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Original article

# The Association Between Community Physical Activity Settings and Youth Physical Activity, Obesity, and Body Mass Index

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## Abstract

**Background:** This study examined the association between the level of physical activity (PA) friendliness of the built environment and adolescent PA and body mass index using a national sample of youth and data collected from the communities where they reside.

**Methods:** Data on height, weight, and PA were taken from annual nationally representative cross-sectional Monitoring the Future surveys of 8th and 10th graders in schools, from 2001 through 2003. Measures of safety, outdoor and commercial PA settings, and urban sprawl were constructed using data collected from the communities in which the students reside. Multilevel models were run and controlled for youth and community demographic and socioeconomic characteristics.

**Results:** Increased levels of area deprivation were associated with decreased PA and higher weight. A greater number of commercial PA facilities was associated with increased PA. More compact communities were associated with lower weight and less sports participation.

**Conclusions:** It is important to explore these associations to help guide future development patterns and land use policies to create more active neighborhoods. © 2010 Society for Adolescent Medicine. All rights reserved.

## Keywords:

Adolescents; Environment; Exercise

The United States has been experiencing a growing trend in overweight and obesity among youth, and recent evidence shows that approximately 32% of youth are overweight or obese [1–3]. Physical inactivity affects weight, and in an effort to curb the growing obesity epidemic there is an increasing body of behavioral physical activity (PA) research that has examined associations between local area environmental factors and PA among youth [4–6]. Greater availability of outdoor play and/or sports areas and parks [7–11], and access to commercial PA-related facilities [10, 12–15] have been associated with higher levels of youth PA. However, perceived environmental barriers,

such as lack of access to these types of settings, have been associated with lower income neighborhoods [16, 17].

Neighborhood design can also influence PA levels in youth. Neighborhoods with more cul-de-sacs or low connectivity street networks are associated with higher levels of home-based PA in youth than are high walkability (grid street network) neighborhoods, but these same neighborhoods are associated with lower levels of active travel [18]. More sprawling neighborhoods have been connected with higher prevalence of overweight among youth [4, 6]. Issues of safety, such as danger from traffic, stranger danger, and perceptions of safety, have all been found to have a negative effect on PA levels [5, 10, 19].

The purpose of this study was to determine whether there is an association between the level of PA friendliness of the built environment (i.e., more compact communities with less traffic danger and physical disorder, and the presence of both commercial and outdoor PA settings) and youth PA and

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weight. This study used a national sample of 8th and 10th grade students (13–16 years old) to simultaneously examine the association between measures of neighborhood PA settings, safety, and community compactness or walkability and youth PA, obesity, and body mass index (BMI). Although other studies have examined these environmental factors individually, they could have been subject to omitted variables biases. This study's key strength is that it is the first to simultaneously examine the association of these multiple factors on PA and weight at the national level using environmental data collected directly from the youths' neighborhoods.

## Data and Methods

This study combined repeated cross-sections from 2001 to 2003 of individual-level national data for 8th and 10th grade students participating in the Monitoring the Future (MTF) survey with community-level environmental measures developed through the ImpacTeen Project ([www.impacteen.org](http://www.impacteen.org)).

### MTF survey data

Since 1991, the MTF study, a survey of youth substance use and abuse, conducted by the University of Michigan's Institute for Social Research and funded by the National Institute on Drug Abuse, has collected annual national samples of about 33,000 8th and 10th grade students in the coterminous United States. Located in approximately 420 schools, these students and/or schools were selected on the basis of a three-stage sampling procedure, which is described in detail elsewhere [20]. Questionnaires were administered by an ISR representative in classrooms during normal class periods whenever possible. Students were informed of the importance of accurate responses and assured that their confidentiality would be protected.

### MTF physical activity and weight outcome measures

PA measures were based on self-reported responses to three questions: (1) "How often do you exercise vigorously (jogging, swimming, calisthenics, or any other active sports)?" (vigorous exercise), (2) "To what extent did you participate in school athletic teams this school year?" (sports participation), and (3) "How often do you do actively participate in sports, athletics or exercising?" (PA participation). Using self-reported height and weight, we calculated BMI ( $\text{BMI} = \text{weight (kg)/height (m)}^2$ ). Individuals' body weight status was classified on the basis of BMI for children and teens using the 2000 CDC Growth Chart [21] and obesity was classified as  $\text{BMI} \geq \text{age-sex-specific 95th percentile}$ .

