

ASSOCIATIONS OF NEIGHBORHOOD SAFETY AND NEIGHBORHOOD SUPPORT WITH OVERWEIGHT AND OBESITY IN US CHILDREN AND ADOLESCENTS

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Objectives: To examine the association of neighborhood safety and support with overweight and obesity and whether these associations vary with age, sex, and race/ethnicity among children and adolescents.

Design: Cross-sectional.

Setting: United States.

Main Outcome Measure: Childhood overweight and obesity.

Methods: We used data from the 2011-12 National Survey of Children's Health, a representative sample of US children and adolescents, for the analyses (N=40,730). Using the age-sex adjusted growth chart, parent self-reported weight and height data were used to classify participants as overweight (those with body mass index [BMI] percentile [%] at or above the 85th%) and obese (those with BMI% at or above the 95th%). We used log-binomial regression to quantify the association of neighborhood safety and support with overweight and obesity among children and adolescents before and after adjusting for selected characteristics including physical activity and amount of time spent in sedentary activities.

Results: Children and adolescents living in non-supportive neighborhoods had a 21% (95%CI: 1.10-1.33) higher probability of being obese than their peers living in supportive neighborhoods after controlling for age, sex, race/ethnicity, parent's education, poverty, asthma, physical activity and sedentary activities. Similarly, the probabilities of obesity associated with neighborhood safety and support were 1.30 (95%CI:1.08-156) and 1.18 (95%CI:1.01-1.38), respectively. However, these probabilities vary with race/ethnicity with higher probability being observed among non-Hispanic Whites and Hispanics for overweight and non-Hispanic Whites for obesity.

INTRODUCTION

Childhood overweight and obesity appear to be reaching a plateau in the United States (US) over recent years.¹ For instance, the prevalence of overweight and obesity among children aged 2 to 19 years was 31.6% and 17.3% in 2007-2008 and 32.2%¹ and 16.9%² in 2011-2012, respectively. Moreover, this pattern has been observed across age, sex and race/ethnicity over these years with few exceptions: 1) overweight increased for Hispanic girls and for African American boys aged 2 to 19 years and 2) obesity increased for African American boys aged 12 to 19 years.¹ However, obesity has also increased among children living below 100% of the federal poverty level (FPL) during the same time regardless of age, sex

and race/ethnicity.³ In fact, children living below 100% of the FPL are almost twice as likely to be obese than their counterparts living at 400% or more of the FPL.³ Thus, childhood overweight and obesity continue to be a public health problem.

While individual characteristics are associated with childhood overweight and obesity, features of the built environment such as neighborhood safety and support affect these associations.⁴⁻¹² For example, Singh et al, using data from the 2003 National Survey of Children's Health (NSCH), found that, compared with children living in neighborhoods with the highest social support, children aged 10 to 17 years living in neighborhoods with the lowest social support or lower levels of social cohesion and trust had higher odds of obesity

Conclusions: Living in unsafe and non-supportive neighborhoods may be associated with overweight and obesity among US children and adolescents. Longitudinal studies, accounting for race/ethnicity, are needed to examine the importance of social context where children and adolescents live. *Ethn Dis.* 2016;26(4):469-476; doi:10.18865/ed.26.4.469.

Keywords: Obesity; Children; Adolescents; Neighborhood Safety; Neighborhood Support; United States

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(OR:1.47, with odds higher for girls [OR:1.65] than for boys [OR:1.35]).⁴ However, the same study did not find an association between neighborhood safety and obesity.⁴ In contrast, other studies have found neighborhood safety to be associated with increased BMI z-score, overweight and obesity.^{8,10,12} For instance, Bacha et al found that perceived neighborhood safety was a predictor of BMI z-scores among 5th graders. However, when sex was accounted for, this as-

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sociation was only observed among girls.⁸ Taken together, this evidence suggests that age and sex may modify these associations. However, race/ethnicity has not been investigated as a moderator of these associations.

