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Context matters: Adolescent neighborhood and school influences on young adult body mass index

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Abstract

Purpose: Both schools and neighborhoods play important roles in determining adolescent weight status, but little is known about their relative importance, particularly in predicting long-term weight outcomes. We assessed the impacts of both school and neighborhood socioeconomic composition, social connectedness, and built environment during adolescence on weight status in young adulthood.

Methods: The study sample consisted of 14,625 respondents from Waves I and IV of the National Longitudinal Study of Adolescent to Adult Health. Data were analyzed using cross-classified multilevel modeling to examine the joint effect of adolescents' school and neighborhood predictors on body mass index (BMI) 13 years later.

Results: Living in a neighborhood with lower average parent education during adolescence, and attending a school with lower average parent education, were each associated with higher BMI in young adulthood. Living in a neighborhood with more physical activity resources predicted lower young adult BMI, independent of adolescent weight, parent obesity status, and demographic characteristics. School physical activity resources and perceptions of social connectedness (in the school or neighborhood) were not significantly associated with young adult BMI.

Conclusions: These findings highlight the importance of school and neighborhood socioeconomic composition during adolescence on young adult weight status. Results also suggest that improving neighborhood infrastructure may promote healthy weight.

Keywords

Obesity; neighborhood/place; multilevel modeling

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About 39.6% of United States (U.S.) residents are obese, including one in five adolescents [1,2]. Adolescence is a sensitive period for excess weight gain due to increased fat deposition beginning at puberty [3,4]. During adolescence, youth begin to gain autonomy to adopt behaviors and habits that may have a long-term influence on their weight status [5]. As children reach the adolescent years, health behaviors such as diet and physical activity are increasingly shaped by environmental factors outside the family such as eating norms, accessibility to physical activity resources, and social connectedness [6,7]. The multiple critical changes occurring during adolescence highlight the importance to understand environmental risk and protective factors during adolescence in planning public health decisions to promote long-term health among youth.

Studies have shown that schools and neighborhoods - two contexts in which adolescents spend the most time - have important bearing on adolescents' weight [4,7–10]. However, most studies face two key limitations: (1) they use single-level analysis, which cannot capture obesity risk at a contextual level; and (2) they examine one context at a time, making it difficult to compare the relative influences of multiple contexts. Recent studies have examined the contemporaneous associations between adolescent body mass index (BMI) and both school-level and neighborhood-level demographic characteristics, and although effects of these environments on BMI tend to persist into adulthood [4,5], no studies have compared their long-term influences. Further, prior research integrating these multilevel contexts has not examined how specific aspects of the built environment (e.g., access to physical activity resources) or social connectedness may be associated with BMI [11,12].

This study uses data from the National Longitudinal Study of Adolescent to Adult Health (Add Health) to investigate whether school and neighborhood characteristics during adolescence predict BMI 13 years later. We hypothesized that higher socioeconomic status, social connectedness, and physical activity resources at both the school-level and neighborhood-level would predict lower BMI in young adulthood. Based on cross-sectional evidence that schools are more salient than neighborhoods in explaining variation in adolescent weight [11, 12] and that schools provide direct opportunity and support for dietary intake and exercise, we predicted that school factors would be more strongly associated with young adult weight status than neighborhood factors.

Methods

Data

Add Health is a longitudinal survey of a nationally representative sample of adolescents in grades 7 to 12 at baseline (Wave I; 1994–1995; $N = 20,745$) followed into adulthood. A sample of 80 high schools and 52 feeder middle schools from the U.S. was selected to ensure this sample is representative of U.S. schools with respect to region of country, urbanicity, school size, school type, and ethnicity [13]. The current study uses in-home interview data from Wave I and Wave IV (aged 24–32 years; 2007–2008). Of respondents who participated in both waves ($N = 15,701$), we excluded youth from the genetic sample (due to unclear school membership; $n = 385$) and those missing neighborhood contextual data ($n = 129$) or BMI at Wave I ($n = 377$) or IV ($n = 212$), resulting in a final analytic sample of 14,625 respondents. Institutional Review Board approval was obtained to conduct

secondary analyses of the Add Health data at Fordham University via IRB Authorization Agreement with UMass Amherst.

Measures

Young adult body mass index.—Height and weight, measured by trained interviewers at Wave IV, were used to calculate the BMI (i.e., the ratio of weight in kilograms over height in meters squared).