### ImpacTeen community data

In any given year, half the participating MTF schools are in their first year of participation and half are in their second year. Only the half-sample of schools cycling out of the MTF survey were involved in the ImpacTeen community data

collection activities. They constituted a national sample replicate. For the 3 years of data in this study, there are approximately 12,000–24,000 students per grade per year for each outcome variable and 396 catchment areas.

Community observations were conducted each year beginning in mid-February and ending in early June. Environmental information was collected in conjunction with tobacco and alcohol marketing information in retail establishments. For each school, a catchment area was defined, reflecting the area from which the school drew the majority of its students, that is, the school enrollment zone. Our sample size for this study consisted of 134, 135, and 127 catchment areas in 2001, 2002, and 2003, respectively.

Using the maps of the catchment areas as guides, trained field teams composed of a lead and an assistant observer were instructed to drive or walk around and record information on advertising, recreational space, social interactions, public events or signage, safety, and the general upkeep of the catchment area to characterize what it was like to live in the area. The two-person teams served as a reliability check for each site observation. If there was disagreement on any measure, field staff would return to verify the measure before leaving the community.

### Community environmental measures

Because our outcome measures ask about more general PA and do not capture walking behavior, we have included measures of destinations where youth are likely to be physically active (commercial facilities and outdoor settings). We also included the local compactness index and measures of safety to explore how some forms of access to these settings might encourage or discourage PA behavior.

Using existing ImpacTeen data, we constructed the following measures. A physical disorder scale was constructed and includes measures on the presence or absence of: (1) homeless persons loitering on the streets; (2) bars on windows of buildings; (3) unkempt or dilapidated buildings; (4) security barriers around residential and retail property; (5) teens hanging out (showing negative behaviors such as smoking or drinking); and (6) vandalism and/or graffiti (Cronbach's alpha (CA) = .75). An outdoor PA-related settings scale was constructed and included measures on the presence or absence of the following: (1) sports areas (e.g., baseball diamonds, basketball and tennis courts, soccer fields, etc.); (2) parks or green spaces, playgrounds, golf courses; (3) public pools and/or beaches; and (4) presence of bike paths and/or lanes (CA = .60).

Data on the availability of commercial PA-related outlets (PA outlets) were obtained from a business list developed by Dun and Bradstreet [22] to construct a measure of PA-related facilities based on 100 different eight-digit standard industry classification codes, such as physical fitness facilities, sports and athletic instruction (i.e., gymnastics), YMCA. The total number of outlets were summed within zip code and divided by zip code population expressed in 10,000 to develop

a measure of PA outlet availability per 10,000 capita. The PA-related outlet density measure was matched to the individual-level data at the school zip code level.

A measure of perceived safety was drawn from the individual-level MTF self-report surveys in which students were asked, “How often do you feel unsafe going to or from school?” Students’ responses were based on a five-point scale that included never, rarely, some days, most days, and every day. The question is form-specific. Therefore, we constructed an aggregate school-level measure of student responses representing the proportion of students from each school who answered some days, most days, and every day.

Using methods developed by Forsyth et al [23], we constructed a measure of traffic danger using US Census TIGER file road classifications which assigns streets higher or lower functional classes. High-road classifications include primary highways and roads, secondary and connecting roads, and roads that provide access to businesses and facilities. The measure represents the ratio of higher road classes to local and neighborhood roads within the catchment area, that is, the ratio of roads with higher speed limits and traffic volumes to all other roads.

Using existing methods [24], a local urban compactness index was developed for each catchment area including dimensions of residential density and street connectivity. A factor was extracted through principal components analysis to represent the level of compactness within a community (CA = .82). We used 2000 U.S. Census data [25], matched at the census block level, to construct a measure of residential density per square mile of the catchment area and two measures for street connectivity (intersection density per square mile and ratio of four-way intersections to all other intersections in the catchment area) using ArcGIS 9 software. The index was transformed to a scale with a mean of 100 and a standard deviation of 25. The larger the value of the index, the more compact the catchment area.

#### Control measures

We controlled for basic demographic measures including gender, grade, race or ethnicity, highest level of schooling completed by father and mother, inflation-adjusted total weekly student income (earned and unearned, such as allowance), whether students worked, and mother’s work status. We controlled for region, year of data collection, whether the school was private versus public, and neighborhood wealth effects by including a site-level measure of median household income from the Census 2000 [25].

#### Statistical analyses

Because students were clustered within sites, we ran a series of two-level random intercept regression models using SAS glimmix and proc mixed to estimate the association between the built environment and outcome variables.

