Published in final edited form as:

Am J Prev Med. 2015 December ; 49(6): 902–911. doi:10.1016/j.amepre.2015.05.021.

Urban Neighborhood Features and Longitudinal Weight Development in Girls

Kathleen M. McTigue, MD, MS¹, Elan D. Cohen, MS², Charity G. Moore, PhD², Alison E. Hipwell, PhD³, Rolf Loeber, PhD³, and Lewis H. Kuller, PhD⁴

¹Departments of Medicine and Epidemiology, University of Pittsburgh, Pittsburgh, Pennsylvania

²Department of Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania

³Department of Psychiatry, University of Pittsburgh, Pittsburgh, Pennsylvania

⁴Department of Epidemiology, University of Pittsburgh, Pittsburgh, Pennsylvania

Abstract

Introduction—The literature on environment and obesity is characterized by studies that are often cross-sectional and lack racial diversity. This study examined associations between neighborhood features and BMI development over 6 years in an urban sample of 2,295 girls (56% African American; mean age at baseline, 11.2 years) in 2004. Analyses occurred in 2011–2015.

Methods—Girls, caregivers, and study staff completed annual neighborhood questionnaires. Linear mixed-effects modeling examined annual changes in neighborhood features and BMI and assessed whether baseline neighborhood features modified BMI growth over time.

Results—At baseline, 40% of participants were overweight/obese. Participants' neighborhoods had few neighborhood problems, moderate levels of safety issues and inconvenient features, low levels of neighborhood disorder, few cases of loitering youth, and substantial traffic volume. Adverse neighborhood features were more common for African American than white participants. Neighborhood features were relatively stable over the follow-up period. African American girls with helpful neighbors had lower annual BMI growth (-0.09 kg/m^2) than others. For white girls, BMI increased more for girls with helpful neighbors ($+0.09 \text{ kg/m}^2$ annually). Regardless of race, living in a Census tract with low levels of educational achievement was linked with higher BMI growth (an additional 0.07 kg/m^2 annually). Girls living in Census tracts with high (versus low) levels of poverty gained an additional 0.08 kg/m^2 gain annually.

Conclusions—Social environment features are associated with BMI change in white and African American urban girls and may be helpful for identifying girls at risk for early adolescent weight gain.

Address correspondence to: Kathleen McTigue, MD, MS, 230 McKee Place, Suite 600, Pittsburgh PA 15208. kmm34@pitt.edu.

No financial disclosures were reported by the authors of this paper.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Introduction

Although a considerable literature on the relationships between environment and obesity has emerged, substantial heterogeneity of the findings^{1–5} makes the identification of policy implications challenging. The field has recently advanced into longitudinal studies^{6–9}; however, a preponderance of cross-sectional data^{2,10–12} remains problematic for establishing causal relationships.

Studies examining neighborhood and body weight have tended to focus on white populations,^{1,10} yet weight-related health risk is greatest among disadvantaged and minority individuals.¹³ Although a growing literature addresses race- or ethnicity-specific risk in youth,^{13–16} longitudinal data remain limited. Lower-SES neighborhoods and those with minority populations often have fewer food and physical activity resources.⁵ Environmental features most strongly linked with body weight or physical activity in minority populations include supermarkets, places to exercise, sidewalks, traffic volume, and safety.^{2,17}

The following analyses capitalize on existing data from an urban, community sample of girls to better understand environmental influences on weight. Girls were followed through early adolescence (approximately age 11–16 years), over which time, BMI for girls of median height is expected to increase by approximately 3 kg/m²¹⁸ and physical activity tends to decline, particularly among African Americans.¹⁹

Methods

Study Sample

In 1999–2000, the Pittsburgh Girls Study (PGS) enrolled girls aged 5–8 years (approximately 25% of the sample per birth year, i.e., birth cohort).^{20,21} A database of city housing units was generated from the city's 911-dispatch system database (including street addresses and 1990 Census-based neighborhood designations) and a U.S. Postal Service database (including individual housing units). After excluding the downtown business district, GIS data divided the remaining neighborhoods into “assignment blocks” comprised of addresses along one side of a street between specified limits.

In the 23 disadvantaged Pittsburgh neighborhoods (25% of families living at or below poverty level per 1990 Census data), each assignment block was selected for enumeration. In each “non-disadvantaged” neighborhood ($n=66$), approximately 50% of assignment blocks were randomly selected for enumeration. In-person enumeration visits verified addresses, added addresses that the database omitted, and determined the demographics of residents' children.

Forty-three percent of 9,485 assignment blocks were selected in non-disadvantaged neighborhoods, as were all 2,190 blocks in disadvantaged neighborhoods. Of selected blocks, 98% were fully enumerated in each neighborhood stratum. Overall, 103,238 households were enumerated. Enumeration procedures identified 3,241 girls (approximately 84% of girls aged 5–8 years identified by the 2000 U.S. Census). Of these, 2,876 were eligible (English-speaking and without developmental disabilities); 2,450 girls and their

primary caretakers enrolled (85.2%). In-home interviews were conducted annually through 2014. PGS's primary focus is on mental health development, so weight was not measured initially. An obesity sub-study was started during the fifth PGS assessment wave (2004–2005), which provided the baseline year for these analyses. These analyses used data from six annual assessments (Waves 5–10) for white or African American girls with Wave 5 BMI ($n=2,295$). Response rates were high: 89%–96% of girls completed each study assessment.

