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Features of the Built Environment Related to Physical Activity Friendliness and Children's Obesity and Other Risk Factors

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Abstract

Objectives—We investigated the relationships among environmental features of physical activity friendliness, socioeconomic indicators, and prevalence of obesity (BMI status), central adiposity (waist circumference, waist-height ratio), and hypertension.

Design—The design was cross-sectional; the study was correlational.

Sample—The sample was 911 kindergarteners through sixth graders from three schools in an urban school district residing in 13 designated neighborhoods.

Measurements—Data from walking environmental community audits, census data for socioeconomic indicators, body mass index, waist circumference, waist-height ratio, and blood pressure were analyzed. A modified Alfonzo's Hierarchy of Walking Needs model was the

conceptual framework for environmental features (i.e., accessibility, safety, comfort, and pleasurability) related to physical activity.

Results—Accessibility was significantly and negatively correlated with prevalence of obesity and with prevalence of a waist-height ratio > 0.50 . When neighborhood education was controlled, and when both neighborhood education and poverty were controlled with partial correlational analysis, comfort features of a walking environment were significantly and positively related to prevalence of obesity. When poverty was controlled with partial correlation, accessibility was significantly and negatively correlated with prevalence of waist-height ratio > 0.50 .

Conclusions—The built environment merits further research to promote physical activity and stem the obesity epidemic in children. Our approach can be a useful framework for future research.

Keywords

CVD risk factors; prevalence; environmental audits; Hierarchy of Walking Needs; children's health; obesity; central adiposity; physical activity friendliness

Background

Children have less autonomy than adults in their health behaviors and thus are more likely to be influenced by the built environment, directly or indirectly through parents and peers when making choices to participate in physical activity (Ding, Sallis, Kerr, Lee, & Rosenberg, 2011). Body composition, overweight status, and obesity can be viewed as more proximal indicators of health risk than physical activity (Dunton, Kaplan, Wolch, Jerrett, & Reynolds, 2009). Therefore, it is important to understand the relationship between the built environment and obesity. The ultimate goal of the research program is to identify modifiable environmental characteristics that can guide interventions and policies to prevent obesity.

Two review articles have summarized the relationship between the built environment and childhood obesity (Dunton et al., 2009; Papas et al., 2007). In one review of the built environment and obesity, only one of the three studies with children found a statistically significant positive association between the built environment and body mass index (Sturm and Datar study as cited in Papas et al., 2007). In two other studies, the distance from the child's residence to the nearest playground was unrelated to obesity status (Burdette and Whitaker study and Liu, Cunningham, Downs, et al. study as cited in Papas et al., 2007). Clearly, more studies are needed to understand the associations among environmental factors and childhood obesity.

In another review of built environmental correlates of childhood obesity, the factors included access to recreation facilities, land-use mix, residential density, walkability, walking/biking facilities, traffic speed/volume, pedestrian safety structures, incivilities/disorders, park access, street connectivity, vegetation, availability of/access to public transportation, number of locked schoolyards, and availability of bicycle and walking trails (Dunton et al., 2009). For children (aged 3 to 12 years of age), vegetation and the presence of hazards (e.g., litter, trash, and noise) were correlated with obesity. In this age group, other findings differed by demographic groups and geographic factors. For example, vegetation

density was negatively associated with BMI in high- but not low-population density areas. The authors concluded that overall for children, associations among physical environmental variables and obesity differed by age, population density, and whether reports were made by the parent or child (Dunton et al., 2009). Additionally, socioeconomic status if not properly controlled for could account for effects of the built environment (Dunton et al., 2009). Given the extensive literature on differential associations among socioeconomic status and the built environment (Taylor, Poston, Jones, & Kraft, 2006; Taylor, Floyd, Whitt-Glover, & Brooks, 2007), relationships among socioeconomic levels and built environmental features of neighborhoods are important to investigate. For most environmental variables related to children and obesity, consistent empirical evidence is not available and specific aspects of these associations are poorly understood. Further studies are needed.