The models adjusted the standard errors to account for within-community clustering, and appropriately modeled variance because of individual differences versus between-community differences (the intra-class correlation coefficient [ICC]) [26]. Sampling weights were used to adjust for differential selection probabilities for the schools. We tested relationships between individual student-level outcomes, individual-level predictors unique to each student, and community-level predictors shared by multiple students within communities.

The ICC was calculated as the area level variance/(area level variance +  $\pi^2/3$ ) for logistic regression models and as the area level variance/(area level variance + residual) for BMI. Proportionate reduction in error was calculated using the following formula: area-level variance of the conditional means model - area-level variance of model 2, 3, or 4/area-level variance of the conditional means model.

## Results

### Random intercept models

Table 1 shows summary statistics for all variables included in the models. Table 2 presents the random intercept estimates for the four outcome variables. The ICC shows that the total variation in outcome variables across catchment areas averages between about 5% and 9%. The remaining 95–91% of variance lies within catchment areas.

The statistically significant z-scores for all five intercept-only models indicate that PA, BMI, and prevalence of obesity vary across catchment areas. The proportionate reduction in error results show that, in most instances, the individual level characteristics account for a higher percent of the variance in the outcome variables across communities than do the environmental variables with the exception of prevalence of obesity. For example, results show that .414 or 41.4% of the variance in vigorous exercise across communities can be accounted for by adding the individual level variables to the model.

### PA outcome measures

Results in Table 3 show physical disorder was significantly negatively associated with students frequently participating in sports. Schools with higher proportions of students who felt unsafe going to or from school were significantly negatively associated with students engaging in all three PA outcome measures. We tested for interactions by gender and found that lower perceptions of safety had a negative effect that was much greater for females. The effect was approximately 35% greater for vigorous exercise and PA participation and 4 times as great for sports participation. The presence of one additional PA outlet was marginally significantly positively associated with students engaging in frequent vigorous exercise and significantly positively associated with students frequently participating in sports. Neighborhood compactness had a negative significant effect

Table 1  
Summary statistics

	Mean	SD	Range	Sample (N)
<b>Outcome variables</b>				
Vigorous exercise <sup>a</sup>	.66	.47	0–1	10,620
Sports participation <sup>a</sup>	.56	.49	0–1	16,180
PA participation <sup>a</sup>	.52	.49	0–1	36,929
Obese <sup>a</sup>	.11	.32	0–1	16,016
Body mass index <sup>a</sup>	22.00	4.57	9.99–56.32	16,016
<b>Explanatory variables</b>				
Physical Disorder Scale	1.89	1.71	0–6	36,929
Outdoor PA Settings Scale	2.41	1.02	0–4	36,929
Commercial PA facilities	4.20	2.95	0–24.46	36,929
Student perception of safety	.13	.09	0–.56	36,929
Traffic danger	.09	.06	0–.29	36,929
Local compactness index	100.71	24.94	73.78–239.38	36,929
<b>Neighborhood control variable</b>				
Median household income	50,208	17,700	17,889–137,324	36,929
<b>Control variables</b>				
South	.33	.47	0–1	36,929
Midwest	.26	.44	0–1	36,929
Northeast	.19	.39	0–1	36,929
West <sup>b</sup>	.22	.42	0–1	36,929
White <sup>b</sup>	.61	.48	0–1	36,929
African American	.14	.34	0–1	36,929
Hispanic origin	.14	.34	0–1	36,929
Asian	.04	.18	0–1	36,929
Other race	.06	.23	0–1	36,929
Private school	.09	.29	0–1	36,929
Grade 8	.50	.49	0–1	36,929
Grade 10	.50	.49	0–1	36,929
Lives with both parents	.75	.43	0–1	36,929
Male	.48	.49	0–1	36,929
Parental education	.72	.44	0–1	36,929
Mother works part-time	.18	.38	0–1	36,929
Mother works full-time	.63	.48	0–1	36,929
Student works	.34	.47	0–1	36,929
Weekly student income	22.11	26.22	0–142.30	36,929

Control variables are expressed as percents.

<sup>a</sup> Sample sizes differ because in order to collect as much varied information as possible on adolescent attitudes, beliefs and behaviors, MTF consisted of multiple forms that included both core and form-specific questions. The questions on physical activity and height and weight were form specific and not always on the same form.

<sup>b</sup> Indicates the referent category.

on the likelihood that students frequently participate in sports, and traffic danger was marginally significantly negatively associated with student PA participation.

