Patterns of neighborhood environment attributes in relation to children's physical activity

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ABSTRACT

Characterizing neighborhood environments in relation to physical activity is complex. Latent profiles of parents' perceptions of neighborhood characteristics were examined in relation to accelerometer-measured moderate-to-vigorous physical activity (MVPA) among 678 children (ages 6–12) in two US regions. Neighborhood environment profiles derived from walkability, transit access, aesthetics, crime and traffic safety, pedestrian infrastructure, and recreation/park access were created for each region. The San Diego County profile lowest on walkability and recreation/park access was associated with an average of 13 fewer min/day of children's out-of-school MVPA compared to profiles higher on walkability and recreation/park access. Seattle/King County profiles did not differ on children's MVPA. Neighborhood environment profiles were associated with children's MVPA in one region, but results were inconsistent across regions.

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1. Introduction

Regular physical activity reduces risk for developing adverse health outcomes and improves cardiovascular, muscular, and metabolic health. For children, the Physical Activity Guidelines for Americans recommends acquiring 60 or more minutes of aerobic physical activity per day, most of which should be moderate-to-vigorous intensity (MVPA) ("Physical Activity Guidelines for Americans," 2008) to realize health-enhancing benefits. Long et al. (2013) reported that children 6–11 years old on average exceeded daily recommendations with the largest proportion of MVPA time occurring outside of school hours (Long et al., 2013), though the proportion meeting guidelines drops dramatically during adolescence (Troiano et al., 2008). Thus, increased emphasis on identifying promising strategies for increasing youth out-of-school MVPA is warranted.

Ecological models propose that features of built environments influence physical activity and may be especially important for out-of-school physical activity (Saelens et al., 2003). Research supports the important role of neighborhood environments in children's physical activity (Bauman et al., 2012; Kneeshaw-Price et al., 2013). A central tenet of ecological models is that multiple factors within and across levels of influence should explain physical activity better than a single factor (Sallis et al., 2009). This principle provides a rationale for simultaneously considering multiple factors when explaining MVPA. Limitations arise when analyzing individual attributes separately, as an individual's residential environment is composed of combinations of physical and social neighborhood features, many of which co-occur. For children, individual features such as recreation facility access, traffic safety, crime safety, and access to public transportation have been associated with children's physical activity in multiple studies while other features, such as street connectivity, residential density, and greater land-use mix have yielded mixed findings (Ding et al., 2011).

Unique combinations of neighborhood features may be associated with MVPA in different ways (Adams et al., 2011). For example, one neighborhood may exhibit high land-use mix and high street connectivity and good access to transit and parks while another neighborhood within the same urban area may exhibit a

different combination of features. Examining combinations of neighborhood features in relation to MVPA may account for more variation in prediction models, thereby strengthening results. The difficulty lies in how best to account for the numerous combinations and complex patterns of built environment features. Different a priori (e.g. indices) and data-driven (e.g. factor analysis) approaches have merits. For example, Tappe et al. explored relationships between perceived built environment features and objective MVPA using a backwards stepwise regression approach. Though this approach considered multiple aspects of built environment features on physical activity while controlling for the other features, the combination of individual features could not be ascertained (Tappe et al., 2013).

The use of latent profile analysis (LPA) to examine built environment features is a relatively new data-driven approach that recognizes the natural co-occurrence of features and seeks to consider this co-occurring impact on outcomes. LPA has shown promise identifying complex patterns of built environment features among adults and older adults with resultant profiles associated with MVPA in these populations (Adams et al., 2012, 2013).

Parent reports of neighborhood characteristics, such as neighborhood safety and proximity to parks, have been associated with greater levels of children's physical activity (Rosenberg et al., 2009). Parents may limit their child's outdoor activity due to negatively perceived access to recreation facilities or poor safety features and crime (Brownson et al., 2009). Therefore, parents' perceived built environment features may be an important measure when examining children's out-of-school MVPA, as combinations of built environment features may be revealed that are not evident in objectively measured neighborhood features.

The first purpose of the present analysis was to explore whether latent profile analysis could derive unique combinations among 11 perceived neighborhood environment features using a validated self-report measure of the built environment. Second, we explored whether objectively measured children's total and out-of-school MVPA differed across derived latent profiles. We expected that combinations of built environment features would result in unique patterns, termed profiles, and that children in physical activity-supportive neighborhood profiles would have more total and out-of-school MVPA. The present analysis was conducted separately in two U.S. metropolitan regions to examine the consistency in profile derivation and relation to children's MVPA.