Measures

Primary caregivers reported their educational status, the child's race, number of parents in the household, and household poverty (i.e., "receipt of public assistance," including participation in the Women, Infants, and Children Program, food stamps, Medicaid insurance, and Temporary Assistance to Needy Families). Study staff measured height and weight via portable stadiometer and digital scale.

At annual assessments, the PGS administered two parent-reported neighborhood measures and field interviewers completed block observations of neighborhood characteristics following intensive training.²² Where the PGS used modified versions of scales validated in other populations, factor analyses with Wave 5 data were used to combine data. For dichotomous items, tetrachoric correlations were used to compute the correlation matrix. This matrix was used in the factor analysis.

Caregivers assessed neighborhood problems using a 17-item "Your Neighborhood" questionnaire.²³ Respondents indicated whether each item was *not a problem*, *somewhat of a problem*, or *a big problem*. The questions are similar to items from a scale measuring social and physical incivilities.²⁴ An eight-item caregiver-completed questionnaire, the "Neighborhood Additional Questionnaire" (NQ), asked respondents to identify things they like about their neighborhood (from 12 options), reasons they might move (from 13 options), and questions on social cohesion.²⁵

A physical disorder index (PDI) was derived from five items (graffiti, bottles, cigarettes, litter, and abandoned cars) from interviewers' block observations of the neighborhood. It has been linked with crime, firearm injuries, homicides and teen births.²² Ordinal responses (*none* [1], *some* [2], *a lot* [3]) for each item were averaged for a summary score. Three additional variables from the questionnaire were included as single-item questions, based on the obesity literature: *loitering youth* (groups of youth hanging out), *single-family houses* (whether buildings are predominantly single-family homes), and *traffic volume*, (moderate to heavy).

Survey measures were categorized as positive or negative factors. Because safety, but not urban density, is typically associated with BMI and physical activity in disadvantaged populations,^{17,26,27} and single-family housing was expected to act as a marker for relatively low crime and higher aesthetic appeal compared with other neighborhoods, single-family housing was considered positive.

Five-year estimates (2006–2010) of Census tract-level data from the American Community Survey (ACS) were linked to PGS data for girls living in Allegheny County in each sample

year. ACS variables included the percentage of the population with: (1) less than high school education; and (2) living below the poverty level.

Statistical Analysis

Racial differences in baseline sample characteristics were evaluated using *t*-tests and chi-square tests. Linear and generalized linear mixed-effects models with random subject effects and fixed effects for race and time were used to test if neighborhood characteristics changed over time.^{28,29} Analyses were adjusted for fixed effects of caregiver's education, single-parent households, household poverty, and birth cohort. A logit link was used for single item outcomes (loitering youth, single-family housing, and moderate/heavy traffic volume). Sampled neighborhood was fit as a random intercept and adjusted for an "administration" variable indicating a transition from paper to computerized survey instruments (using the same question wording) between Waves 6 and 7.

The same modeling approach, with the addition of a random slope for time, tested whether each baseline neighborhood feature was associated with different BMI growth trajectories. Each model initially included a three-way interaction among neighborhood feature, time, and race, and all two-way pairs of interactions between these variables. If the three-way interaction term was non-significant, it was dropped from the model to estimate associations for both racial groups combined. Interaction terms between neighborhood feature and time were examined to see whether annual BMI change differed with increasing level of each neighborhood feature. Models were adjusted for birth cohort, SES, and the survey administration variable. Each model was secondarily adjusted with a time-varying variable indicating when girls moved to a new address. All analyses were weighted to account for oversampling of disadvantaged neighborhoods.

To see whether neighborhood change was associated with BMI change, the BMI slope and neighborhood slope were calculated for each participant and linear regression analyzed the relationship between slopes.

This study was approved by the University of Pittsburgh IRB. Data were analyzed (2011–2015) using Stata, version 12.1 with two-sided testing ($\alpha=0.05$).

Results

At baseline, girls were aged 11 years on average, poverty was common, and 40% were overweight or obese (Table 1). African American girls had more overweight (19%) or obesity (26%) than white girls (16% and 17%, respectively), a larger increase in BMI over time, and more markers of low SES. Between Waves 5 and 10, 59% of girls (white, 40%; African American, 74%) moved to at least one new residence.

For the "Your Neighborhood" questionnaire,²³ initial exploratory analysis showed that all items belonged together in a single factor, representing 78% of total variance. Cronbach's α was 0.95. A "Neighborhood Problem" score was therefore calculated as the mean response across the 17 items; higher scores indicate more problems. Based on factor analyses, responses from the NQ were combined into four subscales. The NQ-Appreciation subscale

was calculated as the number of neighborhood features respondents indicated liking (e.g., friends, shopping, schools). Factor analysis showed factor loadings between 0.41 and 0.73. Two factors emerged from a series of responses about why respondents would move from their neighborhoods. The binary NQ-Unsafe subscale indicates any safety-related reasons why respondents would move (e.g., gangs, drugs, lack of safety); factor loadings were all >0.83 . The NQ-Inconvenience subscale reflects any convenience concerns that could prompt respondents to move (e.g., for better access to shopping, public transportation, or work); factor loadings were all >0.75 . The NQ-Community subscale's four items are similar to components of the "informal social control" scale³¹ (e.g., *How likely is it that one of your neighbors would do something about it: breaking into houses, selling drugs to kids, being beaten*). Each item's Likert response (*very likely* [4] to *very unlikely* [1]) were summed (construct range, 4–16); factor loadings were all >0.90 .