School physical activity resources.—School-level physical activity resources were assessed through questions asked of school administrators to indicate whether three types of physical activity resources (athletic physical, non-athletic physical, and physical fitness or recreation center) were provided at their school (1 = provided, 0 = not provided or referred to other providers). We then summed each school administrator's responses to the three questions.

School social connectedness.—School social connectedness was assessed by five statements from the Wave I in-home survey: (1) "I feel close to people at this school"; (2) "I feel like I am part of this school"; (3) "I am happy to be at this school"; (4) "the teacher at this school treats students fairly"; and (5) "I feel safe in my school"[14]. Each item used a five-point scale (from strongly agree to strongly disagree). We reversed-coded each item and created a mean score for every individual, such that a larger number reflected higher overall school social connectedness. Finally, we averaged individual responses from all Wave I participants who attended each school to create school-level social connectedness scores (from 1 to 5).

Neighborhood physical activity resources.—Thirteen categories of physical activity facilities (e.g., parks and pools) within 5 km Euclidian (i.e., straight-line) radius of each respondent's residence were calculated by Add Health at Wave I [8]. We aggregated these individual scores for all youth living in the same neighborhood (defined as census tracts) to indicate neighborhood-level physical activity resources. We chose the 5 km distance based on the estimation of a 5- to 10-minute drive to a physical activity facility in urban and rural communities, as others have done using Add Health data [15,16,]. (Sensitivity tests using an alternate 1 or 3 km distance revealed similar findings.)

Neighborhood social connectedness.—Neighborhood social connectedness was assessed by responses to five statements from the Wave I in-home survey: (1) "You know most of the people in your neighborhood"; (2) "You have stopped on the street to talk with someone who lives in your neighborhood"; (3) "People in this neighborhood look out for each other"; (4) "Do you usually feel safe in your neighborhood?"; and (5) "How happy are you with living in your neighborhood?". We dichotomized responses to the last statement (true = "very much" or "quite a bit"; false = "somewhat", "very little", or "not at all"), and then summed the number of true statements to the five items for every individual. We averaged individual responses from all Wave I participants who lived in each neighborhood to create neighborhood-level social connectedness scores (from 0 to 5).

Individual covariates.—Individual covariates were constructed from the Wave I in-home interview, including adolescents' sex (0 = female, 1 = male), race/ethnicity (mutually exclusive dummy variables: non-Hispanic Black, Hispanic, Asian and Pacific Islander, and Other, with non-Hispanic White as the reference category), age (in years), self-reported general health (from 0 = poor to 4 = excellent), and self-reported height and weight (used to calculate baseline BMI). We created two binary indicators of family socioeconomic status (SES): parents' college completion, based on adolescents' report of the highest grade their parents completed (1 = either parent completed college; 0 = neither parent completed college), and whether the resident mother received public assistance (1 = mother currently receiving public assistance; 0 = not) [11]. Parents reported their marital status, and responses were dichotomized into mutually exclusive dummy variables: single never married, widowed, divorced, and separated, with married as the reference category. Parents also reported the obesity status of their child's biological mother and father (1 = either parent had obesity; 0 = neither parent had obesity).

School and neighborhood SES covariates.—Using Wave I in-home interview data, we calculated separate school-level SES variables of the proportion of students within each school who were White, who had parents with a college degree, and who had mothers who received public assistance. We aggregated school-level SES from individual-level data because such information is not directly available. For neighborhood-level SES variables, we used data from the 1990 U.S. census that reports the proportion of residents within each neighborhood who were White, had a college degree and had received public assistance.

Statistical analysis

We constructed a series of cross-classified multilevel models (CCMM) to estimate the associations between Wave IV BMI and individual-, school-, and neighborhood-level factors (i.e., fixed effects) and the proportion of variance in Wave IV BMI attributable to each level (i.e., random effects). The major advantage of CCMM compared with traditional multilevel models is that it allows for estimation of the effects of multiple non-nested contexts (e.g., students may attend schools outside of their neighborhoods). Our models included: a *null model* with the random effects of schools and neighborhoods; an *adjusted model*, incorporating individual-level covariates; *model 1a*, adding school SES variables to the adjusted model; *model 1b*, adding school social connectedness and physical activity resources to model 1a; *model 2a*, adding neighborhood SES variables to the adjusted model; *model 2b*, adding neighborhood social connectedness and physical activity resources to model 2a; and *model 3*, a full model that included individual-, school-, and neighborhood-level variables.

