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Associations between the neighbourhood built environment and out of school physical activity and active travel: An examination from the Kids in the City study

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ABSTRACT

This study's aim was to examine selected objectively-measured and child specific built environment attributes in relation to proportion of out-of-school time spent in moderate-to-vigorous physical activity (%MVPA) and active travel in a group of ethnically and socio-economically diverse children ($n=236$) living in Auckland, New Zealand. Street connectivity and distance to school were related to the proportion of trips made by active modes. Ratio of high speed to low speed roads and improved streetscape for active travel were related to %MVPA on weekdays only. Inconsistent results were found for destination accessibility. Local destinations (particularly schools) along a safe street network may be important for encouraging children's activity behaviours.

1. Introduction

Many national bodies recommend that children participate in at least 60 min of moderate to vigorous physical activity (MVPA) per day for optimal health (World Health Organization, 2010; NZ Ministry of Health, 2015; UK Department of Health, 2011). Children's MVPA can be accumulated via a range of activities (e.g., organised sports, unstructured free play, and active travel – walking or cycling for transport), which can occur in a variety of settings (e.g., school, home, neighbourhood). Active travel is a physical activity of particular interest, with studies showing a positive relationship between active travel and objectively assessed MVPA (Oliver et al., in press; Schoeppe et al., 2013a, in press). Moreover, reducing trips made by car has significant co-benefits such as enhancing children's knowledge of their local environment (Mitchell et al., 2007), and reducing traffic congestion and carbon emissions (Badland and Oliver, 2011).

Much is known about the associations between children's physical activity and demographic, home, and school factors (Sallis et al., 2000; Ferreira et al., 2007; Sterdt et al., 2013; National Institute for Health and Clinical Excellence, 2008). A range of individual (sex, age), social (parent support, parent perceptions), household (socio-economic status, car accessibility), and environmental (programme/facility access, time spent outdoors) factors have been associated with overall physical activity and MVPA in children (Pont et al., 2009; Copperman and Bhat, 2007; Carver et al., 2008; Butte et al., 2014; Edwardson and Gorely, 2010; Bergh et al., 2011). A recent meta-analysis revealed that children accumulate more MVPA on weekdays than weekend days (Brooke et al., 2014). In addition, findings showed that on school days, more MVPA is accumulated in school than out of school (Brooke et al., 2014). For active travel, negative relationships have been found for higher household income and increased car ownership, and positive relationships have been observed for ethnicity (non-white), and having presence (rather than absence) of recreation

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facilities and active travel infrastructure (Pont et al., 2009, Davison et al., 2008).

Socio-ecological models are especially useful for understanding associates and predictors of children's activity behaviours, as the activity must be undertaken in specific physical settings (Sallis et al., 1998). It has been suggested that the specificity of socio-ecological models could be improved by using theory-driven behaviour and context measures (Giles-Corti et al., 2005). There has since been a call for "more age- and sex-specific research using behaviour- and context-specific measures, with a view to building a more consistent evidence base to inform future environmental interventions" (Giles-Corti et al., 2009). Use of objective measures of the environment and behaviours is also an important consideration (Ding et al., 2011).

Active travel is an important component of children's physical activity and one that has declined in many countries over recent decades (Fyhri et al., 2011; Ministry of Transport, 2009; Ministry of Transport, 2012). In New Zealand over a 20 year period the mean number of minutes per week children engage in active travel has almost halved from 130 min to 69 min, while the proportion usually travelling to school by car has almost doubled (Ministry of Transport, 2012). Travel to or from school has been the focus of research investigating associations between active travel and the built environment to date (Panter et al., 2008). Distance to school appears to be a consistent predictor of actively travelling to school (Wong et al., 2011; D'Haese et al., 2011; Oliver et al., 2014a; van Loon, 2011). Traffic may also be an important contributing factor; for example, Giles-Corti et al. (2011) observed a significant interaction effect of "traffic volume" (characterised by road hierarchy) in the relationship between street connectivity and children's walking to school. Findings showed a link between street connectivity and walking, but this relationship did not hold true for children attending schools where traffic volume was high.