Healthy People 2020 targeted a 10% reduction of childhood obesity to 16.1% by 2020 (United States Department of Health and Human Services, Office of Disease Prevention and Health Promotion, n.d.). Moreover, one of the objectives of the White House Task Force on Childhood Obesity Report is to reduce childhood obesity prevalence to 14.6% by 2020 and to five percent by 2030 (Barnes, 2010). From this report, one key question for future research is: How does the built environment increase physical activity rates and reduce obesity? This paper presents an approach and method that may be useful in addressing this key research question and the research questions in our study.

A core concept for this paper is physical activity friendliness or environmental friendliness toward physical activity. Environmental friendliness toward physical activity is determined by the extent to which the physical environment provides cues and opportunities for physical activity and by the presence or absence of environmental attributes associated with rates of physical activity (Brownson et al., 2004).

Research Questions

Our purpose was to operationalize a conceptual framework of physical activity (i.e., a modified Hierarchy of Walking Needs Model) and to assess the associations among four environmental factors, a composite physical activity friendliness score, children's obesity, and other cardiovascular risk factors. Our research questions were:

1. What are the relationships among physical activity friendliness of neighborhoods and the prevalence of obesity, central adiposity, and hypertension among children?
2. What are the relationships among environmental features related to physical activity friendliness of neighborhoods and children's risk factors controlling for poverty and education?

The data from this study will be informative to address one of the key questions from the White House Task Force on Childhood Obesity Report: How does the built environment reduce obesity?

Methods

Three primary reasons guided the selection of the Hierarchy of Walking Needs model for this study. Ecological models are particularly well suited for studying physical activity, because people are physically active in specific places. Therefore, it is a priority to study characteristics of places that facilitate or hinder physical activity (Sallis et al., 2006). The Hierarchy of Walking Needs model is placed within the context of an ecological framework to fully understand how people make decisions related to being active (Alfonzo, 2005). Second, the hierarchy is the only known model to specifically enumerate the relative importance of environmental characteristics. The hierarchy implies that the absence of higher-order needs (i.e., associated amenities of the built environment) does not restrict the choice to be active if lower-order needs have been fulfilled (Alfonzo, 2005). This distinction is critical for design guidance and decision making related to interventions. Third, the hierarchy has clear and distinct conceptual definitions of environmental features that can be operationalized and measured with scale items from an environmental audit assessment (Alfonzo, 2005).

Conceptual Model

The Hierarchy of Walking Needs model has five levels of need: feasibility, accessibility, safety, comfort, and pleasurability; these levels are the antecedents within the decision making process. The model's fundamental premise is that the basic levels of need (e.g., feasibility, accessibility, and safety) have to be met before the higher levels of need (e.g., comfort and pleasurability) are considered in the decision to walk or to be physically active (Alfonzo, 2005). The research team decided that there were not sufficiently relevant data for the first level of the model which is feasibility; therefore, four of the five levels of the Hierarchy of Walking Needs model were operationalized to address the research questions. Four levels (i.e., accessibility, safety, comfort, and pleasurability) were operationalized to establish a physical activity friendliness score for each neighborhood (block group).

Description of St. Louis University Environmental Checklist Audit Tool

The St. Louis University Environmental Checklist Audit Tool is used to understand the relationships between street-scale environments and physical activity. Features of the street-scale environment include types of destinations, sidewalk quality, presence of litter and graffiti, presence of trees, availability of public transit, and types of recreational destinations. The audit tool is particularly well suited for capturing elements in the transportation and land use environments (Brownson et al., 2004). The St. Louis Environmental Checklist Audit Tool was selected for use in this study because it is comprehensive, reliable, and valid and has a training module (Brownson et al., 2004). The instrument can be accessed from the following website: www.activelivingresearch.org/files/audit_tool_checklistpdf.

We selected items to represent each of the four levels of need. The selected questions from the tool are presented in Table 1. For accessibility, we chose questions related to residential and non-residential land uses, types of commercial destinations, types of public or government service destinations, types of recreational facilities/destinations, sidewalks, bike

lanes, street shoulders, wide outside lanes, and good connectivity. For safety, we chose questions related to the presence of bars, liquor stores, and adult entertainment (e.g., strip clubs, night clubs, etc.) and the presence of physical disorder (e.g., people fighting, acting hostile, threatening, stray dogs, and other animals). For comfort, we chose questions related to street type, street design and characteristics, traffic calming devices (e.g., traffic signals and speed bumps), aggressive drivers, crossing aids, street lighting, and types of service amenities. For pleasurability, we chose questions related to attractive features and whether people are visible.