At baseline, caregivers reported a moderate appreciation of neighborhood features (NQ-Appreciation mean, 7.12) and quite high expectations that neighbors would offer help when needed (NQ-Community, 13.70; Table 2). Most girls (74%) lived on a block of predominantly single-family houses. More positive neighborhood features were reported for white girls, whereas negative neighborhood features were more common among African Americans. Few neighborhood problems (construct mean, 1.33) were found. Safety or convenience concerns that could prompt a move from the neighborhood were reported by 28% and 22% of respondents, respectively. Low physical disorder levels (mean PDI, 1.23) and few instances of loitering youth (6%) were reported, but $>25\%$ of participants lived with substantial traffic volume. Changes in surveyed neighborhood features were similar for white and African American girls; most remained stable or improved modestly.

In each year, 91%–94% of the sample resided in Allegheny County. On average, in participants' home Census tracts, 13.0% of the population had less than high school education and 24.3% lived below the poverty threshold, with lower education levels and more poverty near African American girls' homes ($p<0.001$, Table 2).

BMI growth rates were consistently higher for African American girls than for white girls (Table 3). For example, African American girls whose caregivers appreciated many features of their neighborhood (third quartile NQ-Appreciation) grew on average by 0.80 (SE=0.031) kg/m² annually, whereas white girls in highly appreciated neighborhoods grew by 0.64 (SE=0.032) kg/m². Neighborhood appreciation did not alter BMI trajectory (two-way interaction, $p=0.868$), and this finding was not significantly different between the two racial groups (three-way interaction, $p=0.054$). The impact of helpful neighbors on BMI growth differed by race (for three-way interaction, $p<0.001$): African American girls with helpful neighbors (higher NQ-Community) showed 0.09 kg/m² less growth per year ($p<0.001$), whereas white girls with helpful neighbors showed 0.09 kg/m² more growth annually than those with less helpful neighbors ($p=0.012$). Girls' BMI growth did not differ with home proximity to single-family housing.

Negative neighborhood features had similar effects on BMI change across racial groups. BMI growth did not differ with any of the negative neighborhood features. Adjusting the

longitudinal models for girls' moves to new home residences impacted the findings minimally and did not alter the model interpretations (data not shown).

Regardless of race, girls living in Census tracts where at least 18% of residents had less than high school education gained an additional 0.07 kg/m² each year, compared with girls in areas where low education levels were uncommon (Table 3). Likewise, living in a Census tract with high (versus low) levels of poverty was linked with 0.08 kg/m² additional BMI gain annually.

The slope of BMI change was not correlated with the slope for the change in any of the continuous neighborhood measures (correlation, -0.06 to 0.06). Slopes for the binary neighborhood variables could not be calculated owing to insufficient variation.

Discussion

In this female sample from disproportionately disadvantaged urban neighborhoods, neighborhood features were relatively stable over 6 sample years. Social environment features, but not physical environment features, were associated with BMI change. African American girls in neighborhoods where parents felt that neighbors would help out if difficult circumstances arose had lower annual BMI growth than those living near less helpful neighbors. Conversely, white girls living near helpful neighbors gained more BMI annually than those with less helpful neighbors. Girls living in Census tracts with low educational attainment had greater BMI growth than those in more-educated locales. Likewise, girls in poor Census tracts had higher BMI growth rates than those in more-affluent areas. However, annual BMI change was not associated with changes in survey-based neighborhood features.

The lack of associations between physical environment features and BMI are consistent with prior research showing environmental factors to be less reliably associated with obesity or physical activity among low-income or minority individuals versus other populations.^{10,17,27} This may reflect different interactions among land use, infrastructure, and social environment in urban versus suburban populations.³⁰ Our findings suggest that social environment features may be more salient for girls in predominantly disadvantaged urban settings.

The differential effect of helpful neighbors by race was unexpected, but both effects are supported by prior literature. The NQ-Community measure is based on questions used to operationalize informal social control (i.e., the capacity of a group to regulate its members to achieve collective goals), which is closely related to social cohesion.^{31,32} As safety concerns may impact physical activity or body weight in urban settings,² and perceived safety may mediate associations between neighborhood quality and children's physical activity,^{3,33} we hypothesized that girls whose neighbors were willing to intercede would be more likely to be physically active and therefore gain less BMI. However, other literature focusing on social networks and social support shows that obesity can spread through social ties,^{34,35} success in pursuing lifestyle change and weight loss are influenced by social contacts, and attempts to establish healthy eating or physical activity behaviors may be perceived as conflicting with cultural norms.³⁶⁻⁴¹ It is possible that neighbors who are willing to intervene for

community goals act as a marker of social pressure to conform to unhealthy eating and physical activity standards. It is unclear why the effect of neighbors may differ by race, but social cohesion has been linked with health outcomes²⁴ and there are racial variations in social cohesion, body image, and perceived discrimination.^{42–44} This finding warrants follow-up to clarify its mechanisms.

The single geographic region may limit generalizability. For example, after Pittsburgh required state fiscal oversight to avoid bankruptcy in 2004, the local economy rebounded more successfully than some other U.S. cities,^{45,46} so neighborhood changes over the study's timeframe may be atypical. However, PGS obesity prevalence is consistent with national estimates.⁴⁷ Furthermore, the PGS provides an opportunity to understand the effects of the urban environment in a particularly high-risk young urban population for whom national-level data are typically unavailable. These analyses do not address environments outside the home neighborhood (e.g., school), or the full range of neighborhood features that may impact BMI (e.g., proximity to parks, grocery stores, or restaurants).

