Health & Place 16 (2010) 1182–1187

Contents lists available at ScienceDirect

Health & Place

journal homepage: www.elsevier.com/locate/healthplace

Physical characteristics of the environment and BMI of young urban children and their mothers ☆, ☆☆

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ARTICLE INFO

Article history:
Received 6 November 2009
Received in revised form
2 July 2010
Accepted 27 July 2010

Keywords:
Physical environment
Child
Obesity
Race/ethnicity
Disparities
Maternal weight

ABSTRACT

The study examined whether characteristics of the urban physical environment are associated with child and maternal body mass index (BMI) in a sample of 3 year-old children and their mothers from 18 US cities ($N=1997$ dyads). BMI was determined based on measured height and weight. Characteristics of the interior and exterior physical environment, assessed and rated by trained interviewers, were related to child BMI at age 3 and to their mother's BMI. Negative aspects of the physical environment were more strongly related to maternal BMI among whites than among African–Americans or Hispanics.

1. Introduction

The notion that the physical environment can be 'obesogenic' (Booth et al., 2005; Egger and Swinburn, 1997; Lopez and Hynes, 2006; Rundle et al., 2007) has grown in acceptance over the last decade. Despite some evidence that the physical environment is related to obesity early in life (Scott et al., 2007; Spence et al., 2008; Timperio et al., 2005a), most of the work has focused on adults. Urban design factors, land use, availability of public transportation, and physical activity facilities within a certain area can directly influence physical activity and healthy eating. Several studies support the notion that certain aspects of the physical environment – e.g., walkability (Giles-Corti et al., 2003), urban sprawl (Ewing et al., 2003) or land use mix (Frank et al., 2004) – are associated with obesity. Results, however, are mixed (Brug et al., 2006) and underlying mechanisms remain poorly understood (Srinivasan et al., 2003). Current understanding about the role of food availability in the development of obesity illustrates the complexity of the issue. While lower rates of obesity are found among individuals who shop (Morland et al., 2006) or live (Rundle et al., 2009) in areas with more healthy food stores (such as supermarkets compared convenience stores), the actual impact of large-scale retail interventions on obesity has not been established (Cummins et al., 2005a, 2005b). There is increasing recognition that the role of the physical environment on any health behavior can be properly understood only if considered in relation to other components of the environment, which include the multiple spaces an individual may relate to (e.g., school and home) as well as variations in the timing of such interactions (daily, weekly or even throughout one's lifetime) (Cummins et al., 2007).

The influence of the physical environment on children's weight has been addressed less frequently than adults and results are also inconsistent (Dunton et al., 2009; Franzini et al., 2009; Papas et al., 2007; Sallis and Glanz, 2006) as compared to studies of adults. In a national longitudinal sample, researchers found a positive cross-sectional relationship between urban sprawl and obesity in children, however, longitudinal findings were not statistically significant (Ewing et al., 2006). Some studies have examined the association of parental perceptions of the

☆The efforts of Dr. Duarte and Dr. Chambers were supported by the Robert Wood Johnson New Connections Initiative and by the Race, Ethnicity and Obesity Workgroup part of the Emergent Scholars Interdisciplinary Network (ESIN).

☆☆The Fragile Families and Child Wellbeing Study was supported by grant number R01HD36916 from the National Institute of Child Health and Human Development. The contents of the paper are solely the responsibility of the authors and do not necessarily represent the official views of the National Institute of Child Health and Human Development.

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doi:10.1016/j.healthplace.2010.07.009

environment and child obesity risk. Parental perception of the physical environment of neighborhoods as deteriorated was related to obesity in children (Timperio et al., 2005b). Parental perception of neighborhood safety was associated with overweight at age 7 in one study (Lumeng et al., 2006), but not with overweight in children at 3 years, based on data derived from to the Fragile Families and Child Wellbeing Study (Burdette and Whitaker, 2005). A key issue when examining the relationship between the physical environment and obesity risk in children is distinguishing which aspects of the environment may be relevant and at what developmental stage. In general terms one would expect a more consistent relationship between the physical neighborhood environment and obesity promoting behaviors in older than in younger children. As it pertains to toddlers, for example, parental perceptions of urban sprawl may be a less important determinant of a toddler's behaviors and obesity risk than the interior of their homes and buildings. Inasmuch as the home is the primary environment for toddlers, elucidation of the link between these more immediate aspects of the physical environment and early obesity could improve understanding of key mechanisms for this age group.