Design and Sample

Environmental audits and a cross-sectional prevalence study of cardiovascular risk (CV) factors were conducted with children in kindergarten through sixth grade in three schools located in an urban school district in southeastern United States. The St. Louis Environmental Checklist Audit Tool was carried out in the neighborhoods surrounding the three schools participating in the university/school district partnership. Neighborhood characteristics were assessed at the block group level of the census hierarchy because this level is considered appropriate for analysis of residential housing patterns (Iceland & Steinmetz, 2003) and other aspects of the built environment (Hoehner, Handy, Yan, Blair, Berrigan, 2011; Oluyomi et al., 2014). Block groups are the smallest geographic level for release of tabulated census data. All census block groups, in which the children in the prevalence study lived, were selected for the environmental audits. In a prior phase of the same project, children in these three schools had been selected for CV risk factor assessment by a stratified (by grade level), random sample of classrooms. Physiological and anthropometric measurements included weight, height (for BMI calculation), waist circumference and waist-height ratio (to assess central body fat), and blood pressure [systolic (SBP) and diastolic (DBP) blood pressure]. Details of the design, sample size estimates, and methods are reported in an earlier study (Meininger et al., 2010). Of those selected into the sample, 92% participated. The sample for the current study was restricted to 911 children who had participated in the prevalence study and who were residents of 13 block groups that had been assessed with the environmental audit. Each of these 13 block groups had more than 10 children in the prevalence survey. Of the census block groups that were included in this study, the total geographic area covered was approximately 23.6 square miles.

The study was approved by The University of Texas Health Science Center at Houston Committee for the Protection of Human Subjects. Parents/guardians were notified by postal letter in advance of the screening program and asked to return a prepaid postcard if they did not want to give consent for their children's participation. In an assembly at each school before the screening program began the investigators explained the protocol to the children, demonstrated the measurements, and answered questions. As each class participated in the screening, children had another opportunity to ask questions about the procedure and were reminded that they could decline or discontinue participation at any time.

Data Collection and Measures

Census 2000 data were downloaded from the US Census Bureau by one of the investigators (TN) (United States Census Bureau, 2000). Data from the poverty (P90) and education (P37) tables were obtained at the block group level in Summary File 3 (SF3) (United States Census Bureau, 2000). Poverty status of the population residing in the block group was defined as the percentage of family units (all types) with related children less than 18 years of age that had a household income in 1999 below the poverty level. Educational status of the population residing in the block group was defined as the percentage of the population aged 25 years and over with less than a high school diploma or its equivalent.

The data collectors for the screening program and the environmental audits were nursing students enrolled in a community health course as seniors in a baccalaureate nursing program. Students completed an online ethics course (National Institutes of Health, Office of Extramural Research, <http://phrp.nihtraining.com/users/login.php>). They were trained to implement a screening protocol for the measurement of the CV risk factors. The protocol included assembling data collection stations in each school for the privacy of the children. A balance beam scale was used to measure weight to the nearest 1/4th lb.; a stadiometer was used to measure height to the nearest 1/4th inch. Body mass index (BMI) was calculated using the formula, weight in kilograms/height in meters², and percentiles and z-scores of BMI were calculated based on the Centers for Disease Control and Prevention (CDC) age-gender normative data and z-scoring methods (Centers for Disease Control and Prevention, n.d.a, n.d.b). Children with BMI $\geq$ 95th percentile were classified as obese, those $\geq$ 85th < 95th percentile were classified as overweight. Waist circumference was measured to the nearest centimeter, using a flexible non-stretchable tape measure at the narrowest point midway between the bottom of the lowest rib and the superior border of the iliac crest. National data were used to define risk status for waist circumference ($\geq$ 90th percentile) (Fernández, Redden, Pietrobelli, & Allison, 2004) and waist-height ratio (>0.5) (Kahn, Imperatore, & Cheng, 2005). SBP and DBP were measured three times with a 1-minute interval between each reading using a Spacelabs oscillometric monitor, Model 90207 (Redlands, WA). Cuff sizes, procedures and norms by age, sex, and height were based on national guidelines (National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, 2004). The average (mean of the second and third reading in a series of three readings) was used for analysis. Children with SBP and/or DBP $\geq$ 90th percentile on screening were re-measured on two additional occasions within three weeks to confirm pre-hypertensive ($\geq 90^{\text{th}} < 95^{\text{th}}$ percentile) or hypertensive ($\geq 95^{\text{th}}$ percentile) status.