Although PGS data reflect the perceptions of caregivers and trained interviewers, the girls' perceptions are not recorded and are likely to become increasingly relevant as participants approach adulthood. Another limitation is the subjective nature of survey measurements. These analyses leverage a unique opportunity to examine detailed and relatively long-term longitudinal associations between environment and body weight. Although objective environmental measures are often preferred owing to accuracy and reliability concerns, perceived environmental attributes can convey complementary information.^{5,48} Environment perceptions at times more accurately reflect resource accessibility (e.g., the discounting of potential resources because of safety concerns)⁴⁹ and facilitate assessment of social environment factors (e.g., community support).⁵⁰ GIS data are more easily obtained and compared with data at other locations, but the areal units of Census data are without consistent geographic size¹⁰ and may inappropriately aggregate data from qualitatively distinct locales. Although PGS parents may have considered different spatial areas in their assessments, parental perception of the extent their home environs is likely to reflect family norms more closely than do official neighborhood definitions.

Neighborhood change was not associated with BMI change. This may suggest that environmental intervention is not a useful weight management approach for urban girls. Indeed, prior work indicates that environmental approaches for promoting healthy lifestyles may be particularly challenging in female populations.^{8,51,52} Alternatively, the relatively small observed range of neighborhood change may be insufficient to detect an effect on BMI trajectory, and smaller than what could be achieved with a well-delivered intervention. Furthermore, the effect of a given neighborhood change may vary with social context. For example, over this study's timeframe, foreclosure and demolition of low-income Pittsburgh housing sites led to the relocation of hundreds of tenants.^{53–55} Such an imperative for relocation may influence youth differently than, for instance, a parent acquiring a more lucrative job and choosing to move to a more affluent neighborhood. As the study of environment and body weight moves into longitudinal analyses, these findings underscore the importance of considering the complexity that neighborhood change can comprise, including alterations in the neighborhood itself and relocation of individuals, in the context

of financial or social constraints, neighborhood selection factors, and evolving behavior.
8,11,51

Many participants moved to a new home during the follow-up period, yet the relationships between baseline neighborhood features and BMI change were minimally impacted by adjustment for home relocations. Because prior home locations predict subsequent neighborhood characteristics,⁵⁶ one possible explanation is that relocated girls' neighborhood features may often have been quite stable throughout the follow-up period.

Although the potential for environmental change to alter weight trajectories is unclear from these observational data, these findings focus attention on neighborhood aspects that could form the basis of intervention studies. In addition, these findings can be used to identify girls at high risk for early adolescent weight gain and help them to access resources supporting healthier lifestyles. Such implications may be of particular relevance among urban African American girls, given the minority girls' greater likelihood of both living in adverse neighborhood conditions and of going on to develop weight-related health problems such as diabetes and heart disease.

Acknowledgments

These analyses were supported by grants from NIH (MH 081071 and MH056630). The sponsor had no role in the study design; collection, analysis, or interpretation of data; writing of the report; or decision to submit the manuscript for publication. Drs. McTigue, Kuller, and Moore designed the study with assistance from Drs. Loeber and Hipwell. Drs. Hipwell and Loeber collected the data. Mr. Cohen analyzed the data, with input from Drs. Moore and McTigue. All authors were involved in writing the manuscript and provided final approval of the submitted and published version.

References

1. Durand CP, Andalib M, Dunton GF, Wolch J, Pentz MA. A systematic review of built environment factors related to physical activity and obesity risk: implications for smart growth urban planning. *Obes Rev* 2011;12(5):e173–182. 10.1111/j.1467-789X.2010.00826.x. [PubMed: 21348918]
2. Casagrande SS, Whitt-Glover MC, Lancaster KJ, Odoms-Young AM, Gary TL. Built environment and health behaviors among African Americans: a systematic review. *Am J Prev Med* 2009;36(2): 174–181. 10.1016/j.amepre.2008.09.037. [PubMed: 19135908]
3. Galvez MP, Pearl M, Yen IH. Childhood obesity and the built environment. *Curr Opin Pediatr*. 2010;22(2):202–207. 10.1097/MOP.0b013e328336eb6f. [PubMed: 20090524]
4. Feng J, Glass TA, Curriero FC, Stewart WF, Schwartz BS. The built environment and obesity: a systematic review of the epidemiologic evidence. *Health Place*. 2010;16(2):175–190. 10.1016/j.healthplace.2009.09.008. [PubMed: 19880341]
5. Townshend T, Lake AA. Obesogenic urban form: theory, policy and practice. *Health Place*. 2009;15(4):909–916. 10.1016/j.healthplace.2008.12.002. [PubMed: 19201641]
6. Block JP, Christakis NA, O'Malley AJ, Subramanian SV. Proximity to food establishments and body mass index in the Framingham Heart Study offspring cohort over 30 years. *Am J Epidemiol*. 2011;174(10):1108–1114. 10.1093/aje/kwr244. [PubMed: 21965186]
7. Gibson DM. The neighborhood food environment and adult weight status: estimates from longitudinal data. *Am J Public Health*. 2011;101(1):71–78. 10.2105/AJPH.2009.187567. [PubMed: 21088263]
8. Boone-Heinonen J, Gordon-Larsen P. Obesogenic environments in youth: concepts and methods from a longitudinal national sample. *Am J Prev Med* 2012;42(5):e37–46. 10.1016/j.amepre.2012.02.005. [PubMed: 22516502]

