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Physical environmental characteristics promoting independent and active transport to children's meaningful places

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A B S T R A C T

Research on urban structural characteristics promoting physical activity is often focussing on just few of the settings where children and youth spend their time. To overcome this, we used mapping methodology where children themselves defined their important places. Then, the associations between the urban structure and children's active transport and independent mobility were studied. Principal component analysis was used to compose multivariate profiles of physical environment around meaningful places. We found that structure dominated by single family housing promoted both independent mobility and use of active transport modes. Dense urban residential structure allowed for independent mobility but did not promote active transport.

Introduction

Children's physical activity and active transportation (van Loon & Frank, 2011; Mikkelsen & Christensen, 2009; Pont, Ziviani, Wadley, Bennett, & Abbott, 2009) and related obesity (Dunton, Kaplan, Wolch, Jerrett, & Reynolds, 2009) in different physical environments are themes that have been widely researched in recent years. Commonly, this body of research hopes to discover which elements of the physical environment could promote physical activity in children and young people, who are becoming increasingly overweight and are getting less and less exercise.

The research on environments promoting physical activity has often concentrated on some specific locations or trips, when in fact children's physical activity takes place in a variety of places (van Loon & Frank, 2011). The focus has too often been on the built environment surrounding a child's home, school or on some specific structures, such as parks. In addition, much of the research has concentrated on mobility on trips to school (e.g. Spinney & Millward, 2011). In their study on London children, Steinbach, Green, and Edwards (2012) found no significant environmental correlates of walking on the school journey, but several that were associated with walking outside the school commute and at weekends or during holidays. The writers hypothesise that the walking environment plays a bigger role in the travel mode choice for the optional trips.

Rather than narrowing the scope of our research to a few locations and trips, the focus should be on the multiple environments where children and young people spend their time. Indeed, only a third of the daily trips Finnish children make are to and from school, while 52 per cent of the trips are made due to leisure activities and the remaining 15 per cent due to shopping and other errands (Finnish Transport Agency, 2012). Moreover, concentrating on some specific locations, such as parks, and researching their role in promoting physical activity, is problematic. While green environments as settings for physical activity are widely studied, a recent study (Wheeler, Cooper, Page, & Jago, 2010) found that as little as 7–9 per cent of daily physical activity happened in parks.

Physical activity can be measured quantitatively using accelerometers or heart rate monitoring. When a global positioning system (GPS) is added to the equipment, information on the location of the activity becomes available, allowing the physical environment to be analysed (see e.g. Rainham et al., 2012; Rodríguez et al., 2012). Technical solutions are not the only way of measuring physical activity, but the qualitative aspects of children's physical activity can also be successfully studied. Namely, independent mobility – the possibility to travel to places alone – or activity of transport mode can be used as qualitative proxies for physical activity. Page, Cooper, Griew, Davis, and Hillsdon (2009) have shown that self-reported independent mobility (to eleven queried destinations) is related to objectively measured weekday physical activity in children aged 10–11 years. It has also been reliably shown that children who report active commute modes, walking or cycling on their school journey accumulate significantly

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more objectively measured physical activity (Faulkner, Buliung, Flora, & Fusco, 2009).

Research methods used for studying the physical environment also need some reconsideration. Lately, research reporting individually defined built environment for each subject (known as buffer studies) instead of using administrative boundaries has become increasingly common, as the review by Feng, Glass, Curriero, Stewart, and Schwartz (2010) shows. While the use of geographically defined buffers has made the comparison of study findings easier, Ding and Gebel (2012) still stress the importance of identifying and defining the place, and continue by suggesting that environments outside residential neighbourhoods should also be considered while studying the physical environment correlates of active living. One advance towards the direction of studying multiple physical activity settings with a detailed definition of the environment is reported by Cervero and Duncan (2003), who have studied the physical environment's effects on cycling and walking, by buffering both the origins and the destinations of trips.

Despite these advances, more systematic, representative and location-sensitive research is still needed that takes into account the varying environment usage patterns of children. We propose that emphasis should be placed on the multiple activity settings where children spend their time, and on the physical environment of these settings. The children can be given the possibility to inform research on their meaningful places, as defined by themselves. For example, Wridt (2010) has utilised a qualitative GIS approach in studying simultaneously children's own perceptions of their neighbourhood and the actual activity potentials of specific physical settings. We suggest that the ways in which the multiple places promote physical activity by allowing for active transportation and independent mobility can be studied using self-reported information on children's mobility to these places. The environment around these places and its associations to the independence and activity of transport to the places can nevertheless be studied in a quantitative manner.

