, and interact^{90,91}.

Similarly, green spaces (e.g., parks) and nature have been shown to be consistently important neighborhood features for healthy child development. Playing outdoors supports contact with

nature, which impacts on children's restorative experiences and emotion-regulation ⁹², and cognitive functioning, such as attentional capacity ⁹³, and self-discipline ⁹⁴. Natural play environments (with elements such as trees, wood, and flowers) appear better for children's cognitive and physical development than physical 'man-made' play areas ⁹⁵. Children who play in natural areas engage in more physically demanding play, demonstrate better gross-motor skills (e.g., climbing, balance, coordination), have increased attention spans, and fewer sick days at day care centres compared with children who play in purpose-built playgrounds ⁹⁶.

Close proximity to local destinations is an important component of destination accessibility. Poor proximity to urban green spaces for example, has been associated with behavioral problems such as hyperactivity/inattention ⁹⁷. Moreover, proximity may be important for children and families' decisions to use neighborhood resources. Children (and parents) are more likely to use destinations and services, if available, located within walking distance of their home ⁹⁸⁻¹⁰¹. Although younger children rely on others to accompany them to local destinations ¹⁰², as children age and become more independent, parents have reported that a round trip of 1.6 km (i.e., 800 m one-way) is an acceptable walking distance for primary school-aged children ¹⁰³. Thus, proximity to destinations becomes more important as children age; older children often travel by foot, scooter, bike, or public transport, and they are more likely to engage in these modes if destinations are close and located along a safe commute route (e.g., low traffic).

However, people do not necessarily use their closest destination, such as a park, for example ¹⁰⁴. In fact, Veitch et al. (2006) found that regardless of age, sex, or socioeconomic status, some children did not necessarily visit their closest park ¹⁰⁵. Rather children tended to visit

more attractive parks with appealing attributes, such as better play equipment ¹⁰⁶. Martin and Wood (2012) argue that uninteresting and uninviting fixed structures (including some purpose built play equipment) that characterize many modern parks often limit the scope to play creatively and imaginatively ⁸⁸. Provided they are safe, playgrounds should offer a range of activities and some level of managed risk, otherwise children perceive these structures as ‘unexciting and unchallenging’ ^{107,108}, which decreases the likelihood they will use them ¹⁰⁵. Although referring to the ‘micro-scale’ built environment, it is important to better understand which design attributes affect the quality of destinations (e.g., parks), services (e.g., schools and child care), and spaces (e.g., streetscape), and how these features may affect neighborhood perceptions and satisfaction, entice use, and influence child health and development. In this way, spaces and places can be manipulated in a way that can promote use and better developmental outcomes for children.

It is important to explore what are the key *local* destinations needed for healthy children and families. Further, we need to build cities with equity in mind. While we cannot expect everyone to be within a 10-minute walk from a hospital, there could be an argument that every neighbourhood should have a child care center or access to public transport infrastructure within walking distance. Given that access to better quality destinations may provide greater developmental benefits for children ^{109,110}, any differences within and between neighborhoods may increase inequities in child development (increasing potential geographic disadvantage), disproportionately disadvantaging those who are developmentally vulnerable. Although the evidence on both distribution and quality of destinations by neighborhood disadvantage appears mixed, studies generally suggest that more deprived areas may have access to poorer quality parks, services and destinations than more affluent areas ¹¹¹⁻¹¹³. Exploring and understanding different neighborhood structures is essential to

identify high risk areas, and will provide the necessary traction for informing communities and policymakers on building livable neighborhoods that support optimal child outcomes *across* the socioeconomic spectrum.

Advancing the research agenda on neighborhoods and child development

While we acknowledge the value in exploring how child, family, and neighborhood factors will interact to shape a child's development, exploring how neighborhood built environments directly impact child development is an essential first step to determining the direction and strength of this relationship. As conceptualized by Goldfeld et al. (2015), other aspects of the neighborhood (e.g., social capital, social norms) may interact with the built environment ¹¹⁴. The built environment may have a direct impact, but it may also influence other neighborhood factors (e.g., collective efficacy) for which neighborhood design may be a facilitator, barrier or modifier of behavior. Nevertheless, we can identify emerging and exciting opportunities to influence policy and practice and to advance the agenda for built environment and child development research despite a number of key conceptual and methodological challenges. Key questions for this emerging field include identifying specific built environment attributes that would provide the most 'bang for buck' for policymakers and practitioners to prioritise, and determining the optimal 'child or family-friendly' environment for children and families.

How can we address the research gaps?