Despite the different specifications of neighborhood safety and support across studies,⁴⁻¹¹ it could be hypothesized that perception of safe and supportive neighborhoods may: a) decrease obesity by encouraging parents to allow their children to

spend more time outside, leading to increased physical activity and less indoor sedentary behaviors such as television viewing; and b) add norms to influence and control unhealthy behaviors (eg, poor diet) related to obesity.¹³⁻¹⁶ Therefore, our study investigates the association of neighborhood safety and support with overweight and obesity after controlling for selected characteristics including physical activity and sedentary activities. We further examined whether these associations vary with age, sex, and race/ethnicity among US children and adolescents aged 10 to 12 years.

METHODS

Data Source

Our study used data from the 2011-2012 National Survey on Children's Health (NSCH), which was a representative sample of children in 50 states and the District of Columbia.¹⁷ The NSCH is a telephone survey conducted by the National Center of Health Statistics, Centers for Disease Control and Prevention, under the direction and sponsorship of the Department of Health and Human Services and the Maternal and Child Health Bureau, Health Resources and Services Administration.¹⁷ The survey collected information between February 2011 and June 2012 from households with at least one child aged 0 to 17 years at the time of the interview (N=95,677 children). A complex sampling design was used to cluster children within households with stratification by state and sample type (landline and cell phone). The interviews were conducted in Eng-

lish, Spanish, Mandarin, Cantonese, Vietnamese, and Korean. Surveys were mostly completed by mothers (68.6%) and fathers (24.2%). The survey had completion rates of 54.1% for the landline sample and 41.2% for the cell-phone sample.¹⁸

Variables

The dependent variable was body mass index (BMI), calculated using information reported by parents on weight and height and using the Centers for Disease Control and Prevention age-sex growth chart.¹⁹ BMI was defined by NSCH as: underweight or below the 5th percentile (%); healthy weight or between 5th and 84th%; overweight or between 85th and 94th%; and obese or at or above the 95th%. For analytical purposes, overweight was specified as a BMI percentile ≥ 85 th% and obesity as ≥ 95 th%. Because parents underestimated height in younger children leading to overestimation of overweight in the 2003 NSCH, BMI has been calculated only for children and adolescents aged 10 to 17 years since the 2007 NSCH.²⁰

The independent variables were neighborhood safety⁵ and neighborhood support.²¹ Neighborhood safety was derived from the following survey question "How often do you feel (child name) is safe in your community or neighborhood?" with answers of never, sometimes, and usually/always safe for children. Neighborhood safety was combined by NSCH into two categories: never/sometimes safe (no) and usually/always safe (yes). Neighborhood support, a construct capturing social cohesion, trust and reciprocity,^{4,13,21} was derived

by NSCH from the following statements: 1) "People in my neighborhood help each other out"; 2) "We watch each other's children in this neighborhood"; 3) "There are people I can count on in this neighborhood"; and 4) "If my child were outside playing and got hurt or scared, there are adults nearby who I can trust to help my child." Response options used a 4-point Likert scale from 1 (strongly agree) to 4 (strongly disagree). If at least three of these questions had valid responses, NSCH calculated the mean to classify neighborhoods as supportive if the mean score was between 1 and <2.25, and non-supportive if it was between ≥ 2.25 and ≤ 4.00 .²²

Previous studies^{4,12} have identified characteristics such as age, sex, race/ethnicity, physical activity, daily amount of time of sedentary activities, asthma, education and poverty as confounders of the association between neighborhood characteristics and obesity. The child's age was recorded as a continuous variable and was further categorized in two groups 10-13 and 14-17 years. Sex was specified as male and female. Race/ethnicity was collected through two questions, one for ethnicity and one for race. Ethnicity was recoded as Hispanic or not. Respondents who answered 'no' to the ethnicity question were allowed to identify all possible categories that described the race of the child. If a race other than one of the seven categories provided by NSCH (White, Black or African American, American Indian, Alaska Native, Asian, Native Hawaiian, Pacific Islander) was indicated, a verbatim response was written.^{22,23} NSCH used this information to develop several definitions for race/

ethnicity. For analysis purposes, we used race/ethnicity specified as non-Hispanic White, African American or non-Hispanic Black, Hispanic, and multiracial/other non-Hispanic.

