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A park typology in the QUALITY cohort: Implications for physical activity and truncal fat among youth at risk of obesity

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ABSTRACT

Background. The operationalization of opportunities for physical activity (PA) in parks has not been studied extensively.

Objectives. To explore associations between park types, PA and adiposity in youth.

Methods. Data were from an ongoing cohort study in children at risk of obesity. Data were collected in 512 participants (2005–2008). Analyses were restricted to 380 participants living within ≥1000 m of ≥1 park (n parks = 576). Park types were identified using principal component and cluster analyses. Linear and logistic regressions were used to explore associations between park types, and PA and adiposity. The reference category was children living near smaller-sized parks with no team PA features.

Results. Nine park types were identified. Compared to the reference group, children living near esthetically pleasing parks with few team sports installations reported more 15-minute bouts of PA/week (bouts of PA) ($\beta = 5.2$ [90% CI: 2.3; 8.1]) and variety of PA (1.6 [0.1; 3.1]), and had less % truncal fat (−3.4 [−6.4; −0.5]). Children living near parks that were low on safety items with cycling infrastructure reported more bouts of PA (2.2 [0; 4.3]) and variety of PA (0; 2.2]). Children living near parks with a variety of PA installations reported more bouts of PA (2.5 [0.2; 4.7]) and variety of PA (1.4 [0.2; 2.5]). Children living near parks that had team sports and pool features reported more bouts of PA (2.5 [0.4; 4.7]). No significant associations were found for objectively-measured PA.

Conclusion. Parks that emphasize unstructured activities may increase self-reported PA and be associated with less % truncal fat among youth at risk of obesity.

1. Introduction

Childhood overweight and obesity are recognized public health concerns (Ng et al., 2014). Their associated health risks have been well documented (Hoey, 2014). Increasing levels of physical activity (PA) among children at risk of obesity may be one important factor in obesity prevention and management (Brown et al., 2015). Currently, only 14% of five to 11 year-old, and 5% of 12 to 17-year old Canadians are meeting the Canadian youth guidelines of 60 min daily of moderate to vigorous PA (MVPA) (ParticipACTION, 2015).

Parks are essential aspects of the built environment that can be optimized for health benefits. They provide a widely accessible opportunity for PA, yet little is known about how to operationalize these opportunities or the extent to which they influence PA and adiposity outcomes among youth at risk of obesity. Some park characteristics have been associated with PA among a general youth population including playgrounds (Potwarka et al., 2008; Besenyi et al., 2013; Rung et al., 2011; Cohen et al., 2006), basketball courts (Rung et al., 2011; Cohen et al., 2006; Floyd et al., 2011), trails (Kaczynski et al., 2008; Shores and West, 2008), and walking paths and running tracks among girls (Cohen et al., 2006). One study in children using accelerometers and geographic positioning systems (GPS) found that although park use was low overall, children were more likely to use parks with a high density of green vegetation (Dunton et al., 2014). Although the presence of parks has been correlated with a lower risk of obesity among youth

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(van Hulst et al., 2015; Nesbit et al., 2014), recent literature reviews have found inconsistent findings in the overall relationship between parks, obesity and PA (Casey et al., 2014; Ding and Gebel, 2012). This discrepancy may be because the majority of studies only assess the presence or absence of parks without considering specific park types, features and amenities.

There remains much to learn about how parks differ and which types of parks are most likely to promote PA among youth. An illustration of the installations and amenities that are likely to promote PA and help reduce adiposity among youth may help guide investments in park design. The aims of this study are to 1) distinguish park types in a Canadian city according to their salient features identified in comprehensive in situ audits and 2) explore whether distinct parks types are associated with PA and adiposity outcomes among children living nearby.

2. Methods

2.1. Study design

2.1.1. Participants

Data collected during the baseline assessment of the Quebec Adipose and Lifestyle Investigation in Youth (QUALITY) Cohort Study (Lambert et al., 2011) were used. Youth were considered to be at high risk for obesity because one or both biological parents were obese, a prerequisite to participate in the QUALITY study. A detailed description of the study design and methods is available elsewhere (details can be found in Lambert et al., 2011). Briefly, families were recruited using a school-based recruitment strategy. Among those eligible, 630 families (one child, aged 8–10 years, and both biological parents) completed baseline data collection (September 2005–December 2008), including a clinic visit during which questionnaires were completed and biological and physiological measurements taken. Written informed consent was obtained from the parents, and assent was provided by the children. The Ethics Review Boards of CHU Sainte-Justine and Laval University approved the study. A detailed audit of the parks around the homes (n = 512) of the participants located in the Montreal Census Metropolitan Area (MCMA) was conducted.

2.1.2. Park identification and audits

Park identification was conducted using a two-stage process. First, land use information from CanMap (Digital Mapping Technologies, Inc., 2007) were integrated in a geographic information system to extract 'parks and open spaces' polygons. The three closest parks within a 500 m walking network buffer around the exact addresses of the participants were identified. Second, additional parks were identified on-site using a 'seek and assess' procedure when observers walked all the street segments in the 500 m buffer zone. If no parks were found within 500 m, the walking buffer was increased to 1000 m, with the closest park being included in the sample. When observers found a park not in the CanMap dataset, they would draw its spatial boundaries on the map provided. A detailed description of the park identification process can be found in Bird et al. (Bird et al., 2015).