In many cases, researchers have concentrated on single, objectively measured environmental variables and their effect on children's physical activity, or they have studied multiple environmental variables separately, without commenting on how these variables correlate (Lin & Yu, 2011). The associations between physical activity and multiple, individually studied variables can be difficult to interpret, and the results might sometimes seem internally contrasting. To overcome this, some trials have been made to bring multiple physical environmental variables together. Maybe the most widely known composite measure is the walkability index (Frank et al., 2006), which incorporates land use mix, street connectivity, net residential density, and retail floor area ratios. Lately, researchers have tried to address the problem of interrelationships between built environment variables by using principle component or factor analysis, in order to compress multiple GIS-derived variables into fewer dimensions that can then be used in further analysis (Boone-Heinonen, Guilkey, Evenson, & Gordon-Larsen, 2010; Cervero & Duncan, 2003; Song & Knaap, 2007; Yan, Voorhees, Clifton, & Burnier, 2010). Another statistical technique is latent profile analysis, which has been used to build multivariate profiles of the neighbourhood recreation environment in relation to adolescent physical activity (Norman et al., 2010). Relying more on geostatistical methods, Buck et al. (2011) used the kernel density method to calculate the density of sidewalks, cycle paths, intersections, public transport stations, public playgrounds, sports facilities, and parks and green spaces. They also analysed the residential density and land use mix, after which they made these nine variables comparable and calculated a moveability index.

In this study, we use principal component analysis to compose multivariate profiles of the physical environment around meaningful places that children have marked on maps. We further analyse whether some environments, as defined by these multivariate profiles, promote children's active transport and independent mobility to these places. We define active transport as walking or cycling to the place (Larsen et al., 2009; McDonald, 2007; McMillan, Day, Boarnet, Alfonzo, & Anderson, 2006; Mota et al., 2007). Independent mobility is often defined as being able to move without adult supervision (Hillman, Adams, & Whitelegg, 1990; Page, Cooper, Griew, & Jago, 2010), or more detailed accompaniment can be questioned (Romero, 2010). We define independence as travelling to the location alone. In this study, our aim is to find relevant co-occurring environmental attributes that promote children's physical activity, using active transport and independent mobility as proxies of physical activity. To inform the researchers and practitioners about the locations of actual environments that satisfy these activity-promoting attributes, the analysis is also presented with maps.

Method

Data collection method and procedure

We suggest that a place-based research strategy is not possible without a specific methodology. In this study, an Internet-based softGIS survey (Kahila & Kyttä, 2009; Kyttä, 2011) was used to study children's independent mobility and active transport to their meaningful places. The softGIS methodology developed at Aalto University, Finland, is an advanced example of Public Participation GIS (PPGIS, see Brown, 2012) that enables the mapping of environmental experiences and daily behaviour practices with respect to specific locations. The softGIS methodology has been developed together with urban planners and other actors in the health promotion field, professionals from social, health, cultural, education, youth work and other sectors in an attempt to produce applicable knowledge for these multisectoral actors.

In the softGIS survey for children (Fig. 1), the respondents used the Internet interface to mark places on a map that were functionally, emotionally or socially meaningful. They also described how accessible these places were, in terms of independent mobility and active transport. Moreover, the respondents were asked to mark their home and daily routes to school, and to answer questionnaires concerning school journeys, perceived health and well-being. The data was collected in 17 schools from six residential areas of Helsinki, Finland, during the autumn of 2009. The ethics board from the Education Board of the City of Helsinki approved the research, and informed consent was gathered from both the responding children and their parents. The six residential areas represent different urban structures ranging from the inner city urban core to suburbs built in the 1950s, and fringe areas dominated by single-family housing. The data collection was organised in computer equipped classrooms, led by a research assistant. A total of 901 children, of whom 47 per cent were from year 5 (approximately 11 years of age), and 53 per cent from year 8 (approximately 14), participated and marked a total of 5211 meaningful places.

Outcome variables

With each meaningful place marked on the map, the respondents were asked how they travelled to the location. Independent mobility was measured with the question "With whom do you travel to this place?" The selectable options were alone, with friends, and accompanied by an adult. The answers were recoded into a dichotomous variable: coming to the place alone (1) as opposed to with friends or adults (0).