For the environmental audits, the baccalaureate students were trained by an investigator (WCT) during a two-day period for data collection and data entry. Day one included a classroom session discussing the audit instrument, and a practical experience using the instrument in a neighborhood near the University. Day two included an interactive discussion focused on student questions about use of the instrument and data entry. Students' pilot tested the instrument the following week in neighborhoods in the areas of the schools. Two different groups of students used the audit to assess the same geographic areas during the same time period in designated block groups. The pairs working together did not

consult with each other or communicate with other groups of students. Out of the 132 items on the instrument, agreement between raters ranged from 94% to 99%. In an earlier study, for the checklist audit, the social environmental items had either fair or poor agreement, the lowest agreement of any domains (Brownson et al., 2004). However, in this study, because the raters were observing at the same time, the inter-rater agreement for the social environmental items (e.g., people outside talking), was not appreciably lower than the other domains.

Audit Procedures—Each census block group contained multiple street segments. Two intersecting street segments (one north/south and one east/west) were selected for each census block group. The street segments were selected by first driving the perimeter of the block group to establish the boundaries, and then selecting intersecting street segments in the block group that did not extend beyond the boundary in any direction. An audit was one street segment either north/south or east/west with each street segment being 0.4 miles. A street segment length of 0.4 miles was manageable for walking auditors to thoroughly inspect visually, measurable by an automobile odometer, and based on previous research with similar audit procedures (Taylor, Franzini, Olvera, Poston, & Lin, 2012). Thirteen block groups and twenty-six street segments were included in this study.

Nursing students traveled and worked in pairs for the audits. Each group received a map of the census tract and the block group. Students called faculty at the time they started the audit with the exact names of the streets that were at the center point of the block group. After completing the audit, students returned to the meeting place and faculty reviewed the forms for completeness. Each audit took between 1–2 hours to complete. Under the guidance of faculty (CB and SU) students entered the data into SPSS data files. Data were checked for completeness and accuracy (TN).

Analytic Strategy

Calculation of Physical Activity Friendliness Score—The two audits for intersecting street segments in each of the 13 block groups were combined. An individual score for each of the four levels of physical activity friendliness (i.e., accessibility, safety, comfort and pleurability) was computed by adding the components of the audit within each level. A total combination score for physical activity friendliness was calculated by summing the scores across all levels.

Statistical Analysis Plan—To assess the strength of the monotonic relationship between variables and because of the small sample size ($n=13$ block groups), Pearson product-moment correlation coefficients were used. In order to adjust the correlations for poverty and educational levels at the block group level, we used partial correlations. Spearman rho correlations were not used because the ordinal level data did not meet the criterion of true ranks. All statistical analyses were conducted with SAS 9.3. The alpha level for statistical significance was $< .05$.

Results

We demonstrated that operationalizing the constructs of a modified Hierarchy of Walking Needs Model with the St. Louis Environmental Checklist Audit Tool was feasible and practical with appropriate training of auditors. The questions in the audit did correspond to the environmental features of accessibility, safety, comfort, and pleasurability.

Description of children and block groups

A total of 911 children of the 1,070 who had been screened resided in the 13 eligible block groups; these 911 children comprised the sample for this study, which was 50.9% female with a mean age of 8.8 (S.D. 2.2). The ethnic/racial distribution was 71.4% Hispanic, 22.5% African American, 2.5% non-Hispanic White, and 3.6% other. The prevalence of obesity was 28.8% and 17.6% were classified as overweight. The prevalence of central adiposity was 28.4% of the sample with a waist circumference 90th percentile and 43.9% with a waist-height ratio greater than 0.5. Hypertension or pre-hypertension was present in 8.8% of the children. Descriptive statistics for continuous variables are in Table 2.

