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Youth physical activity and the neighbourhood environment: Examining correlates and the role of neighbourhood definition

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ARTICLE INFO

ABSTRACT

The primary objective of this study was to examine relationships between neighbourhood built and social environment characteristics and moderate to vigorous physical activity (MVPA) in a sample of children aged 8—11 in Vancouver, British Columbia and the surrounding lower mainland region ($n = 366$). A secondary objective was to assess how neighbourhood definition influences these relationships, by using measures calculated at multiple buffer sizes: 200, 400, 800 and 1600 m (1 mile). Geographic information systems -software was used to create a broad set of measures of neighbourhood environments. Physical activity was measured objectively using accelerometers. Relationships between MVPA and neighborhood characteristics were assessed using generalized estimating equations to account for the clustering of children within schools. Sex specific relationships were assessed through sex stratified models.

When controlling for child age, sex and ethnicity, MVPA was positively associated with commercial density, residential density, number of parks and intersection density; and negatively associated with distance to school and recreation sites. When entered as a composite index, these measures accounted for 4.4% in the variation in MVPA for the full sample (boys and girls). Sex stratified models better explained the relationships between neighbourhood environment and physical activity. For boys, built and social environment characteristics of neighbourhoods accounted for 8.7% of the variation in MVPA, and for girls, neighborhood factors explained 7.2% of the variation. Sex stratified models also point towards distinct differences in factors associated with physical activity, with MVPA of boys associated with wider ranging neighborhood characteristics than MVPA of girls. For girls, two safety-related neighbourhood features were found to be significantly associated with MVPA: cul-de-sac density and proportion of low speed limit streets. In all models, larger buffer sizes, and predominantly the largest buffer size, best explained environment—physical activity relationships.

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Introduction

Current evidence suggests that many Canadian children and adolescents do not engage in sufficient physical activity to achieve health benefits, with only 9% of boys and 4% of girls accumulating at least 60 min per day of moderate to vigorous physical activity (MVPA) on 6 or more days per week (Colley et al., 2011). Older children may be at particular risk of physical inactivity, with physical activity engagement generally dropping dramatically with age (Janssen & LeBlanc, 2010). Physical activity has many well

documented health benefits for youth, including favorable effects on blood pressure, bone mineral density, mental health and cardiovascular health (Janssen & LeBlanc, 2010). It is also important because current trends in increasing childhood overweight and obesity may in part be explained by low levels of physical activity (Jimenez-Pavon, Kelly, & Reilly, 2010). Taken together, such studies highlight the need to better understand correlates of physical activity.

Previous research has demonstrated the importance of diverse spaces as sites for youth activity, highlighting the need to further study wide ranging characteristics (Lachowycz et al., 2012). This diversity reflects several possible mechanisms of influence on physical activity. Some characteristics are hypothesized to influence the decision as to whether or not to actively commute

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between home and school. In particular, distance to school has been negatively associated with rates of active commuting to school in a number of studies (Larsen et al. 2009; Napier, Brown, Werner, & Gallimore, 2010; Timperio et al. 2006). Similarly, measures of access or physical proximity to parks have been widely studied as correlates of child physical activity, with numerous studies demonstrating positive associations between access and physical activity (Boone-Heinonen, Casanova, Richardson, & Gordon-Larsen, 2010; Dowda, Dishman, Porter, Saunders, & Pate, 2009; Frank, Kerr, Chapman, & Sallis, 2007). More generalized measures of access such as residential and commercial density, and land use mix are also hypothesized to increase the proximity of origins and destinations in neighbourhoods, and have generally been positively correlated with measures of active transportation (Frank, Kerr, et al., 2007; Larsen et al. 2009; McMillan, 2007) and physical activity (de Vries, Bakker, Van Mechelen, & Hopman-Rock, 2007).

Measures of street connectivity have also been hypothesized to influence physical activity, in a similar manner to their hypothesized influence on adults. Specifically, more connected neighbourhoods are hypothesized to be easier to traverse, and thus may be more supportive of active transportation (Van Loon & Frank, 2011). This hypothesis is consistent with the findings of several studies that have demonstrated positive associations between connectivity and measures of physical activity (Bungum, Lounsbery, Moonie, & Gast, 2009; Frank, Kerr, et al., 2007; Schlossberg, Greene, Phillips, Johnson, & Parker, 2006). However, several other studies have found that street connectivity is negatively or not correlated with measures of physical activity (Copperman & Bhat, 2007; Roemmich et al. 2006; Timperio et al. 2006), possibly because smaller block sizes may also create more conflicts between motorists and children walking or bicycling (Copperman & Bhat, 2007).

Measures of the social environment of neighbourhoods have also been linked to child physical activity. In one study, Carver et al. (2005) found that important explanatory factors for adolescent physical activity included self-reported measures of: having friends nearby, having young people of similar age nearby to socialize with, knowing neighbours, and waving or talking to neighbours. Research to date on the patterning of child physical activity on the basis of measures of neighbourhood SES has had mixed results (Molnar, Gortmaker, Bull, & Buka, 2004), but recent analyses appear to lend support to the existence of some association between neighbourhood SES and physical activity. Carson, Kuhle, Spence, and Veugelers (2010), for instance found girls living in low SES neighbourhoods to engage in significantly more weekly screen time and TV/movie minutes than girls living in higher SES neighbourhoods. Oliver and Hayes (2005) similarly found that the prevalence of child and youth overweight in Canada is negatively and significantly related to neighbourhood SES. Molnar et al. (2004) also found associations between youth physical activity and neighbourhood social disorder, gauged by examining videotapes of activity such as adults fighting or arguing in a hostile way, drinking of alcohol in public, and people selling drugs. In contrast to such findings, other studies have found no associations between measures of neighbourhood disorder, children's perception of stranger danger and physical activity patterns of children, leading Davison and Lawson (2006) to speculate that only high levels of social disorder (e.g. people selling drugs) such as those highlighted by Molnar et al. exert an influence child physical activity.

The present study builds on previous research by employing objective measures of both built and social environment characteristics of neighbourhoods and physical activity. Use of objective measures of physical activity in particular may be important because survey measures of physical activity specifically are prone to reporting bias, with children or their families often overstating physical activity levels (Reilly et al., 2008). Our primary objective

was to examine whether characteristics of the neighbourhood environment where children lived predicted objective (accelerometer measured) average daily Moderate to Vigorous Physical Activity (MVPA), when controlling for child age, sex and ethnicity. We controlled for age and sex because studies of youth physical activity generally indicate that boys are more active than females, and that physical activity decreases with increasing age (Trost et al. 2002). Parental restrictions on children's independent mobility may also vary by sex, with greater restrictions often placed on girls (Korpela, Kytta, & Hartig, 2002; Kytta, 2004). Therefore we also examined these relationships using separate models for boys and girls. We controlled for ethnicity because physical activity levels may vary by ethnicity, although findings to-date are inconclusive. Several studies have showed no effect (Faulkner, Buliung, Flora, & Fusco, 2009; Kaczynski, Wilhelm Stanis, Besenyi, & Child, 2013), while others have indicated effects (Belcher et al. 2010) that may reflect differences in socioeconomic status or access to recreational amenities (Whitt-Glover et al. 2009).

While research on neighbourhood environment relationships with youth physical activity has been burgeoning in recent years, there is a recognized need to better understand and improve the operationalization of neighbourhood environment measures (Brownson, Hoehner, Day, Forsyth, & Sallis, 2009; Ding & Gebel 2012). Our secondary objective was therefore to assess how neighbourhood definition influenced the relationships between built and social environment measures and physical activity. To do this, we focused on one aspect of neighbourhood definition, neighbourhood scale, by using buffer based measures at multiple buffer sizes. There currently is little consensus on how best to define neighborhoods in studies of neighbourhood environment associations with child physical activity (Brownson et al., 2009; Frank et al., 2012). This is evident given the widely varying buffer sizes used to date. For example, Frank, Kerr, et al. (2007), Kerr, Frank, Sallis, and Chapman (2007) and Roemmich, Epstein, and Raja (2007) use radii of 800–1000 m, while others such as Nelson, Gordon-Larsen, Song, and Popkin (2006) have used larger buffers (3 km). This variation reflects a lack of understanding of the mechanisms through which the built environment may influence behaviour.

Depending on the hypothesized mechanisms, one might anticipate that either larger or smaller buffer sizes would capture the environments that influence behaviour. For example, if one is to assume a mechanism whereby the child's perceptions of the immediate environment around the home was dominant, smaller buffer sizes might be most appropriate. Alternately, if one assumes that parent's perceptions of their broader activity environments influence their child's behaviour indirectly, larger buffer sizes could be more relevant. To our knowledge, very little research has applied an approach using multiple buffer sizes, despite limited initial findings suggesting that choice of neighbourhood area definition may dramatically influence observed relationships between built environment characteristics, youth physical activity and related health outcomes (Boone-Heinonen, Popkin, Song, & Gordon-Larsen, 2010; Duncan et al., 2012; Mitra & Buliung, 2012). Boone-Heinonen, Popkin, et al. (2010) examined how neighbourhood area influences relationships between two built environment characteristics (number of physical activity facilities and street connectivity) with self reported MVPA. They found the most consistent associations between MVPA and number of facilities with 3 km buffers and intersection density with 1 km buffers. Similarly, when examining active transportation to school as an outcome, Mitra and Buliung (2012) found that the effect of neighbourhood scale varied by built environment characteristic. Using Body Mass Index as an outcome, Duncan et al. (2012) found significant associations with built environment measures calculated