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Relationship between the neighbourhood built environment and early child development

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ABSTRACT

The relationship between features of the neighbourhood built environment and early child development was investigated using area-level data from the Australian Early Development Census. Overall 9.0% of children were developmentally vulnerable on the Physical Health and Well-being domain, 8.1% on the Social Competence domain and 8.1% on the Emotional Maturity domain. After adjustment for socio-demographic factors, Local Communities with the highest quintile of home yard space had significantly lower odds of developmental vulnerability on the Emotional Maturity domain. Residing in a Local Community with fewer main roads was associated with a decrease in the proportion of children developmentally vulnerable on the Social Competence domain. Overall, sociodemographic factors were more important than aspects of the neighbourhood physical environment for explaining variation between Local Communities in the developmental vulnerability of children.

1. Introduction

The first five years of life are important for the physical, cognitive, social and emotional development of children (Shonkoff and Phillips, 2000). Healthy child development is an enabler of human capability into adulthood (Zubrick et al., 2009). A young child's development is influenced by a number of individual child-level factors (e.g., genetics, physiology), family-level factors (e.g., maternal education, parent-child interaction, parenting practices) and environmental factors (e.g., exposure to pollutants/toxicants, crime and safety, access to schools, childcare, health care and recreational opportunities) (Leventhal and Brooks-Gunn, 2000; Hertzman, 2013; Hertzman and Boyce, 2010; Bronfenbrenner, 1979; Irwin et al., 2007; Shonkoff and Phillips, 2000).

The ecological model proposes that context is an important factor in human development (Bronfenbrenner, 1979). For children, these contexts include family and friends, childcare/school, and the local neighbourhood (Leventhal and Brooks-Gunn, 2000). There is mounting evidence that adults have better health when they live in neighbourhoods with good access to shops and services, high quality parks, connected streets to facilitate walking, sufficient residential densities to support public transport and local businesses, minimal crime, and opportunities for social connectedness (Christian et al., 2013; Müller-Riemenschneider et al., 2013; Foster et al., 2013; Pereira et al., 2013; Giles-Corti et al., 2012a). However, there is little understanding of whether (and how) these attributes influence healthy child development. The specific built environment domains identified as likely potential influences on child development include housing density, access to local services, parks and playgrounds and the outdoor home environment (Christian et al., 2015).

The home is the most proximate environmental influence on child development and where children typically spend most time (Siddiqi et al., 2007). While the impact of poor housing conditions on children's health is well understood (Harker, 2006), the effect of the amount of yard space and its attributes (e.g., play equipment, trees, gardens) on

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child health and development (Kelty et al., 2008) is under-researched. For instance, a backyard provides children with space to play and be active, yet in countries such as Australia trends towards larger houses on smaller blocks has resulted in less home yard space available for children to play and be active (Hall, 2010).

Outside the home, parks and playgrounds are a preferred setting for children's free play and activity (Muñoz, 2009), however the quantity, quality and proximity of parks and playgrounds varies significantly, with poorer infrastructure in more socio-economically disadvantaged neighbourhoods (Vaughan et al., 2013; Astell-Burt et al., 2014). Moreover, time spent in outdoor play has decreased drastically over recent decades (Gill, 2008). Outdoor play is associated with more physical activity, lower levels of overweight (Kimbro et al., 2011), self-guided exploration and imaginative play (Moore, 1986; Cosco, 2007) and other physical, cognitive and social-emotional benefits (Barnett, 1990). Moreover, numerous studies confirm the importance of proximity to nature (Fjortoft and Sageie, 2000), green public open space (Taylor et al., 1998; Aarts et al., 2010), parks (Roemmich et al., 2006) and playgrounds (Quigg et al., 2011, Sallis et al., 1993) for outdoor play and physical activity in the early years (Christian et al., 2015). There is also evidence that green spaces may positively impact young children's cognitive (Wells, 2000; Kuo and Taylor, 2004) and motor (Fjortoft, 2004; Fjortoft and Sageie, 2000; Fjørtoft, 2001) development.

Well-designed neighbourhoods ensure children and families have access to local essential services such as childcare, schools (Trapp et al., 2012) and healthcare. Several studies show a positive relationship between early child development and proximity to child-specific destinations (e.g., recreation centre, library, school) and services (e.g., child care centres) (Kenney, 2012; Fan and Chen, 2012; Rosenberg et al., 2011; Brinkman et al., 2012).While access to child education and health services is clearly important for healthy child development and reducing child health inequality (Hertzman and Power, 2005; Irwin et al., 2007), further clarity is required about how proximity to these services impacts on early child development.