There is now increasing opportunity to link neighborhood built environment measures with existing child development outcomes (data linkage process). Neighborhood features can be measured subjectively (i.e., neighborhood perceptions), or objectively (spatial measures that use data with x, y coordinates, i.e., spatial data). Recent improvements in spatial software

(e.g., Geographic Information Systems (GIS)), combined with the availability and accuracy of spatial data means that there is increased capability to now objectively visualise, capture and measure neighborhood features and compare these with outcomes of interest ¹¹⁵. Child development research using spatial measures of the built environment is in its infancy, but there is growing interest, awareness, and capacity to utilize GIS. Capitalizing on the potential to link existing child health and development data to spatial datasets (e.g., destinations and services, street network, park attributes) is cost-effective, and negates the need for primary data collection. Indeed, studies beyond the child development field have linked spatial measures to existing population health datasets, and demonstrate strong associations with selected health and wellbeing outcomes in adults and children ^{116,117}.

Spatial measures can be linked to child development data, provided we know where the child lives (i.e., their ‘neighborhood’). Defining the ‘neighborhood’ is critical because neighborhood size can affect the strength and direction of associations with health behaviors and outcomes ¹¹⁸. Administrative spatial boundaries are commonly used to define neighborhoods, including cities, suburbs, census tracts, school areas, but these boundaries may not reflect the features children and families are exposed to, for example, natural barriers (e.g., busy roads), and the school they attend, or commute routes to the local park.

The Australian Early Development Census (AEDC) for example (an Australian adaptation of the Canadian Early Development Index (EDI)), is a population measure of young children’s development across five main domains: 1) physical health and wellbeing; 2) social competence; 3) emotional maturity; 4) language and cognitive skills; and 5) communication skills and general knowledge ¹¹⁹. To date, there have been two AEDC national data collections (2009 and 2012) with the 2015 data collection currently underway, and further

commitment from government and schools for data collection every three years. In 2012, data on 97.5% of Australian five-year olds were captured ¹¹⁹. Similarly, the USA have also implemented the EDI, in collaboration with Transforming Early Childhood Community Systems (TECCS), a national initiative aiming to develop more effective early childhood service systems through measurement and mapping, community engagement, place-based approaches, and shared knowledge and learning (<http://teccs.net/>). All aim to engage and mobilize local communities, practitioners, and policy-makers with knowledge and resources to help improve early childhood outcomes (<https://www.aedc.gov.au/>). Such information is important to help monitor, and advocate early childhood outcomes. With the lack of population-level studies that examine relationships between the built environment and child health and development, the opportunities to link measures of the built environment to the AEDC and EDI for example, have much utility. The breadth of coverage (e.g., AEDC captures almost *all* Australian five years olds) allows the potential to explore and compare neighborhoods. Moreover, with the same outcome measures available in the US, Canada, and Australia, there is opportunity for cross-country comparisons, providing a powerful resource for policy interventions, planning and evaluation.

Although there is opportunity to use spatial measures of the built environment, child and parent behaviors are likely influenced by both the actual environment as well as how it is perceived. There is often a mismatch between the perceived and objective built environment ¹²⁰, thus it is important to understand how they both influence behaviour and outcomes. It is difficult to obtain child (and parent) perceptions about their neighborhood (e.g., perceived traffic exposure, perceived access to destinations) without primary data collection techniques (e.g., surveys), or qualitative research (e.g., focus groups, interviews). However, integrating subjective (perceptions) *and* objective (spatial) neighborhood measures can provide a more

complete assessment of complex neighborhood physical environments and refine the pathways in which neighborhoods influence child development. Using both subjective and objective measures may offer superior models to inform whether interventions need to target and modify the environment, perceptions or both ¹²¹. Further to this point, exploring relationships between the built environment and other neighborhood factors (e.g., sociodemographic and social) is important to elicit direct and indirect relationships on child development.

A key challenge in this field is addressing causality – what is the direction of effect between the built environment and child development outcomes? Most of the available evidence to date is derived from cross-sectional, observational study designs, and remains vulnerable to reverse causation and to confounding by other factors. However, designing longitudinal studies that explore the impact of built environments on various outcomes is more costly and difficult; it is often not feasible to randomize people into neighborhoods ⁷⁵. However, there are opportunities to conduct longitudinal natural experiments. For example, the RESIDential Environments Project (RESIDE) was a natural experiment that examined how urban planning influenced active living in adults living in Perth, Western Australia; they surveyed participants building new housing developments before they relocated to their new environment, and after they moved ¹²². Understanding causal relationships is essential if we are to develop more effective interventions designed to modify neighborhood physical environments to promote healthy child development. Despite these challenges, it is largely unknown whether there is in fact, an *independent* effect of the built environment on child development *per se*. With increased interest in spatial data and use of data linkage ¹¹⁵, there is now increasing potential for researchers to explore the mechanisms in which neighborhood matters for child development.

Implications for policy and practice

While healthy urban design and planning has an important role to play in transforming neighborhoods ¹²³, redesigning the street network, or building new services and destinations for example, may be difficult and costly to implement, particularly when it comes to retrofitting the structure of existing neighborhoods. Indeed, changing land use zoning regulations, building codes, and environmental changes are orchestrated by government policies and developers ¹²⁴.