The 13 block groups showed wide variation in all measured variables (Table 3). The percentage of families with children living below the poverty level ranged from 2.8% to 41.7%. The percentage of adults over 25 years of age with less than a high school education ranged from 8.5% to 46.6%. Similarly, there was wide variation across block groups in risk factors. For example, the prevalence of obesity among the 13 block groups ranged from 6.3% to 42.4%.

The correlations among physical activity friendliness scores, its components, and the prevalence of risk factors in children are shown in Table 4. Accessibility was significantly and negatively related to the prevalence of obesity ($r = -0.59$, $p = .03$) and to the prevalence of a waist-height ratio > 0.50 ($r = -.66$, $p = .01$). None of the other components in the physical activity friendliness hierarchy was significantly associated with any of the risk factors. Similarly, the total score for physical activity friendliness was not correlated with any of the risk factors.

Correlations of the poverty and educational levels of the block group with physical activity friendliness scores, its components, and the prevalence of each risk factor are in Table 5. There were significant negative correlations of percentage of families with children living in poverty with the total physical activity friendliness score ($r = -0.57$, $p = .04$) and with the pleasurability component ($r = -0.64$, $p = .02$). The percentage of the block group population > 25 years old with less than a high school education was significantly and negatively related to the total score for physical activity friendliness as well as three out of four of its components: total score ($r = -0.79$, $p = .001$); accessibility ($r = -0.69$, $p = .01$); comfort ($r = -0.63$, $p = .02$); and pleasurability ($r = -0.64$, $p = .02$). Neither the percentage of families with children living in poverty nor the percentage of the population > 25 years old with less than a high school education was significantly related to any of the risk factors.

Finally, with partial correlations we adjusted for poverty and educational levels at the block group level, and reexamined the correlations between physical activity friendliness scores

and prevalence of risk factors. When education was controlled, accessibility was not significantly related to prevalence of obesity or prevalence of waist-height ratio > 0.5 (as in the bivariate correlations). However, comfort was now significantly and positively related to prevalence of obesity ($r = .60$, $p = .04$). When poverty was controlled, prevalence of waist-height ratio > 0.5 was significantly and negatively correlated with accessibility ($r = -.68$, $p = .02$), very similar to the bivariate correlation ($r = -.66$, $p = .01$). The correlation between prevalence of obesity and accessibility did not change much, from -0.59 to -0.57 , but enough that the p-value is just above .05. When both education and poverty were controlled, comfort was significantly and positively correlated with prevalence of obesity ($r = .62$, $p = .04$).

Discussion

New findings

One purpose of our study was to demonstrate the feasibility of a comprehensive approach to address one of the key research questions from the White House Task Force on Childhood Obesity Report to the President with respect to features of the built environment that may influence childhood obesity (Barnes, 2010). Moreover, our two research questions addressed associations that are poorly understood related to childhood obesity and the built environment.

We demonstrated that with rigorous, systematic training and implementation, the constructs within a modified Hierarchy of Walking Needs model (Alfonzo, 2005) can be operationalized with a comprehensive set of observations from a reliable and valid walking environmental neighborhood audit (Brownson et al., 2004). In addition, a composite score of physical activity friendliness for each block group can be computed. Our results indicated that there were differences in the basic (i.e., accessibility and safety) and higher level built environmental features (i.e., comfort and pleasurability) related to physical activity friendliness. For example, not controlling for poverty and education, accessibility was significantly and negatively associated with prevalence of obesity. When poverty and education were controlled, comfort was significantly and positively correlated with prevalence of obesity. Further research is needed to understand the meaning of these associations. Perhaps, poverty and education are socio-demographic variables so fundamental to understand and explain associations with the built environment that controlling for these variables can lead to unexpected and puzzling results. It is not clear why comfort features in the environment would be positively associated with obesity. The assumption is that comfort features in the environment would encourage physical activity and be negatively associated with obesity. Additional research can establish whether this result is a consistent finding.