#### Weight-related outcome measures

Results in Table 4 show that physical disorder was associated with both higher BMI and the probability of being obese. Neighborhood compactness had a negative and significant effect on the prevalence of obesity and BMI. We conducted sensitivity analyses of the outdoor PA settings scale to determine whether certain settings were independently associated with PA and weight. Results showed that the presence of bike paths had a negative significant association with the likelihood of being obese and a negative significant association with BMI.

#### Predicted probability models

To explore the relative magnitude of community-level influences on our outcomes, we calculated the probability of changes in PA and BMI-related measures using the coefficients in our models and varying the value of selected predictors one at a time to either the low or high end of the range while holding all other independent variables at their mean. The full set of results is presented in Tables 3 and 4. Results of the predicted probability models suggest changes in the built environment could have the greatest effect on decreasing adolescent obesity, that is, the youth most at risk.

#### Discussion

Consistent with existing evidence [10, 12–15], we found that increased local area PA outlets are associated with

Table 2  
Random intercept variance estimates four explanatory models and all dependent variables

Dependent variable	Model 1 Intercept only	Model 2 Level 1 (control) measures only	Model 3 Level 2 (environmental) measures only	Model 4 Levels 1 and 2 full model
<b>Vigorous exercise</b>				
Intercept	.1845	.1081	.1433	.0921
Z	6.67*	5.14*	5.96*	4.63*
Pseudo $R^2$	–	.065	.046	.065
ICC	.053	–	–	–
PRE	–	.414	.223	.501
<b>Sports participation</b>				
Intercept	.3309	.2098	.2816	.1743
Z	9.35*	8.13*	8.92*	7.72*
Pseudo $R^2$	–	.085	.069	.086
ICC	.091	–	–	–
PRE	–	.366	.149	.473
<b>PA participation</b>				
Intercept	.1609	.1158	.1364	.1072
Z	9.76*	8.84*	9.32*	8.61*
Pseudo $R^2$	–	.065	.035	.065
ICC	.046	–	–	–
PRE	–	.280	.152	.333
<b>Obese</b>				
Intercept	.2070	.1655	.1283	.1179
Z	6.46*	5.57*	4.98*	4.54*
Pseudo $R^2$	–	.046	.026	.045
ICC	.059	–	–	–
PRE	–	.200	.380	.430
<b>BMI</b>				
Intercept	1.076	.279	.776	.211
Z	9.68*	5.09*	8.39*	4.29*
Pseudo $R^2$	–	.125	.088	.125
ICC	.048	–	–	–
PRE	–	.741	.279	.804

Model 1 is the unconditional means model, testing the hypothesis that physical activity, BMI or prevalence of obesity differed between communities. Model 2 includes only the individual-level control (level 1 variables) measures. Model 3 includes only the built environmental measures (level 2 variables) as explanatory variables. Model 4 is the full (individual + environmental measures) model.

\* Indicates significance at  $p \leq .001$ .

higher levels of PA. However, parents who are active, and in turn encourage or influence their children to be more active, may choose to live in neighborhoods that have more PA outlets and should be examined further in future research.

Contrary to existing evidence, which also controlled for neighborhood income and/or SES [7, 9], we found no association between the presence of parks and sports fields and increased PA or reduced weight. Studies that found an association between outdoor PA settings and increased PA [7–11] targeted younger age groups. These types of settings may be less important for PA in older youth. Recent research [27] found that park users are primarily children and adults, and that less than 20% are adolescents, with more males than females using parks. By simultaneously accounting for multiple measures of the built environment, we are able to assess which environmental measures may

have the greatest effect PA behavior, and may also explain why our findings are inconsistent with previous research. The outdoor PA settings scale is limited in the amount of information it captures. Information on students' proximity to these settings or on the features of these settings—such as number, type, and condition of playing fields—may have a greater effect on PA than presence alone. This scale is an aggregate measure of these settings, which may bias the estimated effect of our models toward the null, making our results more conservative.

Lower levels of neighborhood safety were associated with decreased PA, higher prevalence of obesity, and higher BMI. Results showed that perceptions of feeling safe going to and from school are associated with PA. Although our perceived safety measure does not specifically ask about PA, it provides a general indicator of adolescent perceived safety. Previous research [5, 15, 28–30] found no association between perceived safety and youth PA. Only one of these studies [15] asked youth specifically about neighborhood safety; this study was conducted in Portugal and the findings may be less relevant for our sample population. Results of interaction effects by gender suggest that perceptions of feeling unsafe going to and from school was associated with greater decreased PA among females across all three outcome variables. This suggests perceived safety is more important for females and may also help to explain why females engage in more indoor physical activities.

We found an association between the level of physical disorder present neighborhoods and decreased sports participation, increased prevalence of obesity and higher BMI. The effects of the physical disorder scale across our outcome variables were somewhat attenuated when the neighborhood median household income measure was added to the models (results not shown). These results imply that some of the correlation between physical disorder and PA and obesity can be attributed to greater presence of these conditions in low-income neighborhoods.

Consistent with the previous research [6], we found more compact neighborhoods were associated with lower prevalence of obesity and lower levels of BMI. Neighborhoods characterized as being walkable or more compact have also been shown to be associated with adolescent PA [19]. This, coupled with our finding that the presence of bike paths is associated with lower prevalence of obesity and BMI, supports the idea that neighborhoods that are more walkable and bikeable help to increase PA and lower weight. These findings suggest that policies designed to promote more walkable and bikeable communities may have a positive health effect on youth.

More compact neighborhoods were also associated with decreased sports participation. Recent evidence [31] suggests that people living in more compact neighborhoods may substitute different forms of PA (i.e., walking for utilitarian purposes) based on their location, whereas people living in less compact areas may participate more in sports activities. Our finding that students have higher levels of

Table 3  
Results of the association between environmental and physical activity measures

Independent variables	Vigorous exercise <sup>a</sup>			Sports participation <sup>b</sup>			PA participation <sup>c</sup>		
	OR	95% CI		OR	95% CI		OR	95% CI	
Physical disorder scale	.982	.945	1.019	.960*	.923	.998	.992	.963	1.019
Physical disorder = 0	–			1.4% <sup>c</sup>			–		
Outdoor PA settings scale	1.001	.944	1.060	1.026	.966	1.088	1.026	.982	1.071
Commercial PA facilities	1.017**	.997	1.036	1.020*	1.001	1.039	1.009	.995	1.023
PA facilities = 8	1.5% <sup>c</sup>			2.0% <sup>c</sup>			–		
PA facilities = 16	6.3% <sup>c</sup>			8.1% <sup>c</sup>			–		
Student perception of safety	.320*	.164	.621	.442*	.225	.865	.427*	.263	.692
Student perception of safety = 0	4.4% <sup>c</sup>			2.8% <sup>c</sup>			4.7% <sup>c</sup>		
Local compactness index	.999	.996	1.002	.994*	.991	.997	.999	.997	1.001
Local compactness index = 80	–			3.1% <sup>c</sup>			–		
Traffic danger	.591	.210	1.657	.587	.200	1.719	.470**	.214	1.026
Traffic danger = 0	–			–			2.9% <sup>c</sup>		
Median household income	1.002	.997	1.005	.997	.993	1.001	1.001	.998	1.004

Results of predicted probability models expressed as a relative percent change and are bolded below the relevant independent variable. Predicted changes in physical activity if: (1) catchment areas had no physical disorder; (2) the number of commercial PA facilities in catchment areas increased from about 4 to 8 and 16 respectively; (3) no students felt unsafe sometimes, most times, or often going to and from school; (4) the local compactness index decreased to a score of 80 (representing a more sprawling, less connected community), and (5) streets had lower speed limits and traffic volumes.

<sup>a</sup> Vigorous exercise (1 = every day/nearly every day/most days, 0 = sometimes/seldom/never).

<sup>b</sup> Sports participation (1 = to a great extent/considerable/moderate, 0 = slight/not at all).

<sup>c</sup> PA participation (1 = almost every day, 0 = at least once a week, once or twice a month, a few times a year, never).

\* Indicates environmental measures significant at  $p \leq .05$ .

\*\* Indicates environmental measures significant at  $p \leq .10$ .

sports participation in less compact neighborhoods may be related to this substitution effect. Alternatively, this may be a reflection that PA venues for youth are different than those for adults. Although our outdoor PA settings scale picks up the presence of sports fields, it does not capture information on the number of venues available in relation to population or size of the area, nor does it capture what types of sports fields or how many were present in the communities. More sprawling areas would have more space

for sports fields, which may be more important PA outlets for 8th and 10th graders than walkable compact neighborhoods. There may also be more school and community-based sports programs offered or accessible (i.e., affordable) to youth in more sprawling (i.e., suburban or rural) than urban areas. However, utilitarian walking, the kind that occurs frequently in compact neighborhoods, was not measured in this study. These findings should be investigated further in future research.

Table 4  
Results of the association between environmental and weight measures

Independent variables	Obese			Body mass index		
	OR	95% CI		Coefficient	SE	Z-score
Physical disorder scale	1.066*		1.020	1.114	.057**	1.86
Physical disorder Scale = 0	–10.2%				–1.0%	
Outdoor PA settings scale	.948	.885	1.015	.013	.047	.29
Bike paths	.83*	.712	.971	–.269*	.105	–2.56
Bike paths = 1	–9.5%			–1.0%		
Commercial PA facilities	.990	.967	1.012	–.007	.015	–.49
Student perception of safety	1.457	.667	3.179	.321	.547	.59
Local compactness index	.995*	.991	.998	–.009*	.002	–3.73
Local compactness index = 125	–11.8%			–1.1%		
Local compactness index = 175	–33.7%			–3.3%		
Traffic danger	1.055	.315	3.523	–.463	.846	–.55
Median household income	.991*	.986	.995	–.017*	.002	–6.00

Odds ratios and 95% confidence intervals shown for overweight.

Coefficients, standard errors, and z-scores shown for BMI.

Results of predicted probability models expressed as a relative percent change and are bolded below the relevant independent variable. Predicted changes in weight if: (1) catchment areas had no physical disorder; (2) all catchment areas had bike paths; and, (3) the local compactness index increased from the sample mean of 100 to 125 (e.g., Savannah, GA) and 175 (e.g., Brooklyn, NY).

\* Indicates environmental measures significant at  $p \leq .05$ .

\*\* Indicates environmental measures significant at  $p \leq .10$ .

Contrary to prior research [32], we found no relationship between traffic danger and the PA measures or weight outcomes. This measure may be more important for leisure and utilitarian walking and biking to reach PA-related facilities and other neighborhood destinations, but less important for other forms of PA.

Consistent with previous research [33], the results of our random intercept models show the majority of the variance across our outcome measures lies within and not between communities with the environmental measures accounting for 1%–2% of the total variance in PA and weight. The small magnitude of these effects may in part be due to some of the environmental measures being limited in the amount of information they capture. Again this suggests that additional research with more refined environmental measures is needed. Furthermore, community-level variables in general cannot explain much variance in youth outcomes when much of the variance in the outcomes is within communities.

### Study Limitations and Strengths

This study was subject to several limitations. First, we used cross-sectional data and cannot make direct causal inferences about whether these environmental measures directly influenced changes in PA behavior and obesity. Second, we captured information on the presence of outdoor PA settings; we did not capture information on how many settings were present or their relative condition. In future studies, it would be useful to have information on proximity to these areas in relation to where students live, their accessibility (free vs. paid), as well as a rating system on the availability and condition of sports fields, playground equipment, etc. Third, the PA outlet variable was subject to measurement error because of potential inaccuracies in the commercial outlet density data. Finally, the PA and weight measures were self-reported, which are subject to error and bias. Fourth, we were unable to include a mixed land use measure in our local compactness index. However, previous research [34] indicates that measures of urban form are correlated and higher residential density areas frequently have more mixed land uses and greater street connectivity. Our local compactness index, which includes measures of residential density and street connectivity, should serve as a proxy for areas with mixed land use.

Despite these limitations, results from this study revealed important findings. A strength of this study was its ability to simultaneously account for multiple dimensions of the built environment, as well as examine socioeconomic and demographic influences across a range of settings. To our knowledge, this is the first study to attempt to understand how varying aspects of a community are associated with youth health behaviors and outcomes using nationally representative data collected directly for communities where the youth live.

Our results show different measures of the environment are associated with PA and weight. We found that median household neighborhood income was associated with weight,

but not with any of the three PA measures. This suggests that there may be different causal pathways for PA and obesity. The results of the random intercept and the predicted probability models suggest a strong association between the environment and obesity; that changes to the environment could benefit those youth most at risk for future chronic health conditions caused by obesity. It is estimated, with current population growth forecasts, we can expect up to two-thirds of all residential and nonresidential buildings will either be replaced or built over the next 40 years [35]. Given this and the growing evidence connecting the built environment to both PA and weight it is important to further explore these associations to help inform and shape future development patterns and land use policies to create neighborhoods that will aid in not only increasing PA behavior, but also help to reduce the prevalence of obesity among youth.

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