We conducted all analyses in Stata (version 15.0). All continuous variables were standardized (Mean = 0; *SD* = 1) before analysis to facilitate interpretation. As the dependent variable was approximately normally distributed, a Gaussian distribution was specified. The covariance matrix was unrestricted. Two-tailed *p* values are presented for fixed-effect parameters.

We used unweighted data for all analyses, as weighting techniques for CCMM have not been established. This is consistent with four published studies that have used CCMM to analyze Add Health data [11,12,17,18]. We performed multiple imputation to address missing data on covariates (ranging from 1% on race/ethnicity to 20% on parental obesity status) using chained equations [19]. Five complete data sets were imputed to help ensure stable parameters and standard error estimates [20].

We also ran a series of follow-up analyses, which are included in the online supplementary tables. First, we fit the same set of models using non-imputed data with listwise deletion. Additional sensitivity tests were conducted that excluded small neighborhoods with fewer than three participants to check potential bias in estimation of neighborhood contextual effects. We also fit a parallel set of cross-sectional models for Wave I BMI, to allow our findings to be comparable to published Add Health studies on Wave I BMI using CCMM [4,5].

Results

As shown in Table 1, the mean age of the sample at Wave I was 16.2 ($SD = 1.7$) years; 55.1% of the participants were non-Hispanic White, 21.3% were non-Hispanic Black, and 15.8% were Hispanic. Of the participants, 35.4% had parents who graduated from college, and 9.9% had mothers who were on public assistance. Participants' average BMI was 22.6 ($SD = 4.5$) at Wave I, and 29.1 ($SD = 7.5$) at Wave IV. Adolescents attended 132 schools and lived in 1,990 different neighborhoods resulting in 2,653 unique combinations of schools and neighborhoods. The number of students per school ranged from 4 to 1,172, with a mean of 111 and a median of 91 students. The number of adolescents per neighborhood ranged from 1 to 236, with a mean of 7 and a median of 2 students.

Table 2 presents the results of the CCMMs predicting Wave IV BMI. In the *null model*, we found that schools ($\sigma^2_{school} = 1.38$) explained slightly more variance in Wave IV BMI than neighborhoods ($\sigma^2_{neighborhood} = 1.03$). With the addition of individual and family covariates (*adjusted model*), both the school and neighborhood contribution were substantially reduced ($\sigma^2_{school} = 0.22$; $\sigma^2_{neighborhood} = 0.10$), suggesting that most observed school and neighborhood effects on young adult BMI were attributable to individual differences such as baseline weight, race/ethnicity, and family characteristics. Our model also suggested that BMI was higher among Black ($\beta = 0.75$, $p < .001$) and Hispanic ($\beta = 0.44$, $p = .003$) young adults compared to White young adults. In addition, Wave IV BMI was higher among females ($\beta = 0.35$, $p < .001$), youth with higher adolescent BMI ($\beta = 5.08$, $p < .001$), and youth whose parent had obesity ($\beta = 1.16$, $p < .001$), while lower among youth whose parents graduated from college ($\beta = -0.43$, $p < .001$).

When school SES variables were added (*model 1a*), the residual variances for the school ($\sigma^2_{school} = 0.12$) and the neighborhood ($\sigma^2_{neighborhood} = 0.07$) were reduced, but the residual variance at the individual level ($\sigma^2_{individual} = 28.13$) was largely unchanged, indicating that a large portion of the school and neighborhood effects unexplained by individual differences were attributable to school SES. Results also showed a negative association between school average parent education and young adult BMI ($\beta = -0.32$, $p < .001$). In addition, the

positive association between Hispanic ethnicity and Wave IV BMI, and the negative association between parent education and Wave IV BMI, were greatly reduced. In *model 1b*, no statistically significant fixed effects were detected for school physical activity resources and social connectedness, above and beyond effects of individual, family, and school covariates.