Compare and contrast previous best evidence

Few studies with children report a statistically significant positive association between the built environment and body mass index (Papas et al., 2007). For example, the distance from the child's residence to the nearest playground was unrelated to obesity status in two studies (Papas et al., 2007). Our study demonstrated that it is important to identify the type of

environmental feature and risk factor of interest to understand the associations among environmental factors and childhood obesity. To our knowledge, no published studies have adopted this approach.

Overall, our findings indicated that a model encompassing a hierarchical description of an environment can be operationalized and is needed to understand the meaning of the relationships among the built environment and children's weight status and other risk factors. Further studies are needed to replicate these findings and to determine their generalizability across communities.

Limitations of the study

Appropriate caution is needed in generalizing our results because our sample size was small ($n=13$ block groups, $n = 911$ children). The prevalence of obesity for our sample as a whole was high (28.8% at or above the age-sex specific 95th percentile of BMI). This prevalence is greater than a national estimate for children 6 to 11 years old, 19.6% (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010) and various other samples in the United States (Hoelscher et al., 2004; King, Meadows, Engelke, & Swanson, 2006; Kolbo et al., 2006; Lewis et al., 2006). Analysis in our study was based on individual level risk factors of each child that were aggregated to the block group level and related to environmental features of the block group. Characteristics of the specific block in which each child resided were not assessed. Individual level ascertainment of both sets of variables might yield different results. For example, analyzing a street network buffer around the student's home would permit a more individualized unit of analysis.

Other limitations of our study are the absence of a physical activity measure and a sufficient number of block groups for robust analyses such as linear regressions. A physical activity measure is the intermediate variable that links the built environment attributes and weight status in children.

Also, the absence of data related to feasibility, the first level of the Hierarchy of Walking Needs model is a limitation (Alfonzo, 2005). We do not know to what extent the inclusion of a feasibility measure would affect the findings. Moreover, our findings were based on data from walking environmental audits in the neighborhoods (one type of measure, observable, and objective) and not subjective perceptions from residents. However, we do acknowledge the importance of resident perceptions in understanding the relationships among the environment, physical activity, and obesity (Luke, Brownson, Naleid, & Kreuter, 2004; Taylor et al., 2007). Studies should combine both objective and subjective assessments of the environment to fully understand the environment, physical activity patterns, and obesity. Also, from a statistical perspective the amount of variance accounted for by the built environment related to the weight status of children is of considerable interest. Future research can address these limitations and issues.

Strengths of the study

The strengths of our study include the physical activity friendliness score for each neighborhood block group based on a comprehensive, conceptual model with data from neighborhood environmental audits. Our environmental audit instrument captured land use

mix, neighborhood design, safety, street connectivity, and accessibility, all important correlates of physical activity. In addition, the auditors (i.e., nursing students) assessed the presence of parks and playgrounds which can be a major venue for youth physical activity.

Furthermore, we analyzed each built environmental factor separately and as part of a composite score. This approach can be useful in future research to comprehensively assess the attributes of a neighborhood as it relates to physical activity friendliness. Furthermore, our sample was racially and ethnically diverse including African and Hispanic American children. Additionally, the study included a comprehensive assessment of a variety of risk factors related to childhood obesity. We were unable to identify any research investigating the built environment and hypertension in children. Moreover, our measures were objective assessments.

The cardiovascular risk factors were based on a thorough, in-person screening of children. The built environment data were based on walking environmental neighborhood audits with known psychometric properties. We assessed the quality of the environment as well as the presence and absence of features. We analyzed environmental features individually as well as a composite score. Finally, to fill a clear gap in the literature, we used a comprehensive conceptual framework with four built environmental features (i.e., accessibility, safety, comfort, and pleasurability) and a composite physical activity friendliness score. This framework is organized in a hierarchal fashion to distinguish between basic and higher level built environmental features of physical activity friendliness.