Children do not spend time exclusively at school or home – and the recognition of neighbourhoods as child-relevant 'places' to spend time in, travel through, experience, and 'colonise' is becoming commonplace (Hooper et al., 2015; Rogers, 2012; Carroll et al., 2015). Limited research has considered out-of-school physical activity and trips to non-school destinations in relation to built environment factors (Schoeppe et al., 2013a). Yet such investigations remain an important step towards ensuring greater analytical specificity for the hypothesised environment-activity relationship. Positive associations between out-of-school physical activity and dwelling density, destination accessibility (Giles-Corti et al., 2009), and street connectivity have been found in some studies (de Vries et al., 2007; Frank et al., 2007), and negative associations found in others (Copperman and Bhat, 2007; Mecredy et al., 2011). One recent US investigation revealed that areas profiled as having higher walkability and recreation/park access were associated with children's MVPA accumulated out of school hours in one study region (San Diego), but not another (Seattle/King County) (Kurka et al., 2015). A time-use examination of weekend physical activity in children aged 5–17 years revealed associations between physical activity and destination availability, dwelling density, and active transport infrastructure (Copperman and Bhat, 2007).

Increasingly, innovative approaches are being developed to understand the built environment from a child's perspective. Two particularly relevant examples are the child-specific neighbourhood destination accessibility index (NDAI-C) (Badland et al., 2015) and the school walkability index (Giles-Corti et al., 2011). The NDAI-C is a spatial index of accessibility to destinations that are relevant to children. The index builds on the previous adult-focused NDAI (Witten et al., 2008) by drawing on child-specific locational data and frequency of access to destinations to develop an empirically-derived objective index pertinent to children's activity behaviours. To our knowledge, no research has yet considered the relationship between the NDAI-C and children's physical activity or travel behaviours. The school walkability index also improves on its adult-focused 'walkability index' predecessor (Leslie et al., 2007), by including a measure of traffic exposure, drawing from the well-established link between traffic exposure and children's active travel behaviours. Since its development, the school walkability index and derivatives (in terms of traffic exposure) have consistently been linked with children's active travel (Trapp et al., 2012; Kurka et al., 2015), but this variable has rarely been explored with regard to MVPA. Lastly, while not child-specific, the Systematic Pedestrian and Cycling Environmental Scale (SPACES) provides an objective assessment of a given streetscape from the perspective of a pedestrian or cyclist (Pikora et al., 2002, 2003). This tool considers the most vulnerable street users using a comprehensive range of factors at the street level and thus may contribute to a more detailed understanding of factors related to children's activity behaviours. Indeed, links between the environment as assessed by the SPACES and children's active travel have been established (McMillan, 2007), but again this measure has seldom been explored in terms of children's MVPA.

Advances in GIS technologies offer new approaches for delineating population-specific neighbourhood boundaries, or buffers, in health and place research. Buffers are boundaries placed around a point or area using a predefined scale and a Euclidean or street network distance (Thornton et al., 2011). The scale used for these buffers have traditionally been relatively arbitrary, generally ranging from 200 m to 1600 m (Wong et al., 2011). The alignment of objective physical activity data with global positioning systems (GPS) monitoring data or participant mapping data overlaid with GIS spatial information has led to greater insight on buffer distances that are more meaningful to specific populations of interest. For example, in a study using GPS and accelerometry to investigate the mobility of US adults, findings revealed most MVPA occurred in locations "near home" (125–1666 m from the residential address), as compared with locations further or closer to home (Hurvitz et al., 2014). Such findings can be useful in identifying buffer distances that are likely to yield the greatest sensitivity for a given population.

Accordingly, the present challenge is to gain a deeper understanding of how specific built environment features outside the school and home environments are associated with children's MVPA, and active travel beyond school to other neighbourhood destinations. This paper builds on earlier research and provides greater specificity by using objective child-specific measures of activity and the built environment to consider out-of school activity on weekdays as well as weekend days, while accounting for relevant individual, social, and household factors. By taking a deliberate child-centred approach to describing built environments, we aim to provide improved specificity in socioecological modelling of the built environment–physical activity relationship.

2. Methods

2.1. Protocol

The Kids in the City study was an investigation of children's use and experiences of diverse urban neighbourhoods (Carroll et al., 2015). Data collected enable associations between built environment features and children's independent mobility, active transport, physical activity, and body size to be examined. Design and methods of the full study are described in detail elsewhere (Oliver et al., 2011c, in press).

In brief, data were collected from children in school years 5–8 (9–13 years of age) from nine schools across Auckland, New