2. Methods

2.1. Design and sampling

This secondary analysis used baseline data from the Neighborhood Impact on Kids Study (NIK), including parent surveys, objectively measured physical activity, and measured anthropometrics of participating children. NIK is a longitudinal cohort study in Seattle/King County, WA and San Diego County, CA examining neighborhood environment characteristics in relation to child and parent overweight and obesity, with baseline measures (2007) and follow-up measures collected two years apart (Saelens et al., 2012). Neighborhood selection and participant recruitment details have been published previously (Frank et al., 2012). To maximize within-neighborhood homogeneity of environmental features neighborhoods were defined as census block groups rather than larger census tracts. Objective data were used to calculate walkability, park proximity and quality, grocery store availability, and fast food restaurant concentration (Frank et al., 2012). Block groups were then categorized by median split into "good" and "poor" physical activity environments and "good" and "poor"

nutrition environments. These categories were used to build a 2×2 matrix of eligible block groups, with the four cells referred to as quadrants. Households with children aged 6–11 years from the identified block groups were selected using probability sampling within each quadrant and contacted by phone. Eligible children were able to engage in MVPA, did not have underlying medical conditions associated with obesity, and were not involved in medical treatment that had a substantive impact on growth. Excluded children had a chronic illness known to affect growth, < 10th percentile BMI for age and gender, an eating disturbance indicative of substantial eating disorder psychopathology, a medically prescribed dietary regimen, or a psychiatric problem that would interfere with participation (Saelens et al., 2012). Only one child per household was eligible to participate. After screening for eligibility, 944 families agreed to participate. Among these families, 757 consented and had a measurement visit. Institutional review boards at Seattle Children's Hospital, San Diego State University, Emory University, and Arizona State University approved this study and present analyses.

2.2. Measures

2.2.1. Perceived neighborhood environment

The present study used an adapted version of the original Neighborhood Environment Walkability Scale (NEWS) that combined NEWS and NEWS-Youth subscales, both reliable and valid surveys of physical activity-related neighborhood environment constructs (Saelens et al., 2003; Rosenberg et al., 2009; Adams et al., 2009). The child's parent or guardian completed the surveys for the neighborhood where the child lived a majority of the time. The subscales included residential density (6 items), land use mix-diversity (14 items), land use mix-access (6 items), street connectivity (3 items), pedestrian facilities (3 items), aesthetics (4 items), traffic safety (4 items), and crime safety (7 items). In addition, an 11-item scale measured recreation facility/park access, and one item measured public transit access. Residential density items were rated on a 5-point scale from "none" to "all," with the scale computed as the sum of item responses weighted by values approximating density of households per unit area relative to a single-family detached residence. Land use mix-diversity, transit access, and parks and recreation facility access items were rated on a 5-point scale (i.e., 1–5 min, 6–10 min, 11–20 min, 21–30 min, 31+ min), with item responses representing walking time to stores, transit stops, recreation facilities, etc. in the participant's neighborhood. Each of these scale scores was computed as the mean of constituent item responses. Items in the remaining scales were all rated on a 4-point scale from "strongly disagree" to "strongly agree," with scale scores computed as the means of item responses. Data were recoded as needed so that higher values were expected to be associated with more physical activity. All subscales have previously shown moderate to good test-retest reliability (NEWS: $r=0.58$–0.80, NEWS-Y: $r=.56$–$.87$) (Saelens et al., 2003; Rosenberg et al., 2009). The NEWS and NEWS-Youth with standardized subscale scoring procedures are available from http://sallis.ucsd.edu.

2.2.2. Moderate to Vigorous Physical Activity (MVPA)

Moderate-to-vigorous physical activity (MVPA) was measured objectively with the ActiGraph (GT1M) accelerometer (Pensacola, FL). Project staff in-person instruction to parents and children on how to have children properly wear the device. Children were asked to wear the accelerometer for 7 days for at least 10 h per day during waking hours except during water-based activities, such as showering or swimming. Children were asked to re-wear the accelerometer if fewer than 6 valid days were recorded. Physical activity counts were captured in 30 s epochs, and non-wear time