In *model 2a*, which added neighborhood-level SES covariates, the residual variances for the school ($\sigma^2_{school} = 0.10$) and neighborhood ($\sigma^2_{neighborhood} = 0.08$) were reduced, but the residual variance at the individual level ($\sigma^2_{neighborhood} = 28.12$) was largely unchanged. We found that living in neighborhoods with lower average parent education predicted higher young adult BMI ($\beta = -0.31, p < .001$). The associations between Wave IV BMI and Hispanic ethnicity and parent education were reduced, similar to the school SES model (*model 1a*); in addition, the positive association between non-Hispanic Black and Wave IV BMI was also greatly reduced. Adding neighborhood physical activity resources and social connectedness (*model 2b*) further reduced the residual variances for the school ($\sigma^2_{school} = 0.09$) and neighborhood ($\sigma^2_{neighborhood} = 0.06$). A 1-*SD* increase in neighborhood physical activity resources predicted a decrease in young adult BMI by 0.12 ($p = .037$). Neighborhood social connectedness did not predict young adult BMI. A negative association between neighborhood percentage of Whites and BMI emerged ($\beta = -0.16, p = .049$).

In *model 3*, when individual, school and neighborhood factors were simultaneously included in the model, the negative association between neighborhood physical activity resources and BMI remained significant, with a similar effect size ($\beta = -0.13, p = .029$). The negative associations between school or neighborhood parent education and BMI remained significant, with reduced effect sizes ($\beta = -0.19, p = .021$, and $\beta = -0.19, p = .009$, respectively). The negative association between neighborhood percentage of Whites and BMI was not significant in this model.

Non-imputed data yielded results consistent with multiple imputation (Table A1). After excluding small neighborhoods (Table A2), the full model (*model 3*) showed attenuated association between BMI and school parent education; however, the association between BMI and neighborhood physical activity resources was stronger ($\beta = -0.26, p = .004$); similar patterns – fixed and random effects of school and neighborhood – remained in all other models. Our cross-sectional analyses of Wave I BMI (Table A3) yielded results similar to our main findings except that neighborhood physical activity resources were not significantly associated with Wave I BMI in all models.

Discussion

The current study is the first to compare early influences of schools and neighborhoods on young adult weight outcomes simultaneously, and it adds to previous literature on contextual influences on development by exploring the relative contributions of both school-level and neighborhood-level socioeconomic, social, and built environment characteristics to young adult BMI. This study found that attending a school with lower mean levels of parent education, and living in a neighborhood with lower average parent education, were each associated with higher BMI in young adulthood. More neighborhood physical activity

resources near an adolescent's home predicted a decrease in BMI in young adulthood. These effects were independent of adolescent weight, parent obesity status, and individual, school, and neighborhood SES.

Consistent with a substantial body of evidence [21–24], we found that lower levels of parent education (at both the school- and neighborhood-level) were associated with higher BMI in young adulthood. Parents' education level may be stronger predictors of BMI than parent income to the extent that higher educational attainment leads to a healthier lifestyle at home, such as exercise and healthy eating [25]. In line with several studies [1,2], we identified racial/ethnic disparities in young adult BMI above and beyond individual differences in SES. Further, after accounting for neighborhood-level SES, we found that the Black-White difference in BMI was reduced from .74 to .56, an effect not found when using school-level SES to explain BMI. Our results suggest that neighborhood SES environments, and their related inequalities in neighborhood quality, are important potential explanations to racial disparities in BMI. Specifically, adolescents living in disadvantaged neighborhoods tend to experience elevated levels of stress and have increased risks of poor diet and physical activity, which may put them on a trajectory to obesity in adulthood [26, 27]. Notably, BMI disparities between Black and Hispanic young adults, when compared to White young adults, still persist after accounting for neighborhood and school SES, social connectedness, and physical activity resources, highlighting the need to better understand social sources of racial/ethnic disparities in health.

We found that more neighborhood physical activity resources during adolescence were associated with lower BMI in young adulthood. Proximity to physical activity resources (e.g., parks, recreation centers, pools) near one's home during adolescence may be associated with increased exercise, promoting healthy weight across development [7,8,10]. It is also important to note that the effect of neighborhood physical activity resources was not found at Wave I. Although the effects of these lifestyle choices may not be seen immediately, eating and physical activity habits formed during the adolescent years might impact youth's long-term health [28,30]. According to the cumulative disadvantage theory, risk or protective environmental factors during adolescence may accumulate over time, thereby increasing heterogeneity in later life [29]. Our findings underscore the need for longitudinal data to examine the long-term implications of the adolescent neighborhood environment on obesity.

In this study, school physical activity resources were not associated with young adult BMI, contrary to our hypothesis. However, other school factors such as quality physical education class and chances for organized sports may be more important than the facilities themselves. Adolescents, particularly high school students, remain seated during most of their school time [31]. According to a national survey in 2015, only 27.1% of youth in grades 9 to 12 engaged in the recommended 60 minutes of daily physical activity [31].