Recommendations for future research

In future studies, physical activity levels can be assessed for children in each block group. Then the relationships among the composite score and its component sub-scores, physical activity patterns, and weight status can be carefully analyzed among economically, racially, and ethnically diverse children in various neighborhoods. This approach and these data can assist in developing effective interventions related to the built environment and healthy weight among children to help achieve the White House goals to reduce childhood obesity to five percent by the year 2030 (Barnes, 2010). A public health concern is the differential opportunity structures for healthy behaviors that exist in various neighborhoods, particularly as they relate to income and education (Oliver & Hayes, 2005). Changes to the environment may benefit children most at risk for obesity and future chronic health conditions related to obesity (Oliver & Hayes, 2005; Slater et al., 2010). The built environment merits further research to promote physical activity and stem the obesity epidemic in children. Specifically, future research can investigate whether recreation facilities, surrounding neighborhoods, or school environments are the most critical venues and for which subgroups of youth.

We present an approach that may be a useful framework for future research. To fully understand the contribution of the environment to prevent and reduce obesity, comprehensive approaches to assess the environment are needed as exemplified in our study.

Implications for public health nursing

One of the hallmarks of public health nursing practice is the use of holistic approaches that incorporate multiple determinants of population health, including physical and social environments (Keller, Strohschein, & Schaffer, 2011). There are opportunities for public health nurses to include features of the built environment that influence health as part of their community assessment and advocacy efforts (DeGuzman & Kulbok, 2012). In their work with individuals and families, public health nurses can discuss strategies for overcoming barriers to physical activity in the built environment. The findings of this study, although based on a small sample of census block groups, suggest a connection between characteristics of the residential built environment and prevalence of obesity among children. These findings contribute to the limited but growing understanding of the pathways through which environmental factors impact health status at the population level. The methods we implemented for the environmental assessment and the conceptual framework we adapted to organize and analyze data can be applied in public health nursing practice. Specifically, the St. Louis Environmental Checklist Audit Tool could be used by neighborhood residents, community leaders, and public health personnel, including public health nurses, to assess neighborhoods. The conceptual model, the Hierarchy of Walking Needs, could provide a framework for communities to prioritize areas that may need to be addressed to improve the physical activity friendliness of neighborhoods. Building on these findings and methods, we recommend further research to strengthen the evidence base for designing environments that support population health as well as prevent obesity in children.

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Table 1

Selected Questions from the St. Louis University Environmental Checklist Audit Tool to Operationalize the Levels of a modified Hierarchy of Walking Needs Model

Questions from the St. Louis University Environmental Checklist Audit Tool
<i>Accessibility</i>
1. Residential and non-residential land uses
3. (a–u) Types of commercial destinations
4. (a–m) Types of public or government service destinations
5. (a–j) Types of recreational facilities/destinations
9. (a–c) Sidewalks, bike lanes, street shoulders, wide outside lanes
12. (b) Good connectivity
<i>Safety</i>
3. (r) Bars, liquor stores, and adult entertainment (e.g., strip clubs, night clubs, etc.)
20. Physical disorder (in general)
21. (a–h) Physical disorder (specific types)
23. (i, j) People fighting, acting hostile, threatening, stray dogs, other animals
<i>Comfort</i>
12. (a, c–g) Street type, street design and characteristics, traffic calming devices, aggressive drivers, crossing aids, street lighting
15. (a–h) Types of service amenities
<i>Pleasurability</i>
16. Attractive features
17. Comfort features
23. (a–h) People visible

Table 2

Descriptive Statistics, Characteristics of Children Screened, n = 911

Description	Minimum, Maximum	Mean	S.D.
Height (cm)	105.4, 172.7	134.6	14.3
Height (in)	41.5, 68.0	53.0	5.6
Weight (kg)	15.1, 117.0	37.2	14.6
Weight (lb)	33.3, 258.0	81.9	32.3
BMI (kg/m ²)	10.8, 42.00	19.8	4.6
z BMI	-5.47, 2.94	0.84	1.11
SBP (mm Hg)	65.0, 148.0	106.3	8.9
DBP (mm Hg)	41.0, 93.0	61.6	6.4
Waist circumference (cm)	46.0, 128.0	68.5	13.0
Waist circumference (in)	18.1, 50.4	27.0	5.1
Age (year)	5.0–15.0	8.8	2.2