Physical activity information was collected among children aged 6 through 17 years through the question, "During the past week, how many days did (child name) exercise, play a sport, or participate in physical activity for at least 20 minutes that made (him/her) sweat and breathe hard?" The responses were classified into four categories by NSCH as: 0 days, 1-3 days, 4-6 days, and every day. Daily time spent on sedentary activities was derived by NSCH from the question: "On an average weekday, about how much time does [child name] usually spend in front of a TV watching TV programs, videos, DVDs, or playing video games?" and categorized as 1 hour or less, more than 1 hour but less than 4 hours, and 4 hours or more per day. Current asthma was specified using the following questions: "Has a doctor or other health care provider ever told you that (child) had asthma?" and "Does (child) currently have asthma?" If yes was answered to both questions, the child was considered to have asthma and without asthma otherwise.

Education of the parents or guardian was derived from NSCH using the question "What was the highest grade or year of school completed by child's mother, father or guardian?" The answers were categorized as less than high school, high school graduate and more than high school. Poverty level in the household was based on the Department of Health and Human Services (DHHS) guide-

lines;⁴ <100% Federal Poverty Level (FPL); 100%-199% FPL; 200%-399%; and $\geq 400\%$ FPL, with lower level of FPL indicating the poorest household. Because of the number of missing values, the imputed files for poverty were used for the analyses.¹⁷

The analysis was limited to children and adolescents aged 10 to 17 years for whom BMI information was collected (n=43,864 records). We excluded records with missing information on neighborhood support (n=859), neighborhood safety (n=57), education (n=1,628), physical activity (n=250), race/ethnicity (n=253), and asthma (n=87). These exclusions yielded an analytical sample of 40,730.

Statistical Analyses

Descriptive statistics for selected characteristics were calculated for the total population and according to neighborhood safety and support. The prevalence estimates of overweight and obesity were also calculated. Chi-square tests of independence were used to determine significant associations of each covariate with each outcome.

We used log-binomial regression to estimate prevalence ratios (PR) for the effect of neighborhood safety and support on overweight among children and adolescents before and after adjusting for selected variables. This analysis was repeated for obesity. In addition to the unadjusted PR, three models were fitted: 1) adjusted for age, sex, race/ethnicity (Model 1); 2) additionally adjusted by parents or guardian education and poverty (Model 2); 3) further adjusted for asthma (Model 3); and finally, 4) additionally adjusted for physical activity and sedentary activity (Model 4).

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To determine whether the associations of neighborhood support and safety with overweight and obesity differ by age, sex and race/ethnicity, interaction terms of neighborhood

support and neighborhood safety with each one of these covariates were tested in the fully-adjusted models.

Data management procedures were carried out using SAS 9.4 (SAS

Institute Inc., Cary, NC) whereas the statistical analyses were conducted using SUDAAN 11.0.1 (RTI, Research Triangle Park, NC) to account for the complex sampling design and yield

Table 1. Distribution and prevalence of overweight and obesity for selected characteristics among US children and adolescents aged 10-17 years: 2011-2012 NSCH