Several prior studies have suggested that favorable school and neighborhood environments encourage outdoor play, allow faster transmission of healthy messages, and promote healthy weight in adolescents [7,8,10]. However, perceptions of social connectedness during adolescence were not associated with young adult BMI in this study. It is likely that some

aspects of social environments are more salient than others [9]. Future longitudinal studies, with more detailed measures of various types of social environments (e.g., safety, norms and collective efficacy, discrimination, dyadic relationships with school/neighborhood members), may be helpful to uncover key social influences on weight status in school and neighborhood settings.

Limitations

There were several limitations to this study. First, we used self-reported height and weight to calculate baseline BMI as objective measurement was not available at Wave I. However, high correlation between BMI calculated from self-reported versus measured height and weight was reported at Wave II in Add Health ($r = .92$) [32]. Second, unweighted data were used, as methods to incorporate sampling weights into CCMM have not been developed [17,33]. While Add Health is a nationally representative sample of U.S. adolescents, without the application of sampling weights, findings are not generalizable to the U.S. youth population. Third, because Add Health used a school-based sampling design, the number of participants per neighborhoods was smaller than the number of participants per school. As a result, variance in BMI was likely estimated more reliably at the school-level than at the neighborhood-level; however, two studies conducted in Add Health using CCMM did find meaningful variation of Wave I BMI both between neighborhoods and between schools [11,12]. Moreover, when we conducted a sensitivity test in which small neighborhoods were excluded, we obtained similar results. Fourth, only a restricted set of proxy variables were available from Add Health to characterize the social and built environment of the school and the neighborhood. Other important dimensions of the social environment (e.g., social media and social ties between individuals) and the built environment (e.g., the food environment and traffic) should be examined in future studies [7, 10]. Future research should also consider objective measures, such as GIS mapping and trained observations, to characterize and compare the school and the neighborhood environments. Finally, we measured school and neighborhood environment at Wave I, but most participants have changed neighborhoods, and in a few cases, changed schools after the baseline measurement. However, information on when and why the respondents moved and the change in neighborhood conditions is not available to investigators. Future longitudinal studies should examine residential stability and life transitions across adolescence in understanding the longitudinal association between school and neighborhood environment and weight-related outcomes.

Conclusion

This study suggests that school and neighborhood socioeconomic conditions and the built environment are important contextual factors to modify during adolescence to promote healthy weight development. Pediatricians and other clinicians should consider these macro-level environments when working with adolescents and their families. Additionally, state and local-level policy makers may consider improving neighborhood infrastructure to ensure that communities offer sufficient and safe space for recreational activities that are also attractive and accessible to adolescents. Nonetheless, improvement in the built environment alone may not be sufficient. Schools may need to combine physical activity facility improvement with a comprehensive school-based physical activity program that emphasizes exercise, nutrition,

and physical education. Future efforts to reduce obesity, and racial/ethnic disparities in obesity, must start early and improve not only individual-level behaviors and family-level processes, but also structural characteristics and social processes of the school and the neighborhood.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

BMI	body mass index
U.S.	United States
Add Health	National Longitudinal Study of Adolescent to Adult Health
CCMM	cross-classified multilevel models
SES	socioeconomic status

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Implications and Contribution

By assessing the prospective association between adolescent school and neighborhood factors with young adult BMI, these findings help to inform public health decisions about key environmental variables for adolescent health interventions. Findings suggest that improving school and neighborhood socioeconomic conditions and the built environment may promote healthy weight development.

Table 1.

Descriptive statistics of the sample and multilevel structure of data

	<i>M (SD)/%</i>		
<i>Individual level (N = 14,625)</i>			
Male	47.5%		
Age	16.2 (1.7)		
Race/ethnicity			
Non-Hispanic White	55.1%		
Non-Hispanic Black	21.3%		
Hispanic	15.8%		
Non-Hispanic Asian and Pacific Islander	6.0%		
Non-Hispanic Other	1.6%		
General health	2.1 (0.9)		
Mother on public assistance	9.7%		
Parents graduated college	35.4%		
Parents' marital status			
Married	71.3%		
Single never married	5.4%		
Widowed	3.6%		
Divorced	14.8%		
Separated	4.9%		
Either parent had obesity	22.1%		
Wave I BMI	22.6 (4.5)		
Wave IV BMI	29.1 (7.5)		
		<i>M (SD)</i>	Minimum Maximum
<i>School level (N = 132)</i>			
School % White	59.8 (33.0)	0.0	100.0
School % public assistance	11.1 (9.2)	0.0	44.5
School % parents graduated college	34.4 (18.0)	6.7	91.2
School PA resources	0.9 (1.0)	0.0	3.0
School social connectedness	3.7 (0.2)	3.3	4.3
		<i>M (SD)</i>	Minimum Maximum
<i>Neighborhood level (N = 1,990)</i>			
Neighborhood % White	67.2 (32.4)	0.0	100.0
Neighborhood % public assistance	10.5 (9.7)	0.0	61.8
Neighborhood % graduated college	23.7 (14.6)	0.0	82.5
Neighborhood PA resources	88.7 (107.1)	0.0	905.0
Neighborhood social connectedness	3.5 (1.1)	0.0	5.0