Note. BMI - body mass index; z BMI - standard deviation units away from the mean, based on smoothed curves developed for the CDC growth charts; SBP-systolic blood pressure; DBP-diastolic blood pressure

Table 3

Descriptive statistics and characteristics of census block groups assessed, n=13

Physical activity friendliness	Mean	Median	SD	Min	Max
Total Score	36.9	36.0	9.5	22.0	54.0
Accessibility	6.8	7.0	4.2	2.0	14.0
Safety	14.6	14.0	3.0	10.0	20.0
Comfort	7.6	8.0	3.3	2.0	13.0
Pleasurability	7.9	9.0	3.4	0.0	12.0
Census 2000 Variables (%)					
Families with children in poverty	14.9	7.7	11.6	2.8	41.7
Adults 25 years below H.S. education	31.7	33.6	8.5	18.5	46.6
Prevalence of Risk Factors (% of Children Screened)					
Obese	27.7	28.7	9.0	6.3	42.4
Overweight	16.1	15.9	4.2	9.1	21.7
Pre-hypertensive or Hypertensive	8.7	7.3	5.9	0.0	19.0
High Waist Circumference	27.5	26.2	15.0	0.0	53.8
Waist-height ratio > 0.5	40.4	42.9	12.1	18.8	53.8

Note. H.S. - high school; Obese - 95th percentile; Overweight - 85th < 95th percentile; Pre-hypertensive or Hypertensive - 90th percentile; High Waist Circumference - 90th percentile

Table 4

Correlations of Components of Physical Activity Friendliness (PAF) with Risk Factors among Children Screened, n = 13 Block Groups with > 10 children Screened. Pearson Correlation Coefficients, 2-sided tests

	Prevalence Obesity	Prevalence Overweight	Prevalence Prehypertension/Hypertension	Prevalence High Waist Circumference	Prevalence WHR > 0.5
Accessibility	-0.59 p = .03*	-0.07 p = .83	-0.33 p = .28	-0.52 p = .07	-0.66 p = .01**
Safety	-0.15 p = .63	-0.16 p = .60	-0.06 p = .86	-0.35 p = .24	-0.24 p = .43
Comfort	0.18 p = .55	0.08 p = .79	0.14 p = .65	0.15 p = .62	0.09 p = .76
Pleasurability	-0.10 p = .75	0.32 p = .29	-0.02 p = .96	-0.08 p = .79	-0.00 p = .99
Total PAF Score	-0.28 p = .36	0.06 p = .84	-0.12 p = .70	-0.32 p = .29	-0.33 p = .26

Note: Obesity - 95th percentile; Overweight - 85th < 95th percentile; Pre-hypertensive or Hypertensive - 90th percentile; High waist circumference - > 90th percentile; WHR - waist-height ratio

* = p < 0.05;

** p < 0.01;

*** p < 0.001

Table 5

Correlations of Poverty & Education with Components of Physical Activity Friendliness (PAF) and Prevalence of Risk Factors among Children Screened, n = 13 Block Groups with > 10 Children Screened. Pearson Correlation Coefficients, 2-sided tests

	Percent Below Poverty	Percent > 25 years Education Below High School
Accessibility	-0.23 p = .46	-0.69 p = .01**
Safety	-0.36 p = .22	-0.12 p = .71
Comfort	-0.36 p = .22	-0.63 p = .02*
Pleasurability	-0.64 p = .02*	-0.64 p = .02*
Total PAF Score	-0.57 p = .04*	-0.79 p = .001***
Prevalence Obesity	0.18 p = .55	0.39 p = .19
Prevalence Overweight	-0.43 p = .14	-0.12 p = .71
Prevalence Hypertension/Pre-hypertension	-0.01 p = .98	0.33 p = .28
Prevalence Waist Circumference 90 th Percentile	0.19 p = .54	0.34 p = .26
Prevalence WHR 0.5	-0.02 p = .95	0.41 p = .17

Note. Obesity - 95th percentile; Overweight - 85th < 95th percentile; Pre-hypertensive or Hypertensive - 90th percentile; High waist circumference - > 90th percentile; WHR - waist-height ratio

* = p < 0.05;

** = p < 0.01;

*** = p < 0.001