All parks were evaluated by two of 9 trained independent observer pairs, using the Parks, Activity and Recreation Among Kids (PARK) Tool, a 92-item direct observation park evaluation tool (Bird et al., 2015). The observers walked through the entire park to make sure they did not miss any sports installations or other park amenities. The PARK tool has demonstrated reliability and was developed specifically for youth PA in parks (Bird et al., 2015). An extensive observer training (detailed in Bird et al., 2015) was conducted to try to achieve high inter-rater reliability. Inter-rater reliability was generally high, with 86% of items across all parks having good to excellent overall agreement (≥75% agreement). Observers assessed a total of 576 unique parks, 345 of which were pre-identified using CanMap and 231 of which were identified on site during mild weather between the hours of 8:00 and 17:00 in 2008 (76%), 2009 (21%), and 2010 (3%), from June to December inclusively.

2.2. Measures

2.2.1. Self-reported physical activity

Child participants responded to a questionnaire on PA administered by a trained interviewer instructed to query participants about the physical activities they did over the past week for at least 15 min outside regular gym class. The response scale was yes or no for each of 28 different activities, for every day of the week, and included a, "Not in the last week" response option. The 3-day test-retest reliability of the original instrument was 0.74 (Sallis et al., 1993) and, in a different sample of adolescents, this version of the PA recall showed evidence of convergent validity with energy intake (Johnson-Down et al., 1997). Two subsequent recalls were conducted by phone with the participants during different seasons. The three recalls were averaged to create two variables: 1) mean sum of self-reported 15-min bouts of PA over one week (hereinafter referred to as bouts of PA), and 2) mean variety of different self-reported PA (i.e. the average number of different types of physical activities practiced and reported by the child over the three recalls).

2.2.2. Objective physical activity

Objective PA was measured using a calibrated accelerometer (Actigraph, model 7184, Pensacola, Florida, USA) fitted to the child during the clinic visit and instructed to be worn for the following 7 consecutive days. Only data of children with a minimum of 4 days with ≥10 h of wear time were retained, based on established guidelines (Colley et al., 2011). The accelerometer data were partitioned into six variables based on established cut-offs of counts-per-minute (Evenson et al., 2008): mean sedentary PA, mean light PA, mean vigorous PA, mean MVPA, and a dichotomized variable of meets the current guidelines of 60 min of daily MVPA or not.

2.2.3. Body composition

Total lean mass, total fat mass and central fat mass were measured in grams during a clinic visit using Dual Energy X-ray Absorptiometry (DXA). We defined child's truncal fat as the percentage of central-to-total body fat. It was calculated as ((central fat mass in grams) / (total fat mass in grams)) ∗ 100.

2.2.4. Anthropometric measurements

Weight, height and waist circumference were measured according to standard protocols (Lambert et al., 2011). BMI was analyzed using two cut-off points: 1) ≥85th percentile for overweight and obese versus not, and 2) ≥95th percentile versus not for obese children versus all others using the CDC reference curves (Centers for Disease Control and Prevention. Recommended BMI-for-age Cutoffs Atlanta, 2014).

2.2.5. Control variables

Child's age was analyzed as a continuous variable. The child's sexual maturity (Tanner stage) was evaluated by a trained nurse using Tanner stages (Marshall and Tanner, 1969; Marshall and Tanner, 1970). Puberty was considered either initiated (Tanner stage > 1) or not (Tanner stage = 1). Household income was self-reported by the participating child's biological parents on a 12-point response scale ranging from < $10,000 to ≥ $140,000. Household income was dichotomized as < $80,000 or ≥ $80,000.

2.3. Analyses

2.3.1. Park typology

The park typology (PT) was identified using a two-step approach. First, 41 variables from the park audit tool were selected using two criteria: variables with frequencies of ≥5%, and those that applied to the entire park. A principal component analysis (PCA) was performed using a varimax rotation and principal components extraction. A ten-factor solution was retained based on eigenvalues ≥0.95, for exploratory purposes. The minimum eigenvalue retained was 0.99. Internal consistency of factors was examined. Variables (37/41) were retained if they loaded onto a factor at 0.3 or higher; at this point, 9% of the variance in the variable is explained by the factor, a proportion generally agreed to be the lowest limit for which a component loading should be considered for inclusion (Tabachnick and Fidell, 2007) (see Table 1).

The second step applied a hierarchical cluster analysis using Ward's minimum-variance to the components created in step 1, with the addition of park area (in m^2), in order to identify distinct park types. Hierarchical cluster analysis begins with each multidimensional observation (park) as a single cluster and then repeatedly merges the next two closest until a single cluster encompassing all the data remains (Tan et al., 2005; van Hulst et al., 2012). This method results in a typology wherein substantively comparable parks are grouped together independent of geographical location (van Hulst et al., 2012). We examined results for N = 6 to N = 9 clusters, attempting to identify substantively distinct park types based on the dendogram, pseudo *F*, pseudo t^2 and the cubic clustering criterion plots.