Population-level studies examining the impact of housing density, outdoor space, traffic exposure, the outdoor home environment, nature and parks on early child health and development are required (Christian et al., 2015). The aim of this study was to determine if a child's social, emotional and physical development is associated with the neighbourhood built environment.

2. Methods

2.1. Study design and setting

Population data from the Australian Early Development Census (AEDC) was linked with objective (Geographic Information Systems (GIS)) measures of the natural and built environment (street connectivity, residential density, traffic volumes, proximity to goods, services and child-relevant destinations, green space, home outdoor space). A cross-sectional study of spatial patterns in developmental vulnerability among 149 Local Communities (inclusive of 23,395 children, mean age 5.3 years) in Perth, Western Australia was undertaken.

2.2. Spatial units

Area units were Australian Early Development Census (AEDC) Local Communities, whose boundaries are based on the Australian Bureau of Statistics' Statistical Area 2 (SA2) digital boundaries (Australian Bureau of Statistics, 2011). SA2's are based on suburbs and localities with an average population size of 10,000 persons. Of the 171 Local Communities in Perth, 22 were excluded from the analysis because there were no AEDC data for those areas (i.e., zero children).

2.3. Developmental vulnerability

Data on developmental vulnerability were sourced from the 2012 AEDC, a population-wide census of all Australian children in their first year of schooling (Brinkman et al., 2014). The 2012 AEDC census includes 96.5% (n = 289,973) of all Australian children enrolled in their first year of full-time school (AEDC, 2013). The AEDC has construct and concurrent validity and predictive ability (Brinkman et al., 2007; Brinkman et al., 2013). The AEDC assigns each child a set of scores on their developmental maturity, as assessed by their teacher, across five domains: Physical Health and Wellbeing, Social Competence, Emotional Maturity, Language and Cognitive Skills, and Communication Skills and General Knowledge (AEDC, 2013). Based on our review (Christian et al., 2015) we focussed on the three domains where there was some preliminary evidence of a relationship between the built environment and child health and development related outcomes: (1) Physical Health and Wellbeing - whether children are healthy, independent, and physically ready for the school day, and their gross and fine motor skills; (2) Social Competence - children's overall social development including how they play, share and get along with other children; and (3) Emotional Maturity - whether children are able to concentrate during the school day, help others, are patient and not aggressive or angry.

2.4. Built environment measures

We used GIS to derive objective area-level measures of the neighbourhood (Local Community) built environment (Table 1).

2.4.1. Walkability

Neighbourhoods that encourage walking among parents may, in turn, increase children's exposure to, and contact with, features of the local neighbourhood. 'Walkability' variables included street connectivity, residential density, land use mix, traffic exposure and density of public transport stops. Street connectivity measures the inter-connectedness of the street network and is the number of three-(or more)-way intersections per square kilometre. Net residential density is the number of dwellings per square kilometre of residential land. We measured land use mix using an entropy-based method (Christian et al., 2011, Frank et al., 2005) which reflects both the number of different land use categories (e.g., residential; retail; office; health, welfare and community; entertainment, culture and recreation; public open space, sporting infrastructure and primary and rural) within an area, and the evenness of their relative abundance. Traffic exposure was calculated as the percentage of minor roads (i.e., roads carrying less than 3000 vehicles per day) to the total length of roads within a Local Community (Main Roads Western Australia Functional Road Hierarchy, 2007).The density of public transit stops was measured as the number of bus or train stops per square kilometre.

2.4.2. Green space

Variables were derived from a spatial public open space layer developed for the Perth metropolitan area in 2011 (n=3463 parks) (Bull et al., 2013). Population-based median distance to nearest park (of any size), pocket park (< 0.3 ha in size), attractive park, nature/conservation area and school grounds were calculated for each Local Community. This was calculated by initially deriving distances to each feature using the smaller spatial scale of SA1 (average population size of 400 persons). The distance from each SA1 centroid to the outer boundary of the nearest feature of interest (e.g., park) was determined, and the median distance (across all SA1s in the Local Community, weighted by SA1 population size) was calculated. This estimates, for each Local Community, how far the average (median) person is from the nearest feature of interest. The advantage of this approach versus an area-based average (e.g., proportion of Local Community area that is park), is that the population-based median