9. Datar A, Nicosia N, Shier V. Parent perceptions of neighborhood safety and children's physical activity, sedentary behavior, and obesity: evidence from a national longitudinal study. *Am J Epidemiol*. 2013;177(10):1065–1073. 10.1093/aje/kws353. [PubMed: 23579555]
10. Papas MA, Alberg AJ, Ewing R, Helzlouer KJ, Gary TL, Klassen AC. The built environment and obesity. *Epidemiol Rev* 2007;29:129–143. 10.1093/epirev/mxm009. [PubMed: 17533172]
11. Matthews S Thinking about place, spatial behavior, and spatial processes in childhood obesity. *Am J Prev Med* 2012;42(5):516–520. 10.1016/j.amepre.2012.02.004. [PubMed: 22516493]
12. Larson NI, Story MT, Nelson MC. Neighborhood environments: disparities in access to healthy foods in the U.S. *Am J Prev Med* 2009;36(1):74–81. 10.1016/j.amepre.2008.09.025. [PubMed: 18977112]
13. McLaren L Socioeconomic status and obesity. *Epidemiol Rev* 2007;29:29–48. 10.1093/epirev/mxm001. [PubMed: 17478442]
14. Adkins S, Sherwood NE, Story M, Davis M. Physical activity among African-American girls: the role of parents and the home environment. *Obes Res* 2004;12 Suppl:38S–45S. 10.1038/oby.2004.267. [PubMed: 15489466]
15. Dulin-Keita A, Kaur Thind H, Affuso O, Baskin ML. The associations of perceived neighborhood disorder and physical activity with obesity among African American adolescents. *BMC Public Health*. 2013;13:440 10.1186/1471-2458-13-440. [PubMed: 23642107]
16. Rossen LM. Neighbourhood economic deprivation explains racial/ethnic disparities in overweight and obesity among children and adolescents in the U.S.A. *J Epidemiol Community Health*. 2014;68(2):123–129. 10.1136/jech-2012-202245. [PubMed: 24072744]
17. Lovasi GS, Hutson MA, Guerra M, Neckerman KM. Built environments and obesity in disadvantaged populations. *Epidemiol Rev* 2009;31:7–20. 10.1093/epirev/mxp005. [PubMed: 19589839]
18. CDC. Clinical Growth Charts: Girls BMI-for-age. 2012; www.cdc.gov/growthcharts/clinical_charts.htm. Accessed October 29, 2012.
19. Kimm SY, Glynn NW, Kriska AM, et al. Decline in physical activity in black girls and white girls during adolescence. *N Engl J Med* 2002;347(10):709–715. 10.1056/NEJMoa003277. [PubMed: 12213941]
20. Hipwell AE, Loeber R, Stouthamer-Loeber M, Keenan K, H.R. W, Kroneman L. Characteristics of girls with early onset disruptive and antisocial behaviour. *Crim Behav Ment Hlth*. 2002;12:99–118. 10.1002/cbm.489.
21. Keenan K, Hipwell A, Chung T, et al. The Pittsburgh Girls Study: overview and initial findings. *J Clin Child Adolesc Psychol*. 2010;39(4):506–521. 10.1080/15374416.2010.486320. [PubMed: 20589562]
22. Wei E, Hipwell A, Pardini D, Beyers JM, Loeber R. Block observations of neighbourhood physical disorder are associated with neighbourhood crime, firearm injuries and deaths, and teen births. *J Epidemiol Community Health*. 2005;59(10):904–908. 10.1136/jech.2004.027060. [PubMed: 16166368]
23. Loeber R, Farrington DP, Stouthamer-Loeber M, Van Kammen WB. *Antisocial Behavior and Mental Health Problems: explanatory factors in childhood and adolescence*. Mahwah NJ: L. Erlbaum Associates; 1998.
24. Sampson RJ, Raudenbush SW. Systematic social observation of public spaces: A new look at disorder in urban neighborhoods. *AJS*. 1999;105(3):603–651. 10.1086/210356.
25. Loeber R, Farrington DP, Stouthamer-Loeber M, Van Kammen WB. *Antisocial Behavior and Mental Health Problems: explanatory factors in childhood and adolescence*. Mahwah NJ: L. Erlbaum Associates; 1998.
26. Frank LD, Kerr J, Sallis JF, Miles R, Chapman J. A hierarchy of sociodemographic and environmental correlates of walking and obesity. *Prev Med* 2008;47(2):172–178. 10.1016/j.ypmed.2008.04.004. [PubMed: 18565576]
27. Scott MM, Dubowitz T, Cohen DA. Regional differences in walking frequency and BMI: what role does the built environment play for Blacks and Whites? *Health Place*. 2009;15(3):882–887. 10.1016/j.healthplace.2009.02.010. [PubMed: 19345134]