Note. SD = standard deviation; BMI = body mass index; PA = physical activity.

Table 2.

CCMMs predicting Wave IV BMI from individual, family, school, and neighborhood characteristics

	Null model	Adjusted model	Model 1a	Model 1b	Model 2a	Model 2b	Model 3
Fixed effects							
<i>Individual level</i>							
Wave I BMI	–	5.08 ***	5.08 ***	5.08 ***	5.08 ***	5.08 ***	5.07 ***
Male	–	–0.35 ***	–0.35 ***	–0.35 ***	–0.35 ***	–0.35 ***	–0.35 ***
Age	–	–0.57 ***	–0.57 ***	–0.56 ***	–0.58 ***	–0.57 ***	–0.56 ***
Black race/ethnicity (vs White)	–	0.75 ***	0.74 ***	0.74 ***	0.56 ***	0.55 **	0.54 **
Hispanic race/ethnicity (vs White)	–	0.44 **	0.38 *	0.38 *	0.37 *	0.47 **	0.41 *
Asian race/ethnicity (vs White)	–	–0.42	–0.42	–0.43	–0.49 *	–0.41	–0.44 *
Other race/ethnicity (vs White)	–	–0.02	–0.03	–0.02	–0.05	–0.01	–0.04
General health	–	0.05	0.04	0.04	0.04	0.04	0.04
Mother on public assistance	–	–0.07	–0.14	–0.13	–0.12	–0.11	–0.14
Parents graduated college	–	–0.43 ***	–0.33 **	–0.33 **	–0.32 **	–0.33 **	–0.27 **
Marital status- single (vs. married)	–	0.07	0.04	0.04	0.03	0.05	0.03
Marital status- widowed (vs. married)	–	–0.04	–0.05	–0.05	–0.06	–0.05	–0.06
Marital status- divorced (vs. married)	–	–0.22	–0.21	–0.21	–0.20 *	–0.19 *	–0.19
Marital status- separated (vs. married)	–	0.06	0.05	0.06	0.07	0.08	0.07
Either parent had obesity	–	1.16 ***	1.17 ***	1.17 ***	1.14 ***	1.14 ***	1.15 ***
<i>School level</i>							
School % Whites	–	–	–0.02	–0.02	–	–	–0.03
School % public assistance	–	–	–0.03	–0.01	–	–	0.03
School % parents graduated college	–	–	–0.32 ***	–0.32 ***	–	–	–0.19 *
School PA resources	–	–	–	–0.07	–	–	–0.04
School social connectedness	–	–	–	0.06	–	–	0.04
<i>Neighborhood level</i>							
NH % Whites	–	–	–	–	–0.13	–0.16 *	–0.16
NH % public assistance	–	–	–	–	–0.06	–0.02	–0.03
NH % graduated college	–	–	–	–	–0.31 ***	–0.28 ***	–0.19 **
NH PA resources	–	–	–	–	–	–0.12 *	–0.13 *
NH social connectedness	–	–	–	–	–	0.04	0.03
Intercept	28.93 ***	28.93 ***	28.91 ***	28.92 ***	28.97 ***	29.00 ***	28.94 ***
Random effects variance							
School	1.38	0.22	0.12	0.11	0.10	0.09	0.07
Neighborhood	1.03	0.10	0.07	0.07	0.08	0.06	0.05
Individual	53.62	28.10	28.13	28.13	28.12	28.13	28.13

Note. BMI = body mass index; NH = neighborhood; PA = physical activity. Sample size = 14,625.

p < .001,

^{**}
 $p < .01$,

^{*}
 $p < .05$.

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