Characteristics	Total, N=40,730, % (SE)	Prevalence			
		Overweight, n=11,649, % (SE)	P ^a	Obesity, n=5,646, % (SE)	P ^b
Overall prevalence		30.7 (.54)		15.1 (.43)	
Age, years			<.001		<.001
10-13	49.0 (.57)	35.6 (.79)		18.2 (.66)	
14-17	51.0 (.57)	25.9 (.73)		12.0 (.55)	
Sex			<.001		<.001
Male	51.4 (.57)	33.8 (.76)		17.6 (.62)	
Female	48.6 (.57)	27.4 (.76)		12.4 (.60)	
Race/ethnicity			<.001		<.001
Non-Hispanic White	58.3 (.59)	25.9 (.56)		11.9 (.42)	
African American	13.9 (.39)	40.3 (1.50)		21.3 (1.24)	
Hispanic	18.5 (.56)	39.4 (1.78)		21.3 (1.52)	
Multi/other non-Hispanic	9.3 (.35)	28.5 (1.74)		12.7 (1.27)	
Parent or guardian education			<.001		<.001
<12	21.1 (.55)	40.0 (1.53)		22.1 (1.33)	
12	34.4 (.52)	32.7 (.85)		16.7 (.71)	
>12	44.5 (.56)	24.6 (.68)		10.5 (.47)	
Poverty			<.001		<.001
0-99% FPL	16.6 (.46)	44.5 (1.55)		26.7 (1.43)	
100-199% FPL	20.7 (.51)	36.6 (1.38)		17.9 (1.09)	
200-399% FPL	30.5 (.51)	28.7 (.92)		13.3 (.70)	
≥400% FPL	32.2 (.50)	21.5 (.74)		8.8 (.51)	
Weekly physical activity, days			.004		.001
0	9.8 (.36)	33.8 (1.79)		19.7 (1.56)	
1-3	26.5 (.50)	33.0 (1.05)		16.3 (.82)	
4-6	40.4 (.56)	29.7 (.83)		14.1 (.66)	
Everyday	23.3 (.49)	28.4 (1.16)		13.3 (.92)	
Daily time sedentary activities, hours			<.001		<.001
0	5.9 (.29)	24.7 (2.59)		11.5 (1.93)	
<1	38.3 (.56)	26.3 (.86)		11.5 (.63)	
1-<4	42.1 (.56)	32.6 (.81)		16.4 (.67)	
≥4	13.7 (.40)	39.3 (1.53)		22.0 (1.36)	
Asthma			.0001		<.001
Yes	18.4 (.43)	34.9 (1.19)		18.6 (0.95)	
No	81.6 (.43)	29.7 (.61)		14.2 (0.49)	
Neighborhood safety			<.001		<.001
No	11.4 (.44)	41.8 (2.10)		24.9 (2.01)	
Yes	88.6 (.44)	29.2 (.54)		13.8 (.40)	
Neighborhood support			<.001		<.001
No	15.1 (.44)	41.3 (1.62)		21.4 (1.41)	
Yes	84.9 (.44)	28.8 (.56)		13.9 (.44)	

a. Chi-square of independence for the association of each covariate with overweight.

b. Chi-square of independence for the association of each covariate with obesity.

Table 2. Unadjusted and adjusted prevalence ratios (95%CI)^a for neighborhood safety and support on overweight and obesity for US children and adolescents aged 10-17 years: 2011-2011 NSCH

Neighborhood characteristics	Overweight				
	Unadjusted	Model 1	Model 2	Model 3	Model 4
Safety					
Yes	1.00	1.00	1.00	1.00	1.00
No	1.43 (1.29, 1.59)	1.26 (1.13, 1.41)	1.14 (1.01, 1.28)	1.14 (1.01, 1.28)	1.12 (0.99, 1.27)
Support					
Yes	1.00	1.00	1.00	1.00	1.00
No	1.43 (1.32, 1.56)	1.32 (1.21, 1.45)	1.22 (1.11, 1.34)	1.22 (1.11, 1.34)	1.21 (1.10, 1.33)
Safety					
Yes	1.00	1.00	1.00	1.00	1.00
No	1.81 (1.53, 2.14)	1.53 (1.29, 1.83)	1.32 (1.10, 1.58)	1.31 (1.09, 1.58)	1.30 (1.08, 1.56)
Support					
Yes	1.00	1.00	1.00	1.00	1.00
No	1.54 (1.33, 1.77)	1.36 (1.17, 1.59)	1.21 (1.03, 1.41)	1.20 (1.03, 1.40)	1.18 (1.01, 1.38)

a. Crude association of BMI categories; prevalence ratios adjusted for age, sex, race/ethnicity (Model 1); additionally adjusted by parent or guardian education and poverty (Model 2); further adjusted for asthma (Model 3); and finally, additionally adjusted for physical activity and sedentary activities (Model 4).

unbiased standard error estimates. Sample sizes presented in Table 1 were unweighted, but all other estimates (proportions, standard errors [SE], PRs and their 95% confidence intervals [CIs]) were weighted.