28. Rabe-Hesketh S, Skrondal A. *Multilevel and Longitudinal Modeling Using Stata* College Station, TX: Stata Press; 2005.
29. Rabe-Hesketh S, Skrondal A. Multilevel modelling of complex survey data. *JR Statist Soc A*. 2006;169(4):805–827. 10.1111/j.1467-985X.2006.00426.x.
30. Lopez RP, Hynes HP. Obesity, physical activity, and the urban environment: public health research needs. *Environ Health*. 2006;5:25 10.1186/1476-069X-5-25. [PubMed: 16981988]
31. Sampson R, Morenoff J, Gannon-Rowley T. Assessing “neighborhood effects”: social processes and new directions in research. *Annu Rev Sociol*. 2002;28:443–478. 10.1146/annurev.soc.28.110601.141114.
32. Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and Violent Crime: A Multilevel Study of Collective Efficacy. *Science*. 1997;277(5328):918–924. 10.1126/science.277.5328.918. [PubMed: 9252316]
33. Beets MW, Foley JT. Association of father involvement and neighborhood quality with kindergartners’ physical activity: a multilevel structural equation model. *Am J Health Promot*. 2008;22(3):195–203. 10.4278/ajhp.22.3.195. [PubMed: 18251121]
34. Valente TW, Fujimoto K, Chou CP, Spruijt-Metz D. Adolescent affiliations and adiposity: a social network analysis of friendships and obesity. *J Adolesc Health*. 2009;45(2):202–204. 10.1016/j.jadohealth.2009.01.007. [PubMed: 19628148]
35. Christakis NA, Fowler JH. The spread of obesity in a large social network over 32 years. *N Engl J Med* 2007;357(4):370–379. 10.1056/NEJMsa066082. [PubMed: 17652652]
36. Buchholz SW, Huffman D, McKenna JC. Overweight and obese low-income women: restorative health behaviors under overwhelming conditions. *Health Care Women Int*. 2012;33(2):182–197. 10.1080/07399332.2011.630115. [PubMed: 22242657]
37. Hindle L, Carpenter C. An exploration of the experiences and perceptions of people who have maintained weight loss. *J Hum Nutr Diet*. 2011;24(4):342–350. 10.1111/j.1365-277X.2011.01156.x. [PubMed: 21414044]
38. Mackert M, Stanforth D, Garcia AA. Undermining of nutrition and exercise decisions: experiencing negative social influence. *Public Health Nurs*. 2011;28(5):402–410. 10.1111/j.1525-1446.2011.00940.x. [PubMed: 22092423]
39. Wing RR, Jeffery RW. Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. *J Consult Clin Psychol*. 1999;67(1):132–138. 10.1037/0022-006X.67.1.132. [PubMed: 10028217]
40. Verheijden MW, Bakx JC, van Weel C, Koelen MA, van Staveren WA. Role of social support in lifestyle-focused weight management interventions. *Eur J Clin Nutr*. 2005;59(Suppl 1):S179–186. 10.1038/sj.ejcn.1602194. [PubMed: 16052189]
41. Gorin A, Phelan S, Tate D, Sherwood N, Jeffery R, Wing R. Involving support partners in obesity treatment. *J Consult Clin Psychol*. 2005;73(2):341–343. 10.1037/0022-006X.73.2.341. [PubMed: 15796642]
42. Mikolajczyk RT, Iannotti RJ, Farhat T, Thomas V. Ethnic differences in perceptions of body satisfaction and body appearance among U.S. schoolchildren: a cross-sectional study. *BMC Public Health*. 2012;12:425 10.1186/1471-2458-12-425. [PubMed: 22691404]
43. Ayalon L, Gum AM. The relationships between major lifetime discrimination, everyday discrimination, and mental health in three racial and ethnic groups of older adults. *Aging Ment Health*. 2011;15(5):587–594. 10.1080/13607863.2010.543664. [PubMed: 21815851]
44. Hobson-Prater T, Leech T. The Significance of Race for Neighborhood Social Cohesion: Perceived Difficulty of Collective Action in Majority Black Neighborhoods. *J Sociol Soc Welf*. 2012;39(1): 89–109.
45. Krugman P A Tale of Two Rust-Belt Cities. *The New York Times*. 2013.
46. Bauder B Officials: Detroit bankruptcy’s impact on Pittsburgh should be minimal. *Trib Total Media*. 2013.
47. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA*. 2014;311(8):806–814. 10.1001/jama.2014.732. [PubMed: 24570244]

48. Ding D, Gebel K. Built environment, physical activity, and obesity: what have we learned from reviewing the literature? *Health Place*. 2012;18(1):100–105. 10.1016/j.healthplace.2011.08.021. [PubMed: 21983062]
49. Hoehner CM, Brennan Ramirez LK, Elliott MB, Handy SL, Brownson RC. Perceived and objective environmental measures and physical activity among urban adults. *Am J Prev Med* 2005;28(2 Suppl 2):105–116. 10.1016/j.amepre.2004.10.023. [PubMed: 15694518]
50. Carroll-Scott A, Gilstad-Hayden K, Rosenthal L, et al. Disentangling neighborhood contextual associations with child body mass index, diet, and physical activity: the role of built, socioeconomic, and social environments. *Soc Sci Med* 2013;95:106–114. 10.1016/j.socscimed.2013.04.003. [PubMed: 23642646]
51. Boone-Heinonen J, Guilkey DK, Evenson KR, Gordon-Larsen P. Residential self-selection bias in the estimation of built environment effects on physical activity between adolescence and young adulthood. *Int J Behav Nutr Phys Act*. 2010;7:70 10.1186/1479-5868-7-70. [PubMed: 20920341]
52. Boone-Heinonen J, Gordon-Larsen P, Kiefe CI, Shikany JM, Lewis CE, Popkin BM. Fast food restaurants and food stores: longitudinal associations with diet in young to middle-aged adults: the CARDIA study. *Arch Intern Med* 2011;171(13):1162–1170. 10.1001/archinternmed.2011.283. [PubMed: 21747011]
53. Witmer. A true ‘renewal’ for Pittsburgh’s East Liberty? *NPR* 2006; U.S. News.
54. Nelson Jones D Film captures moods of East Liberty residents. *Post-Gazette*. 3 13, 2007.
55. McNulty T, Ackerman J. East Liberty complex doomed as HUD foreclosure routs 150 families. *Post-Gazette*. 5 24, 2003.
56. Sampson RJ, Sharkey P. Neighborhood selection and the social reproduction of concentrated racial inequality. *Demography*. 2008;45(1):1–29. 10.1353/dem.2008.0012. [PubMed: 18390289]