Racial and ethnic minorities tend to live in neighborhoods with unequal distribution of the resources that promote healthy behaviors. These inequities put residents at a disadvantage in achieving dietary and physical activity health recommendations. Poor neighborhoods and neighborhoods with a high percentage of racial and ethnic minorities are less likely to have recreational facilities (Gordon-Larsen et al., 2006; Powell et al., 2006). Such disparities in the distribution of recreational facilities appear to be related to lower levels of physical activity and higher rates of obesity among minority adolescents (Gordon-Larsen et al., 2006). Similar patterns exist in the distribution of retail establishments that sell healthy foods (Gordon-Larsen et al., 2006). Evidence shows that the presence of more supermarkets in a neighborhood can influence the consumption of fruits and vegetables particularly among its minority residents (Morland et al., 2006).

The extent at which the physical environment may be related to the weight status of young children and their mothers has not been established. If such a relationship exists, it would be expected to vary across different racial/ethnic groups given what is known about the differential distribution of physical environmental characteristics. Because other socio-demographic characteristics, such as parental educational level or family income, may actually be the sole factors explaining the relationship between the physical environment and childhood obesity, they also need to be considered.

Our secondary analysis of data from an urban mostly minority and low-income sample – derived from the Fragile Families Study (Reichman et al., 2001) – focuses on the association between the conditions of the physical environment with child and maternal body mass index (BMI). Our analysis advances the existing literature by examining how the BMI of very young children (36 months) and their mothers is related to multiple aspects of the physical environment and examines whether such relationships vary across racial/ethnic groups. Our investigation is performed accounting for other socioeconomic factors present in the lives of these vulnerable families.

2. Methods

2.1. Study design and participants

The Fragile Families and Child Wellbeing Study is an ongoing longitudinal study initiated of a US national sample representative of all births from non-married couples in 18 selected cities with more than 200,000 inhabitants between 1998 and 2000. The study oversampled births to unmarried couples in a ratio of 3 to 1 births to married couples, and, when weighted, the data are representative of non-marital births in large US cities (Reichman et al., 2001).

The study protocol consists of telephone interviews with both mothers and fathers at birth and again when children were ages one, three, and five years, as well as in-home assessments of children and their home environments at ages three and five. The first three waves of data are publicly available. The analyses presented herein focus on the in-home assessments ($N=2119$ mother–child dyads) conducted in the third wave, when children were approximately 36 months. Only children for whom the in-home interview included interviewer observations of the conditions of the physical environment and measured height and weight with plausible values ($N=1977$ dyads) are included in the analysis. Specific information from the previous waves (e.g., birth weight, breastfeeding) are used when appropriate.

The Fragile Families and Child Wellbeing Study was approved by the institutional review boards of Princeton University (Princeton, New Jersey) and the 75 participating hospitals. The current analysis was also approved by the New York State Psychiatric Institute Institutional Review Board.

3. Measures

3.1. Body mass index (BMI)

During the in-home assessment, when children were about 3 years old, trained interviewers measured height and weight with participants wearing light clothing and no shoes. An electronic scale (SECA 840 Bella Digital Scale, Hanover, MD) was used to measure weight and a portable stadiometer (SECA 214 Road Rod Stadiometer) for height. Body mass index (BMI, kg/m^2), a measure of relative weight, was calculated from measured height and weight. The 2000 CDC growth reference was used to determine an age- and gender-specific BMI z-score for each child. Definitions of child overweight (85th–95th percentile BMI) and obesity (>95th percentile) reflect current recommendations (Kuczmarski et al., 2002). For children, BMI-z scores, a measure of child relative weight, were used in statistical analyses as a continuous variable. For mothers, weight and height were also measured, except for 195 mothers who self-reported their weight and 122 their height (reasons for self-report were pregnancy, refusal to be measured or exceeded the scales capacity). In the case of pregnant mothers ($n=148$), pre-pregnancy weight was reported. For mothers, obesity was defined as a BMI ≥ 30 and overweight as BMI ≥ 25 but less than 30. BMI was used in statistical analyses as a continuous variable.

3.2. Physical environment

During the third study wave, when children were 36 months old, trained interviewers completed an observation checklist, immediately after finishing in-home interviews, to gather information about the interior and exterior surroundings of the household. We retained for analysis only items with less than 10% missing values (6 out of 28 items were excluded). The interior physical environment was evaluated using 8 items regarding the integrity and organization of the household. The assessment of the exterior physical environment was made using 12 items that addressed the conditions of the building and of the streets within 100 yards the household.