RESULTS

Overall distribution of selected characteristics and the prevalence of overweight and obesity for the population are presented in Table 1. Children and adolescents who participated in 2011 NSCH were more likely to be aged 14-17 years, male, non-Hispanic White, had parents or guardian with more than a high school education, and lived in households at or above 200% of the FPL. Moreover, more than half of children and adolescents were physically active at least 4 days per week but had daily sedentary activities of at least 1 hour. Parents and guardians reported that 18.4% of children and adolescents

had asthma. Finally, parents rated their neighborhoods as safe (88.6%) and supportive (84.9%). Approximately 30.7% of children and adolescents were overweight and 15.1% were obese. The prevalence of overweight and obesity was greater among children who were: aged 10-13 years; male; Hispanic and African American; living with a parent or guardian with less than a high school education; living below 99% of the FPL; non-physically active and having higher daily sedentary time; and reporting asthma (all P<.01). These prevalence estimates were also higher among those living in unsafe and non-supportive neighborhoods (all P<.001).

When compared with US children and adolescents living in safe and supportive neighborhoods, the probabilities of being overweight were 1.43 (95% CI:1.29-1.59) and 1.43 (95%CI: 1.32-1.56) greater among children and adolescents living in unsafe and non-supportive neighborhoods, respectively (Table

2). After controlling for age, sex and race/ethnicity, these associations were attenuated but remained significant (PR: 1.26 [95%CI: 1.13-1.41] for unsafe and 1.32 [95%CI: 1.21-1.45] for non-supportive neighborhoods). These estimates were further attenuated after controlling for parents or guardian education and poverty level (Model 2) and asthma (Model 3). When additionally controlling for physical activity and sedentary time, the association between neighborhood safety and overweight was no longer significant (Model 4). However, children and adolescents living in non-supportive neighborhoods had a 21% (95%CI: 1.10-1.33) higher probability of being obese than their peers living in supportive neighborhoods after controlling for all covariates.

The probabilities of obesity associated with neighborhood safety and support were 1.81 (95%CI:1.53-2.14) and 1.54 (95%CI:1.33-1.77), respectively. These associations remained significant regardless of the

Table 3. Adjusted prevalence ratios^a (95% CIs) for neighborhood support on overweight and obesity according to race/ethnicity for US children and adolescents aged 10-17 years: 2011-2011 NSCH

	Overweight			
	Non-Hispanic White	African American	Hispanic	Multi/other non-Hispanic
Neighborhood Support				
Yes	1.00	1.00	1.00	1.00
No	1.29 (1.14, 1.46)	.93 (.78, 1.12)	1.31 (1.08, 1.59)	1.21 (.91, 1.60)
	Obesity			
Neighborhood Support				
Yes	1.00	1.00	1.00	1.00
No	1.48 (1.22, 1.80)	.80 (.61, 1.05)	1.22 (.88, 1.69)	1.09 (.74, 1.60)

a. Prevalence ratios adjusted for age, sex, parent and guardian education, poverty, asthma, physical activity and sedentary activities.

covariates controlled for. However, the greatest attenuation was observed when controlling for age, sex, race/ethnicity, parents or guardian education and poverty level (1.31 [95%CI: 1.09-1.57] for safety and 1.21 [95%CI: 1.04-1.41] for support; Model 2). In the fully-adjusted model, the probabilities of obesity associated with neighborhood safety and support were 1.30 (95%CI:1.08-1.56) and 1.18 (95%CI:1.01-1.38), respectively. We included both neighborhood safety and support in the final models for overweight and obesity and the estimates remain nearly identical to the ones in Table 2 in terms of significance and strengths of the associations (data not shown).