Table 1.Baseline Sample Description^a and Average Annual BMI Change Over the Time-Frame of the Study

		Total sample (n=2,295)^b	White girls (n=1,002)	African American girls (n=1,293)	p-value
Age		11.2 (1.3)	11.2 (1.3)	11.2 (1.3)	0.905
Body weight status^c					<0.001
	Underweight	40 (2%)	20 (2%)	20 (2%)	
	Healthy weight	1,185 (59%)	560 (65%)	625 (54%)	
	Overweight	358 (18%)	143 (16%)	215 (19%)	
	Obese	440 (22%)	145 (17%)	295 (26%)	
Average 5-year BMI change		4.40 (0.09)	3.91 (0.12)	4.75 (0.13)	<0.001
Caregiver's education					<0.001
	>12 yr	1,793 (84%)	809 (88%)	984 (82%)	
	< 12 yr	337 (16%)	114 (12%)	223 (18%)	
Household status					<0.001
	Co-habiting parents	1,217 (57%)	719 (78%)	498 (41%)	
	Single parent	913 (43%)	203 (22%)	710 (59%)	
Receipt of public assistance					<0.001
	No	1,377 (64%)	765 (83%)	612 (51%)	
	Yes	759 (36%)	159 (17%)	600 (49%)	

Note: Boldface indicates statistical significance ($p < 0.05$).

^aData are un-weighted. Continuous measures are depicted by mean (SE) and categorical as frequency (%).

^bDue to low levels of missing data, primarily due to non-completion of an annual survey, denominators differ slightly for the different variables. For white and African American girls, respectively: 8 and 7% of age data, 13%, and 11% of body weight data, 8% and 7% of education data, 8 and 7% of household status data and 8, and 6% of public assistance data are not available.

^cUnderweight: <5th percentile; Healthy weight: 5th to <85th percentile; Overweight: 85th to <95th percentile; Obese >95th percentile.⁴⁴

Table 2.

Neighborhood Measures at Baseline^a and Change Over Time^b

Measure	Possible range	Interpretation n of a higher score	Time-frame	Total sample (N=2,295)	White girls (N=1,002)	African American girls (N=1,293)
Positive features from survey data						
NQ-Appreciation n	0–12	More appreciated neighborhood features	Baseline ^c	7.12 (0.195)	8.10 (0.22)	6.02 (0.15)
			Change score ^d	1.65 (1.48, 1.82)	1.4 (1.18, 1.62)	1.88 (1.62, 2.13)
			Adjusted change score ^d	0.039 (–0.24, 0.32)	–0.16 (–0.50, 0.19)	0.25 (–0.16, 0.66)
NQ-Community	4–16	Neighbors likely to help in more situations	Baseline ^c	13.70 (0.11)	14.30 (0.10)	12.90 (0.11)
			Change score ^d	0.26 (0.12, 0.40)	0.15 (–0.020, 0.32)	0.35 (0.12, 0.57)
			Adjusted change score ^d	–0.0019 (–0.17, 0.17)	0.074 (–0.19, 0.33)	–0.083 (–0.34, 0.17)
Single family houses	0/1	Home block is primarily single-family	Baseline ^c	74%	89%	57%
			Change score ^d	2.92% (0.12%, 5.70%)	–0.67% (–3.81%, 2.48%)	6.9% (2.75%, 11.00%)
			Adjusted change score ^d	2.82% (2.72%, 2.92%)	–0.68% (–0.75%, –0.61%)	8.7% (8.53%, 8.88%)
Negative features from survey data						
Neighborhood Problems construct	1–3	More neighborhood problems	Baseline ^c	1.33 (0.02)	1.21 (0.02)	1.46 (0.03)
			Change score ^d	–0.048 (–0.067, –0.029)	–0.018 (–0.040, .0034)	–0.075 (–0.11, –0.045)
			Adjusted change score ^d	–0.047 (–0.072, –0.021)	–0.017 (–0.050, .015)	–0.078 (–0.12, –0.042)
NQ-Unsafe	0/1	Presence of safety concerns that could prompt moving from the neighborhood	Baseline ^c	28%	19%	39%
			Change score ^d	1.72% (–1.05%, 4.49%)	–0.13% (–3.79%, 3.54%)	2.65% (–1.35%, 6.65%)
			Adjusted change score ^d	1.93% (1.89%, 1.97%)	–0.37% (–0.392%, –0.35%)	5.49% (5.45%, 5.53%)
NQ-Inconvenience	0/1	Inconvenient features that may prompt moving from the neighborhood	Baseline ^c	22%	13%	31%
			Change score ^d	8.32% (5.67%, 11.00%)	4.37% (0.96%, 7.79%)	10.90% (6.95%, 14.80%)
			Adjusted change score ^d	9.00% (8.80%, 9.21%)	2.39% (2.30%, 2.47%)	13.60% (13.50%, 13.70%)