While it may appear challenging, there are a number of examples of other policy and regulatory changes that have made substantial impacts on the built environment. For example, more cost-effective place-based interventions may include temporary site changes such as ‘pop-up’ parks and playgrounds (regeneration of land use or temporary revitalisation of ‘dead space’ into green space), and temporary street closures to traffic to limit traffic ‘corridors’ ¹²⁵. These interventions are intended for children to ‘reclaim the streets’ and play outdoors ^{126,127}. More permanent changes such as improvements to park infrastructure ^{125,128}, instalment of traffic calming infrastructure (e.g., crosswalks, street crossings) ¹²⁹, implementation of bike lanes and pedestrian paths ¹³⁰, and enhancements to aesthetics (e.g., landscaping, public art) have also been popular approaches.

Place-based initiatives that create urban environments for children are not merely the remit of urban designers and planners. Indeed, creating healthy urban environments is complex and requires diverse contributions. Working towards ‘child-friendly’ environments requires input from a range of stakeholders; pediatricians, early childhood service providers, public health professionals, teachers, parents, the wider community, and children themselves all have a role

to play in shaping healthy environments. While it is important to design built environment infrastructure appropriate for children from the outset, developing effective place-based interventions to target healthy child development and behavior is required.

From a service provider perspective, educating families and children about how the “benefits” of playing and interacting with outdoor environments outweighs the “risks” (e.g., injury and safety), and equipping children with the skills to navigate their environments could be viable initial strategies. Disciplines such as psychology and education have implemented initiatives using nature, and raise the need for ‘developmentally appropriate’ environments for example. Rigolon and Alloway suggest that schools should be designed with exposure to nature and interactive spaces in mind ¹³¹. McCurdy et al. (2010) also mention that pediatric health care providers recommend unstructured outdoor activities and having children spend time in natural environments ^{132,133}. Pediatricians for example, may play a role on local advocacy and understanding the impact that the built environment may have on children’s health.

Hence, there is considerable opportunity to connect multiple stakeholders to advocate and consider a socioecological approach to child development by targeting community, policy and systems levels. For example, the Collective Impact Movement recognises that tackling or solving complex problems requires a new model of working together; the current practice of governments funding siloed projects and programs through competitive funding systems is not efficient nor economically viable ¹³⁴. Successful place-based initiatives such as the Harlem Children’s Zone in the U.S. have invested in holistic systemic changes and cross-sector collaboration (e.g., education, social services, and community programs) to advocate

for better child outcomes and social change¹³⁵. The potential of such community-level initiatives is that it has the potential to affect many children, not just the most vulnerable.

Although the current global policy agendas advocate the need for ‘child-friendly’, ‘livable’ cities, and place-based initiatives, these agendas currently lack the evidence and data needed to leverage policy change for healthier child development. The development of indicators (and therefore measurement and data) is one way to augment and accelerate the policy debate. Evidence-based indicators are valuable tools in the policy environment to benchmark, measure, and monitor community progress (success or otherwise ‘failure’), providing more promising leverage points for policy change. As such, indicators can be used to ‘speak to’ policy-makers and practitioners to assess equity of urban design provision, distribution of resources, and identify communities that need support and improvement. Indicators can also help empower communities to better understand and recognise their physical resources and opportunities to improve. Yet, progress on developing indicators to monitor children’s health and wellbeing has not been largely extended to how we design neighborhoods. Indeed, others have called for greater attention to children’s wellbeing, through the development of more targeted urban planning decision support analytics and tools^{136,137}. Some examples are available in the USA, in which the National Survey of Children’s Health (<http://www.childhealthdata.org>) includes indicators for children living in supportive and safe neighborhoods, and in Australia, Community Indicators Victoria (<http://www.communityindicators.net.au/>) includes spatial area-level indicators of public transport and walkability around schools, for example. Developing built environment spatial indicators that planners and policymakers may use to assess how different urban environments support or hinder positive child health and development can help integrate urban planning decisions with child health policy.

Through a child health and development lens, optimal neighborhoods may be described as those with low levels of traffic, and providing access to attractive and safe places where children can play and interact safely with others and their environment, including access to parks, facilities and services, social infrastructure (e.g., schools and child care), and public transport within walking or cycling distance. Yet we need to work towards developing robust spatial indicators of these features to be used in such a way to inform, manipulate existing, or build new, neighborhood built environments that promote better developmental outcomes for children. Such advancements will provide resources for engaging citizens, communities, and policy makers in planning, monitoring, benchmarking, and decision making.

Over 50% of the world's population live in cities¹³⁸. As cities push towards rapid urbanization, higher densities, smaller block sizes, and pressures on public open space, there will only be mounting pressure to build child-friendly and livable cities to support our growing urban populations and future generations. In an environment of competing social and policy interests it would seem ever more important to answer the question of where best to intervene and invest to support positive child development outcomes, with the neighborhood built environment offering real potential as an amenable and powerful platform for impact.

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