



## Associations between availability of facilities within three different neighbourhood buffer sizes and objectively assessed physical activity in adolescents

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### ABSTRACT

This study aims to explore whether objectively measured availability of parks and sports facilities within three different buffer sizes are associated with moderate-to-vigorous physical activity (MVPA) among adolescents, and to identify potential cognitive mediators of this association. Data were obtained from adolescents ( $N=209$ , mean age: 14.5 (SD: 0.6) years) at the follow-up measurement of the Children Living in Active Neighbourhoods study in 2004. MVPA was measured using accelerometers. Availability of parks and sport facilities were measured within 400, 800 and 2000 m buffers around participants' residential homes. Potential mediators (self-efficacy, attitude and the perceived availability of parks and sports grounds) were measured by self-administered questionnaires. No direct association was found between the objectively measured availability of facilities and objective assessments of MVPA and no evidence for mediation by cognitions was found in any of the buffer sizes. More specific and sensitive measures may be needed to understand environmental correlates of MVPA.

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### 1. Introduction

Physical activity (PA) has been shown to be associated with health and quality of life (Lagerros et al., 2004; Ortega et al., 2008; Sacker and Cable, 2006; Sharma et al., 2009). Adolescents are an important group to target in PA promotion programs, since many adolescents in Western cultures are not sufficiently physically active (Lampert et al., 2007; Roberts et al., 2004; Scully et al., 2007; Tammelin et al., 2007). As PA levels decline during adolescence (Breedveld and Tiesen-Raaphorst, 2006; Kjonniksen et al., 2008; Prins et al., 2010) and PA behaviour in adolescence appears to track into adulthood (Telama et al., 2005), the potential health impacts of adolescent PA are considerable.

In order to promote PA in adolescent populations, it is important to understand its determinants. Research to date has focused mainly on cognitive correlates of physical activity, like attitude (Ajzen, 1991) or self-efficacy (Bandura, 1986) and found cognitive constructs such as these to be associated with adolescent PA

behaviour (Van Der Horst et al., 2007). However, the more recently developed socio-ecological models like the Environmental Research framework for weight Gain prevention (EnRG) framework (Kremers et al., 2006) suggest that besides cognitive factors, environmental factors (e.g. availability of parks and sports or recreation facilities) may influence physical activity levels. According to the EnRG framework, the effects of the environment on behaviour may be mediated through individual cognitions. Hence, the environment may have an influence on behaviour through factors such as one's perceptions of the environment, attitudes towards PA and self-efficacy to engage in PA.

Few studies have examined the proposed mediated pathways of environmental influence through individual cognitions on behaviour. Those that have did not find evidence that cognitive constructs mediated the objectively measured environment–PA association in adolescents (Dowda et al., 2009; Maddison et al., 2009). One of the reasons for not finding evidence of mediation may be the choice of buffer size (i.e. spatial scale) in which physical environmental factors are captured, which was acknowledged in both studies. That is, many studies may not capture resources within distances typically accessed by adolescents. To gain more insight into this, it is important to study environmental influences

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on PA at various spatial scales (Brownson et al., 2009). In considering different buffer sizes, it is possible that features further from home are not important because they are less accessible and because people may be less aware that they are there. However, larger buffer sizes may also be positively associated with PA because more facilities of interest to the individual, and thus more opportunities to be active, may be captured. It has been pointed out that not only proximity to a park, but also its features, conditions and aesthetics are important for visiting a park (McCormack et al., 2010). In sum, associations of environmental factors with behaviour and potential mediators (e.g. attitudes, perceived environmental factors, self-efficacy) may differ between buffer sizes chosen, because in larger buffer sizes a larger number of facilities and potentially more facilities that fit with adolescents interests are captured as compared to smaller buffer sizes.

Several studies have confirmed that buffer size is an important factor in PA research among adolescents. While the buffer size around a participant's home is often arbitrary, Timperio et al. (2004) found that parents of Australian youths aged 10–12 reported that 1600 m was an appropriate walking distance for their child (which would be an 800 m return trip from home). Colabianchi et al. (2007) found that a 15 min walk (approximately 1200 m) would be an easy distance to walk for adolescent girls. In qualitative work, Ries et al. (2008) found that adolescents identified proximity of facilities as a major determining factor with regard to facility use, with facilities within walking distance being preferred. However, in the same study it was noted that most small neighbourhood parks are designed for young children and do not have facilities that attract adolescents (Ries et al., 2008). Scott et al. (2007) found that perceived access to facilities was more strongly associated with objectively measured number of facilities when a smaller buffer was used. In addition, facilities in smaller buffer sizes were shown to be more strongly associated with moderate-to-vigorous physical activity (MVPA) (Boone-Heinonen et al., 2010; Cohen et al., 2006). Few studies have used different spatial scales to study mediated pathways. Dowda et al. (2009) studied the associations between self-reported PA and commercial PA facilities using two buffers (0.75 miles and 2.0 miles) among adolescent girls, but found no mediation through self-efficacy in any of the buffer sizes. However, to date no studies have examined the mediation of cognitive constructs on the availability of parks and sports facilities with objectively assessed adolescent MVPA at multiple buffer sizes. The advantage of using an objective measure of MVPA is that it overcomes important limitations of self-reported MVPA, such as recall and reporting biases.

The aim of this paper was to examine mediation of the relation between availability of sports facilities and parks, operationalized at different buffer sizes (400, 800 and 2000 m), and MVPA through perceived environmental factors, attitude and self-efficacy toward MVPA. We hypothesised that: (1) facilities assessed using smaller buffers would be more strongly associated with MVPA than those assessed using larger buffers (because adolescents are more exposed to proximal environments); (2) cognitive variables would show stronger associations with facilities assessed using smaller buffers than with facilities assessed using larger buffers; (3) cognitive variables would mediate the objective environment—MVPA association.

## 2. Methods

### 2.1. Procedure

Cross-sectional follow-up data from the Children Living in Active Neighbourhoods (CLAN) collected in 2004 were used. In the CLAN study, 2096 grade 5 and 6 (10–12 years old) children

attending 19 state elementary schools recruited from high and low socioeconomic areas of Melbourne, Australia were invited to take part in a cross-sectional study in 2001 (Telford et al., 2005) and data were collected from 919 (44% response rate). At that time, 698 families agreed to be recontacted in the future for further research and in 2004 were invited to participate in the follow-up study (i.e. three years after baseline measurements). Of these, 415 adolescents (45% of the older cohort at baseline) participated in the follow-up study. Only adolescents with accelerometer data available in 2004 for four or more weekdays including at least one weekend day and with objectively measured environmental data were eligible for analyses. In total, 67% of the 415 adolescents met these criteria, leaving a sample of 277 (45.1% boys, mean age = 14.5 +/− 0.6 years) eligible for analyses. Only follow-up data were analysed in the present study, because adolescent self-reported data on attitudes towards physical activity were not collected at baseline. There were no statistically significant differences in gender, parental education or baseline MVPA between adolescents who participated in the follow-up and those who did not, or between those who were included in the final sample for analyses and those who participated in the follow-up but were excluded from these analyses. Adolescents who were followed up had fewer parks within 800 and 2000 m buffers at baseline than those who were not followed up. Those who were eligible for analyses had more parks at 800 and 2000 m buffers at follow-up than those who were followed up but excluded. Complete data (i.e. eligible adolescents with information on all cognitions, and confounders) were available for 209 adolescents and these adolescents were included in the analyses.

### 2.2. Measures

#### 2.2.1. Moderate-to-vigorous physical activity (MVPA)

MVPA was defined as activities of  $\geq 3$  Metabolic Equivalents (METs). The resting metabolic rate when sitting is 1 MET and 3 METs consists of activities with three times the energy cost of sitting. In 2004, each adolescent was asked to wear an accelerometer (Actigraph GT1M) on his or her right hip, for one week, to measure physical activity. This accelerometer detects vertical accelerations. The accelerometers recorded activity in one minute epochs, summing the total number of accelerations that occurred in each minute. A higher number of accelerations per minute, means that that the average activity in that minute is performed at a higher intensity. For each minute, counts per minute corresponding to 3 METs were determined using an existing age-adjusted regression equation (Trost et al., 2002; Trost et al., 1998). For this study, only physical activity after school hours (i.e. from the end of the school day to 9 p.m) and on weekend days was examined, as neighbourhood facilities are most relevant during discretionary time. Therefore, the average minutes spent in MVPA after school hours on school days were calculated, excluding days on which accelerometer counts were < 10,000 or > 20 million or vigorous-intensity activity ( $\geq 6$  METs) was > 6 h as these unlikely values may indicate insufficient wear-time or malfunction (Telford et al., 2005). Average MVPA per school day was multiplied by five to compute a summary measure for MVPA during the school week (i.e. Monday to Friday). MVPA during the average weekend day was multiplied by two to compute a score of MVPA during the weekend. Both scores were summed to create a measure of MVPA during a total week. To overcome skewness, the MVPA measure was log transformed, using the natural logarithm.

#### 2.2.2. Objective measures of the environment

Objective measures of the environment were determined using the Geographic Information Systems (GIS) software package,

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