Measure	Possible range	Interpretation of a higher score	Time-frame	Total sample (N=2,295)	White girls (N=1,002)	African American girls (N=1,293)
PDI	1–3	More markers of physical disorder	Baseline ^c	1.23 (0.018)	1.10 (0.010)	1.37 (0.017)
			Change score ^d	–0.034 (–0.053, –0.016)	0.030 (0.01, 0.05)	–0.085 (–0.12, –0.06)
			Adjusted change score ^d	0.038 (0.017, 0.059)	0.038 (0.01, 0.06)	0.038 (0.0003, 0.076)
Loitering youth	0/1	Presence of groups of loitering adolescents	Baseline ^c	6%	2%	10%
			Change score ^d	–1.1% (–2.62%, 0.41%)	–0.28% (–1.58%, 1.03%)	–2.44% (–4.98%, 0.10%)
			Adjusted change score ^d	–1.5% (–1.55%, –1.45%)	–0.12% (–0.13%, –0.12%)	–2.77% (–2.83%, –2.71%)
Heavy traffic	0/1	Presence of heavy traffic	Baseline ^c	28%	25%	32%
			Change score ^d	–0.62% (–3.42%, 2.19%)	2.24% (–2.04%, 6.52%)	–3.84% (–7.73%, 0.04%)
			Adjusted change score ^d	–2% (–2.01%, –1.99%)	–1.13% (–1.15%, –1.12%)	–2.66% (–2.67%, –2.65%)
ACS data						
Percent with less than high school education	n/a	Less education	Baseline ^e	13.0 (6.62)	11.1 (6.38)	14.5 (6.42)
Percent below poverty	n/a	More poverty	Baseline ^e	24.3 (15.15)	17.2 (11.71)	29.6 (15.29)

^aFor each measure, the table includes a range of possible values and information on interpretation, along with baseline value [mean (SE) or %, as appropriate]. All data are weighted. Neighborhood measures reflect several subscales of the Neighborhood Questionnaire (NQ), the Neighborhood Problems Questionnaire, and the Physical disorder index (PDI), along with single-question items on the presence of single-family houses, loitering youth or traffic volume.

^bFor each measure, the table includes the unadjusted 5-year change over time (difference between the baseline and final data waves of the six data waves were examined), as well as the adjusted change. The adjusted change score is calculated as the 5-year beta for linear change over time, estimated as the slope of a linear regression across the five years of follow-up. Models are adjusted for caregiver education, single parent households, household poverty and birth cohort.

^cMean (95% CI) or Frequency (%).

^dDifference (95% Confidence interval); since dichotomous data were averaged, for dichotomous measure, the outcome for such variables is a continuous proportion variable ranging from 0 to 1, and the unadjusted scores are the “mean proportion,” while the adjusted score is the mean proportion from the linear models.

^eACS data reflect pooled data spanning 2006–2010.

Table 3.

Annual BMI Change Over 5 Years of Follow-Up From the Baseline for Girls With Varying Baseline Levels of Neighborhood Factors^a

	High and low levels of each neighborhood feature		<i>p</i> -value for 3-way interaction ^b	Mean (SE) annual change in BMI for girls living in neighborhoods with high and low levels of each neighborhood feature				<i>p</i> -value for neighborhood x wave interaction	
	Low level ^c	High level ^c		Race	Low-level	High-level	slopes ^d		
Positive features									
NQ – Appreciation		11	0.054	White	0.64 (0.036)	0.64 (0.032)	0.004		0.868
				African American	0.80 (0.032)	0.80 (0.031)			
NQ – Community	12	16	<0.001	White	0.59 (0.038)	0.68 (0.035)	0.09		0.012
				African American	0.82 (0.032)	0.73 (0.031)			
Single family houses	0	1	0.057	White	0.66 (0.045)	0.65 (0.030)	-0.01		0.792
				African American	0.80 (0.035)	0.79 (0.037)			
Negative features									
Neighborhood problems	1	1.52	0.279	White	0.64 (0.030)	0.66 (0.034)	0.02		0.408
				African American	0.78 (0.034)	0.80 (0.030)			
NQ – Unsafe	0	1	0.215	White	0.64 (0.031)	0.66 (0.042)	0.02		0.642
				African American	0.79 (0.030)	0.80 (0.039)			
NQ – Inconvenience	0	1	0.844	White	0.64 (0.032)	0.66 (0.038)	0.01		0.650
				African American	0.79 (0.031)	0.80 (0.037)			
Physical disorder (PDI)	1	1.4	0.150	White	0.64 (0.031)	0.66 (0.032)	0.02		0.292
				African	0.79	0.80			
				American	(0.032)	(0.032)			
Loitering youth	0	1	0.556	White	0.65 (0.030)	0.70 (0.072)	0.05		0.414
				African American	0.80 (0.033)	0.85 (0.060)			
Traffic volume	0	1	0.650	White	0.67 (0.030)	0.61 (0.039)	-0.06		0.083
				African American	0.82 (0.032)	0.76 (0.041)			
Census variables									
Percent less than HS	7.9	17.6	0.989	White	0.64 (0.033)	0.71 (0.035)	0.07		0.014
				African American	0.75 (0.030)	0.81 (0.034)			
Percent below poverty	11.1	33.1	0.052	White	0.64 (0.032)	0.72 (0.043)			0.007
				African American	0.73 (0.032)	0.81 (0.033)			

Note: Boldface indicates statistical significance ($p < 0.05$).

^a The table displays betas from linear regression models for girls with high versus low levels of each neighborhood features at baseline (i.e., girls at the first and third quartile of each neighborhood measure); models are adjusted for birth cohort, SES, and the survey administration variable; each neighborhood feature is modeled separately.

^b Interaction between neighborhood, data collection wave and race.

^c Low and high levels are defined by the first and 3rd quartiles for continuous variables, and by the two levels of binary variables.

^d Difference in slopes of BMI change over time for girls living in neighborhoods with high versus low levels of the neighborhood factor under consideration (high level – low level); because the 3-way interaction term was dropped when non-significant, the difference in slopes is not race-specific for those models.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript