The associations of perceived neighborhood disorder and physical activity with body mass among African American adolescents

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Abstract

Background: Neighborhood socio-contextual factors may be one of the reasons for decline in physical activity and high levels of obesity among African American adolescents. This study examined the relationship of perceived neighborhood physical and social disorder with obesity status among adolescents and examined the role of physical activity in this relationship.

Methods: Study included 101 African American adolescents aged 12-16 years and one of their parents from one metropolitan area in the southeastern part of the United States. Participants completed self-administered paper surveys which included demographic information and neighborhood disorder scale. Adolescents were asked to wear accelerometers for 7 consecutive days to assess their moderate-to-vigorous physical activity. BMI was calculated from height and weight measured using standard protocols. Meditation models were used to examine whether the relationship between neighborhood disorder and obesity was mediated by physical activity.

Results: Perceived neighborhood disorder was significant and positively related to obesity status; however, there was no evidence of significant mediation of moderate-to-vigorous physical activity in this relationship. Conclusion: Future studies should longitudinally assess perceived neighborhood disorder characteristics and childhood adiposity to examine the timing, extent, and the mechanism by which perceived neighborhood disorder characteristics increase the risk of obesity.

Key Words: neighborhood, physical activity, obesity, adolescent, race/ethnicity
Participation in physical activity is a key health promoting behavior that prevents weight gain and reduces the risk for obesity among adolescents [1, 2]. However, for this population, there are age-related declines in physical activity levels with peak declines evidenced between 15 to 18 years of age [3-6]. While both national and international guidelines suggest that adolescents participate in at least 60 minutes of moderate to vigorous physical activity per day to reduce the risk of obesity, it is estimated that less than 10 percent of US adolescents meet this recommendation [2, 5, 7]. African American adolescents are even less likely to meet the recommended physical activity guidelines and are also more likely to be overweight and obese than their non-minority counterparts [5]. National estimates indicate that 41.2 percent of African American adolescents age 12 to 19 years are either overweight or obese (23.7 percent are obese) relative to 30.0 percent among white adolescents age 12 to 19 years (16.1 percent are obese) [8].

Neighborhood socio-contextual factors may be one of the contributing factors associated with declines in physical activity and the high levels of obesity among African American adolescents. African American adolescents are more likely to reside in low-income urban areas that have more built environmental barriers and socially disordered environments such as abandoned buildings, crime and graffiti [9, 10]. Research findings indicate that built environment factors such as less availability of parks, poor neighborhood walkability and street connectivity are associated with less participation in physical activity [11-14]. The associations of the built environment with obesity are less clear; some studies suggest significant associations with adolescent obesity [15] while other studies fail to find a significant relationship [16]. Low socioeconomic status neighborhood contexts may be associated with less physical activity [17, 18]. Some studies indicate that low-SES neighborhoods are associated with obesity [18-22],
whereas others do not [23, 24]. However, the general findings from the literature on neighborhoods and health underscore that neighborhood contexts, whether built or economic, are associated with participation in physical activity and obesity.

While the literature on the roles of the built environment and neighborhood economic context provide compelling evidence for neighborhood effects, the subjective contexts of African American adolescents’ neighborhood perceptions and the relationships with physical activity participation and obesity status, are less well understood. Although social factors such as neighborhood safety, social cohesion and perceptions of crime have been evaluated among multi-ethnic samples of adolescents participating in the Healthy Passages Study [25], additional factors related to neighborhood context that might affect African American adolescent participation in physical activity and obesity outcomes warrant attention.

**Methods**

To examine the relationship of perceived neighborhood physical and social disorder with physical activity and obesity status among African American adolescents, we utilized the conceptual framework developed by Burdette and Hill [26]. This framework suggests that perceived neighborhood disorder indirectly affects obesity risk through psychological distress, which leads to poorer diet, and less participation in physical activity. There are observable indicators of neighborhood disorder that include crime, vandalism, graffiti, public loitering, and the presence of abandoned buildings. These signs of disorder may induce psychological distress because neighborhood disorder may increase potential risks of physical threats and/or perceptions of increased victimization risk. When exposed to neighborhood environmental stressors, the increase in psychological distress may result in chronic activation of the physiological stress response and increase unhealthy coping behaviors such as unhealthy eating.
behaviors and less physical activity participation. Individuals who are stressed may not engage in regular physical activity and may be more likely to participate in sedentary behaviors that are obesogenic. In addition, the disordered neighborhood environment may discourage physical activity within neighborhoods due to fear of crime or the absence of physical activity promoting resources. Therefore we hypothesize that among adolescents, perceived neighborhood disorder will be associated negatively with physical activity, which in turn will be associated positively with obesity.

Data for the current study are from a cross-sectional study that examined the social and cultural factors that influence African American adolescents’ participation in physical activity. Adolescents who were 12 to 16 years of age and their parents were recruited from the Birmingham, AL metropolitan area, where the population is predominantly African American (73.4 percent) and 32.7 percent of families with children have income below the poverty level (US Census Bureau: American FactFinder. Available at http://factfinder2.census.gov/, 2010.)

To recruit study participants, we used passive and active recruitment strategies such as flyers and snowball sampling. Parents responded to flyers at local recreational centers, churches, community centers, newspaper and word of mouth advertising from previous study participants. For this study, snowball sampling was the most effective recruitment strategy. Study eligibility included children who self-identified as African American and presented with no physical or mental impairment, all study related events and data collection were obtained at the University of Alabama at Birmingham, Department of Medicine. Interested teens and one of their parents were invited to participate in a 90-minute study meeting. Informed consent was obtained from the parents and teens provided assent for the study. Parents and teens received $10 each for completing the surveys and teens received additional $25 dollars for wearing and returning the
All study materials, methods, and study ethics were approved by the Institutional Review Board of the University of Alabama at Birmingham.

The sample size calculations were generated for multivariate linear regression models using the PASS statistical software. The sample size was calculated based on a significance level $\alpha = 0.05$ with varying levels for beta such that Power $(1 - \text{Beta})$ equals 0.90, 0.85, or 0.80. The sample size calculations were adjusted for the multivariate nature of the analyses by including a conservative estimate of the $R^2$ ($R^2 = 0.10$) that is attained when family income, a primary independent variable used in our proposed sampling procedure, is regressed on 10 other independent variables in the regression models. The sample size calculations are strong evidence that the proposed sample size of 120 will have enough power to conduct the multivariate analysis for this study.

Data were collected in Spring 2011. Of the 145 adolescents screened to be eligible, 116 (62 girls and 54 boys) completed the study. The remaining 29 eligible participants reported conflict of parent and teen schedule as the main reason for not attending the study meeting. During the study meeting, adolescents and parents completed self-administered paper surveys and received accelerometers, which they returned approximately one week after the study meeting. Of the 116 who participated in the study, 15 were excluded due to missing/incomplete data (nine were missing information on perceived neighborhood disorder, four were missing information on income, one was missing information on BMI and one did not have accelerometer data for three days). There were no significant differences in age, sex, socioeconomic status, perceived neighborhood disorder, moderate-to-vigorous physical activity, or BMI between those with missing data and those participants included in data analyses.

**Measurements**
Dependent variables

**Body Mass Index.** Trained research staff collected anthropometric measurements. Adolescent’s heights were measured without shoes using a portable stadiometer (Seca 213) to the nearest 0.1 cm. Weight was measured in light clothing without shoes to the nearest 0.1 kg using a digital scale (Seca 813). Two independent measurements were taken for weight and the average of the two was used to calculate BMI using the formula kg/m². We then standardized children’s BMI into percentiles using the age-sex specific height charts provided by the Centers for Disease Control and Prevention [27]. According to the criteria, children in the less than the 5th percentile of weight-for-height were identified as underweight, 5th to less than 85th percentile of weight-for-height were identified as normal weight, children in the 85th to less than 95th percentile of weight-for-height were identified as overweight, and children above the 95th percentile of weight-for-height were identified as obese.

Independent Variables

**Perceived neighborhood disorder.** Parents and adolescents self-reported neighborhood conditions using the full 15-item version of the Ross and Mirowsky [28] Neighborhood Disorder Scale. There were no significant differences in mean neighborhood disorder scores between parents and adolescents, therefore, we used adolescent responses for all analyses. Statements assessed perceptions of physical and social disorder, and a prosocial neighborhood environment. Examples of the scale items include ‘there are too many people hanging around on the streets near my home,’ ‘my neighborhood is noisy,’ and ‘I can trust most people in my neighborhood.’ Response options for the social and physical disorder used the Likert format (‘strongly agree’ = 4 to ‘strongly disagree’ = 1). The prosocial neighborhood environment items were reverse coded. The responses for the items were summed and the possible score values were 15 to 60, with
higher scores indicating greater perceived neighborhood disorder. The Cronbach’s alpha was $\alpha = 0.913$. We constructed quartiles of perceived neighborhood disorder to examine outcomes of interest by degrees of perceived neighborhood disorder.

**Physical activity.** We assessed teens’ physical activity via Actigraph uniaxial accelerometers (Model GT1M; Actigraph Manufacturing Technology Inc., Pensacola, FL, USA) which demonstrate a high degree of reliability [29]. The research staff explained the purpose of the accelerometers and demonstrated its use at the study meeting. Adolescents were asked to wear the accelerometers around their waist using an elastic belt for 7 consecutive days including nights and were instructed to take it off only for bathing or swimming purposes. To improve compliance, at least two reminders were sent through email, text message, or phone call based on the participants’ desired method of contact. Epoch length was set at one minute and data expressed as counts per minute (counts min$^{-1}$). Accelerometry data were considered valid if counts were present for at least three days with at least 8 hours of recording per day. We used child and age specific algorithms to determine physical activity. Daily and total counts per minute were summed and averaged as minutes spent in sedentary (1 to 1.5 METs), light (1.5 to 4 METs), moderate (4 to 7 METs) and vigorous (> 7 METs) physical activity. Because children engaged in few minutes of vigorous physical activity, values were combined with moderate physical activity.

**Covariates**

Age, sex, and socioeconomic status were included as covariates. Parents reported the age and sex of the child. Age was treated as a continuous measure and sex was treated as a categorical variable. Parents self-reported the total annual household income and the highest level of education completed by any adult in the household (1 = less than high school, 2=
complete high school, 3 = some college, and 4 = college graduate). For analyses, these measures were treated as continuous variables.

Data analysis

All variables were evaluated for normality. We conducted sex specific analyses but found no significant differences, thusly, all analyses presented include both adolescent girls and boys. Means, standard deviations, and percentages were computed for the dependent and independent variables by perceived neighborhood disadvantage group. Simple bivariate correlations were evaluated to test for multicollinearity [30, 31]. None of the variables was significantly related and all independent variables and covariates were included for analysis. One-way ANOVA’s were conducted to assess significant differences for the dependent and independent variables p<.05, by perceived neighborhood disadvantage group.

We analyzed a series of single mediation models to examine whether the relationship between neighborhood disorder and body mass was significantly mediated by physical activity. In these analyses, we assessed neighborhood disorder as a continuous variable and examined adolescent BMI as a continuous measure of BMI percentile and we also created a value to assess obesity status (1 = underweight, 2 = normal weight, 3 = overweight and 4 = obese) that corresponded to the CDC percentiles. To examine the indirect (meditational) effect in these models, we used the bootstrap procedures outlined by Preacher and Hayes [32] and their publicly available Indirect SAS macros available at http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html. Bootstrapping is a nonparametric procedure that is robust to departures from the assumptions of normally distributed sampling distributions and is the most appropriate method for small sample sizes [32]. We included the bias-corrected (BC) and bias-corrected and accelerated (BCa) confidence intervals to account for the asymmetric distribution of point
estimates [32]. We set the BCa confidence intervals at 0.95 with 5000 resamples [32]. In bivariate plots and simple correlation analysis, the socioeconomic status related variable, education, was confounded by its non-linear association with obesity status, which did not allow for the interpretation of the effects of education on obesity status. To model the non-linear relationship of education to obesity status, we created a variable, squared-education for each participant and this non-linear effect was added as a covariate in the mediation models. As recommended by Preacher and Hayes, all of the point estimates presented in the mediation analyses are the unstandardized beta coefficients [32]. The probability criterion was set at \( \alpha <0.05 \). We used SAS version 9.2 (SAS Institute Inc, Cary, NC) for all analyses.

Results

Table 1 presents the characteristics of the African American adolescent participants for the full sample and by quartile of neighborhood disorder, where higher quartiles indicate greater perceived disorder. There were no significant differences in the age of participants by quartile of disorder. A larger percentage of females were in the second and third quartiles of perceived neighborhood disorder. Although there were no significant differences in the average BMI percentile by quartile of neighborhood disorder, adolescents in the higher quartiles of perceived neighborhood disorder had a slightly higher mean BMI percentile. A greater percentage of overweight and obese children were in the highest quartile of perceived neighborhood disorder. There were no significant differences in physical activity levels by quartile of perceived neighborhood disorder. A greater percentage of children in quartile 1 of perceived neighborhood disorder resided in households with incomes of $75,000 or more. Almost half of the adolescents in the sample resided in households where an adult had obtained a college degree or higher.

Mediation Models
Figure 1, Panel A presents the unstandardized beta coefficients for the unmediated association of perceived neighborhood disorder with BMI percentile, while controlling for income, education, age and sex. There was no significant relationship between perceived neighborhood disorder and BMI percentile. Panel B of Figure 1 presents unstandardized beta coefficients for the model examining whether physical activity mediated the relationship between perceived neighborhood disorder and BMI percentile. Perceived neighborhood disorder was not significantly related to moderate-to-vigorous physical activity. Moderate- to-vigorous physical activity was significantly and inversely related to BMI percentile. The direct path of perceived neighborhood disorder remained statistically insignificant and there was no evidence of mediation (Table 2).

Figure 2, Panel A presents the unstandardized beta coefficients for the unmediated association of perceived neighborhood disorder with obesity status, while controlling for income, education, age and sex. Perceived neighborhood disorder was significant and positively related to obesity status. Panel B of Figure 2 presents the unstandardized beta coefficients for the model examining whether moderate-to-vigorous physical activity mediated the relationship of perceived neighborhood disorder on obesity status. Given the non-significant association between perceived neighborhood disorder and moderate-to-vigorous physical activity presented in Figure 1, we report relationships between remaining variables. Moderate-to-vigorous physical activity was significant and inversely associated with obesity status. The direct path of perceived neighborhood disorder remained statistically significant and there was no evidence of significant mediation of moderate -vigorous physical activity on the relationship of perceived neighborhood disorder on obesity status (Table 2). We also examined whether vigorous physical activity
mediated the associations of perceived neighborhood disorder on percentile BMI and obesity status (data not shown) and found results similar to those presented.

**Discussion**

This study set out to examine if subjective reports of perceived neighborhood disorder were associated with objectively measured physical activity, BMI percentile and obesity status among African American adolescents. Using the theoretical model developed by Burdette and Hill [26], it was hypothesized that living in disordered neighborhoods would affect obesity status through reduced participation in physical activity. The current research provides partial support for the theoretical model and suggests that while adolescent perceived neighborhood disorder is significantly related to adolescent obesity status, physical activity may not be a significant mediator of this relationship.

The findings in the current study are supported by the literature evaluating relationships of social context on obesity. Evenson and colleagues assessed the relationship between neighborhood factors and BMI for adolescent girls and their findings suggest that neighborhood factors such as reduced crime, seeing other children playing outside, and the availability of recreational facilities are associated with lower body mass index [33]. Although the influence of neighborhood factors is minimal, the effects appear to be important and may operate to protect adolescent girls from increased obesity [33]. In the current study, the associations are also minimal, but statistically significant. The associations observed during adolescence may indicate that the obesogenic effects of disordered neighborhoods emerge over time. For the current study, adolescents who live in disordered neighborhoods are more obese and in turn may have greater risk for more negative health outcomes later in life. As such, neighborhood social and physical disorder do appear to have significant associations with the health of adolescents and provides
support for the hypothesis that living in disordered neighborhoods is associated with obesity [26]. Future studies should longitudinally assess perceived neighborhood disorder characteristics and childhood adiposity to examine the timing and extent to which perceived neighborhood disorder characteristics begin to increase obesity risk for individuals.

Contrary to the expected findings outlined by the theoretical model, there are no associations between perceived neighborhood disorder and objectively measured physical activity in the current study. A number of studies rely upon self-reported physical activity assessments [26, 34, 35], and the findings of Heinrich and colleagues indicate that neighborhood factors such as incivility and built factors affect physical activity participation of low income African American adults [36]. However, the use of accelerometry in the current study provides an objective measurement of physical activity and strengthens the research findings. Additional studies that use objectively measured physical activity also indicate that neighborhood safety and disorder may not be associated with child and adolescent physical activity levels [37]. Other studies that examine area-level SES also do not find significant relationships with physical activity [18]. However, because the adolescents in this study engaged in low levels of moderate-to-vigorous physical activity, it cannot be stated that neighborhood factors do not affect physical activity. Bivariate correlations (data not shown) indicated that drug use in the neighborhood was significantly and negatively associated with participation in moderate-to-vigorous physical activity. Evenson and colleagues also examined social and built environment factors related to physical activity and showed that while perceived neighborhood crime is not significant, factors such as street lights, recreational facility access, and the presence of other children playing outside are associated with greater non-school related physical activity participation for adolescent girls [33]. Therefore, while perceived neighborhood social disorder such as crime
levels may decrease feelings of safety, it appears that population density on the streets may provide a buffering effect against neighborhood disorder [33]. Future studies that incorporate accelerometry should separate school based physical activity from physical activity during non-school hours to determine the extent to which neighborhood factors may affect physical activity among children. Neighborhood disorder may not be relevant if children get most of their physical activity at school [20].

Participation in moderate-to-vigorous physical activity is inversely associated with both percentile BMI and obesity status. This finding is of great importance because on average, children in this study did not meet daily recommendations of at least sixty minutes of moderate-to-vigorous physical activity. We also examined whether participation in light physical activity was associated with obesity and percentile BMI but found no significant associations (data not shown). In addition to wearing the accelerometers, the adolescents also maintained daily physical activity logs where they self-reported the types of physical activity and the duration. For girls, the top three activities were walking for exercise, dance, and basketball. For boys, the top three activities were basketball, football and walking for exercise. This suggests that although adolescents were active, the accelerometer data reflected that the activity levels were insufficient to meet the recommended guidelines. Research findings from a nationally representative sample of children and adolescents, indicate that children are more likely to engage in sporadic physical activity than structured physical activity [38]. These sporadic bouts of physical activity are strongly associated with reduced overweight and obesity among children. The relationship between sporadic physical activity and obesity remains after accounting for total physical activity and may be important to include in addition to a total measure of moderate-to-vigorous physical activity [38].
Because physical activity did not appear to mediate the association of perceived neighborhood disorder and obesity, future research should test the additional neighborhood disorder pathways through diet, which is a key component of the perceived neighborhood disorder theoretical model outlined by Burdette and Hill [26]. Fast food density and grocery store access, fruit and vegetable availability are known to differ by neighborhood context [39-42] and are associated with poorer diet quality and adolescent obesity [43, 44]. An exploration of the relationship to diet in conjunction with the neighborhood pathway through physical activity may provide more evidence for the mechanisms through which perceived neighborhood disorder affects obesity.

While informative, this study is not without limitation, the sample size is relatively small and was obtained from a limited geographical region, which may not be generalizable to African American adolescents as a whole. The sample data are cross-sectional in nature and therefore causality could not be established. Also, while the use of accelerometer data strengthened the findings, the data presented may not represent regular physical activity patterns of adolescents throughout the year. Further, we measured neighborhood disorder to indirectly assess stress and did not include biomarkers of stress such as cortisol or inflammation. Future work should incorporate these measures to examine the extent to which neighborhood context directly affects physiologic functioning. Despite the study limitations, this research expands the current literature by incorporating a theoretical model to assess the mechanism through which perceived neighborhood disorder affects obesity risk among children. The inclusion of traditional measures of body mass index coupled with objective measures to assess physical activity through accelerometry data, strengthen the current findings and suggest that perceived neighborhood disorder may affect adolescent obesity.
Conclusions

The current study findings highlight the associations between adolescents’ perceptions of neighborhood perceptions of social and physical disorder and physical activity engagement with body mass among African American adolescents, a group who is at higher risk for both low-physical activity participation and obesity. While the findings indicate that physical activity may not mediate associations of neighborhood disorder on body mass, both may play a role in obesity. Therefore, community-based interventions to decrease obesity among African American adolescents should devote attention to both neighborhood perceptions and physical activity outcomes.

Competing interests
The authors declare that they have no competing interests.

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Authors’ contributions
AJK, HT and MLB were involved in the conception and design. AJK conducted the analysis. AJK and HT wrote the first version. OA was involved with interpretation of the physical activity data. All of the authors were involved with drafting and revising the article and final approval.

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References


Table 1. Descriptive Statistics by Quartile of Perceived Disorder, Higher Quartiles Indicate Higher Perceived Disorder

<table>
<thead>
<tr>
<th></th>
<th>Full Sample N = 101</th>
<th>Quartile 1 Perceived Disorder n = 23</th>
<th>Quartile 2 Perceived Disorder n = 26</th>
<th>Quartile 3 Perceived Disorder n = 20</th>
<th>Quartile 4 Perceived Disorder n = 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>13.9 (13.7–4.2)</td>
<td>13.7 (13.1–14.2)</td>
<td>14.0 (13.5–14.6)</td>
<td>14.0 (13.4–14.6)</td>
<td>14.0 (13.5–14.5)</td>
</tr>
<tr>
<td>Sex (% female)</td>
<td>55</td>
<td>46.1</td>
<td>61.5</td>
<td>65.0</td>
<td>48.5</td>
</tr>
<tr>
<td>BMIpct (mean, SD)</td>
<td>69.0 (63.2–74.7)</td>
<td>65.0 (51.4–78.6)</td>
<td>67.8 (56.4–79.1)</td>
<td>72.5 (63.4–81.5)</td>
<td>70.6 (58.6–82.5)</td>
</tr>
<tr>
<td>Percentile BMI n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>3 (2.9)</td>
<td>1 (4)</td>
<td>1 (3.8)</td>
<td>0</td>
<td>1 (2.8)</td>
</tr>
<tr>
<td>Normal weight</td>
<td>56 (55.4)</td>
<td>14 (56)</td>
<td>16 (61.5)</td>
<td>12 (60.0)</td>
<td>15 (42.8)</td>
</tr>
<tr>
<td>Overweight</td>
<td>19 (18.8)</td>
<td>5 (20)</td>
<td>5 (19.2)</td>
<td>6 (30.0)</td>
<td>5 (14.3)</td>
</tr>
<tr>
<td>Obese</td>
<td>23 (22.7)</td>
<td>5 (20)</td>
<td>4 (15.4)</td>
<td>2 (10.0)</td>
<td>14 (40.0)</td>
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<tr>
<td>Neighborhood disorder</td>
<td>26.8 (25.0–28.5)</td>
<td>16.2 (15.7–16.7)</td>
<td>21.6 (20.9–22.3)</td>
<td>28.7 (27.8–29.6)</td>
<td>37.4 (35.5–39.3)</td>
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<tr>
<td>Physical activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sedentary</td>
<td>1050.3 (1033.5–1067.2)</td>
<td>1040 (1002.8–1078.8)</td>
<td>1045.5 (1008.0–1083.1)</td>
<td>1076.4 (1040.9–1112.0)</td>
<td>1046.3 (1016.5–1076.2)</td>
</tr>
<tr>
<td>Light</td>
<td>355.3 (340.3–370.3)</td>
<td>356.6 (323.1–390.2)</td>
<td>368.0 (334.0–402.2)</td>
<td>329.8 (304.1–355.5)</td>
<td>358.2 (330.5–385.9)</td>
</tr>
<tr>
<td>Moderate</td>
<td>26.90 (23.2–30.5)</td>
<td>32.19 (23.2–41.1)</td>
<td>24.0 (16.9–31.1)</td>
<td>19.9 (12.9–26.4)</td>
<td>29.3 (22.5–36.1)</td>
</tr>
<tr>
<td>Vigorous</td>
<td>2.81 (2.0-3.6)</td>
<td>4.00 (1.8–6.1)</td>
<td>2.2 (0.9–3.5)</td>
<td>1.9 (0.7–3.1)</td>
<td>2.8 (1.2–4.5)</td>
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<td>Income</td>
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<tr>
<td>&lt;$15k</td>
<td>9 (8.9)</td>
<td>4 (16.7)</td>
<td>1 (3.8)</td>
<td>0</td>
<td>4 (12.1)</td>
</tr>
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<td>$15k - $30k</td>
<td>15 (14.8)</td>
<td>1 (4.1)</td>
<td>2 (7.6)</td>
<td>5 (25)</td>
<td>7 (21.2)</td>
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<td>$30K to $45k</td>
<td>26 (25.7)</td>
<td>8 (33.3)</td>
<td>6 (23.0)</td>
<td>3 (15)</td>
<td>11 (33.3)</td>
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<tr>
<td>$45k to $60k</td>
<td>19 (18.8)</td>
<td>1 (4.1)</td>
<td>8 (30.7)</td>
<td>4 (20)</td>
<td>6 (18.1)</td>
</tr>
<tr>
<td>$60k to $75k</td>
<td>8 (7.9)</td>
<td>1 (4.1)</td>
<td>3 (11.5)</td>
<td>3 (15)</td>
<td>1 (3.0)</td>
</tr>
<tr>
<td>$75k+</td>
<td>24 (23.7)</td>
<td>9 (37.5)</td>
<td>6 (23.0)</td>
<td>5 (25)</td>
<td>4 (12.1)</td>
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<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; High school</td>
<td>4 (3.9)</td>
<td>2 (7.6)</td>
<td>1 (3.8)</td>
<td>0</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>High school</td>
<td>9 (8.9)</td>
<td>2 (7.6)</td>
<td>2 (7.6)</td>
<td>2 (10)</td>
<td>4 (11.7)</td>
</tr>
<tr>
<td>Some college</td>
<td>39 (38.6)</td>
<td>8 (30.7)</td>
<td>6 (23.0)</td>
<td>13 (65)</td>
<td>14 (41.1)</td>
</tr>
<tr>
<td>College+</td>
<td>49 (48.1)</td>
<td>14 (53.85)</td>
<td>17 (65.3)</td>
<td>5 (25)</td>
<td>15 (44.1)</td>
</tr>
</tbody>
</table>

BMI categories: <5th percentile = underweight; 5th to <85th = normal weight, 85th-94.9th = overweight; ≥ 95th = obese
Table 2. Indirect effects of perceived neighborhood disorder on obesity status among adolescents (unstandardized)

<table>
<thead>
<tr>
<th>Model summary for BMI PCT</th>
<th>Bias-Corrected Point Estimate (ab)</th>
<th>S.E.</th>
<th>Bias-Corrected Accelerated Bootstrap 95% Confidence Interval</th>
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</thead>
<tbody>
<tr>
<td>Moderate &amp; vigorous physical activity</td>
<td>0.0110</td>
<td>0.152</td>
<td>-0.4659</td>
</tr>
<tr>
<td>Model summary for Obesity Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate &amp; vigorous physical activity</td>
<td>0.001</td>
<td>0.038</td>
<td>-0.114</td>
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Figure 1. Simple meditational model for the relationships between perceived neighborhood disorder and percentile BMI. Panel (a) path estimates for the direct effect of perceived neighborhood disorder on percentile BMI (controlling for income, education, education^2 (to control for the non-linear effects of education), age and sex) (b) path estimates of the indirect effect of perceived neighborhood disorder on percentile BMI (controlling for income, education, education^2 (to control for the non-linear effects of education), age and sex).

Figure 2. Simple meditational model for the relationships between perceived neighborhood disorder and obesity status. Panel (a) path estimates for the direct effect of perceived neighborhood disorder on obesity status (controlling for income, education, education^2 (to control for the non-linear effects of education), age and sex) (b) path estimates of the indirect effect of perceived neighborhood disorder on obesity status (controlling for income, education, education^2 (to control for the non-linear effects of education), age and sex).
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