No heterogeneity of the associations of neighborhood safety and support with overweight and obesity were observed for age and sex (P for interactions \geq .10). However, heterogeneity was observed for race/ethnicity for the associations of neighborhood safety and support with overweight and obesity (P for interac-

tions=.03 and .001, respectively). For non-Hispanic White children and adolescents, when compared with living in a supportive neighborhood, living in a non-supportive neighborhood was associated with 29% (95%CI: 1.14, 1.46) and 48% (95%CI: 1.22, 1.80) greater probabilities of being overweight and obese, respectively. Similarly, among Hispanic children and adolescents, the probability of being overweight was 1.31 (95%CI: 1.08, 1.59) times higher among those living in a supportive neighborhood compared with their counterparts living in non-supportive neighborhoods. These associations were not observed among African American and multiracial/other non-Hispanic children and adolescents. (Table 3)

DISCUSSION

Our study found that among children and adolescents who participated in the 2011-2012 NSCH, living in an unsafe neighborhood was as-

sociated with a greater probability of being obese regardless of sex, age and race/ethnicity. Moreover, living in a non-supportive neighborhood was associated with a higher probability of being overweight and obese when compared with their peers living in supportive neighborhoods in fully-adjusted analyses. However, the association between neighborhood support and overweight was only observed among non-Hispanic White and Hispanic children and adolescents; whereas for neighborhood support and obesity, the association was found only among non-Hispanic Whites.

Previous studies^{4-8,10-12} examining the association of neighborhood safety with BMI z-score, overweight and obesity have yielded mixed results, with most evidence reporting an association.^{6,8,12} These associations have been observed in children aged 3 to 15 years using different specifications of neighborhood safety. For example, Lovasi et al found that homicide rate within 1 kilometer in any direction was associated with both higher BMI z-score and prevalence of obesity among New York City children aged 3 to 5 years.¹² Our findings showed a positive association between neighborhood safety and obesity among children and adolescents aged 10 to 17 years, even after controlling for age, sex, race/ethnicity, parents or guardian education, poverty, asthma, physical activity and amount of time spent in sedentary activities. In addition, this association was observed regardless of age, sex and race/ethnicity. We did not find an association between neighborhood safety and overweight.

In contrast to neighborhood

safety, studies investigating the effect of neighborhood support on BMI, overweight and obesity have shown consistent results of positive association between non-supportive neighborhoods and these outcomes.^{4,6,9} Consistent with these studies, we found in adjusted analyses that lack of neighborhood support was associated with greater probabilities of being overweight and obese among 2011-2012 NSCH participants. However, these associations vary with race/ethnicity: lack of neighborhood support was associated with higher

Our findings showed a positive association between neighborhood safety and obesity among children and adolescents aged 10 to 17 years

probability of overweight among non-Hispanic White and Hispanic children and adolescents whereas the probability of being obese was only greater among non-Hispanic White children living in non-supportive neighborhoods. Consistent with previous studies,²⁴⁻²⁶ African Americans and Hispanics live in neighborhoods with similar safety and support but their neighborhoods are worse than non-Hispanic Whites. However, although we found a significant difference in overweight and obesity according to neighborhood safety and support for Hispanics and non-

Hispanic Whites, this was not the case for African Americans (data not shown). The latter suggests that overweight and obesity may be influenced by factors other than neighborhood safety and support for African American children and adolescents.

Among the strengths of this study is the use of a nationally representative dataset with a large sample, which allowed us to control for potential confounders and examine effect measure modifiers. However, the study has some limitations that should be mentioned. Due to the cross-sectional nature of the NSCH, we cannot establish a temporal relationship between the exposure and outcome. In addition, the use of parental report of their child's weight and height may result in the underestimation of BMI.²⁷ However, parental report has been considered an accurate indicator of obesity among adolescents.²⁸ We compared our estimates with those of children and adolescents aged 12 to 19 years who participated in the National Health and Nutrition Examination Surveys (NHANES) 2011-2012. Our prevalence estimates of overweight (30.7%) and obesity (15.1%) were lower than those of NHANES 2011-2012 (34.7%¹ and 20.5%,² respectively). However, NHANES 2011-2012 did not collect information on neighborhood conditions. Thus, our results may be under- or over-estimating the true associations. Finally, information on diet was not collected by NSCH. The latter may have been important to understand the lack of association of neighborhood safety and support with childhood overweight and obesity among African Americans.

CONCLUSIONS

Our findings suggest that neighborhood safety and support may be important in preventing overweight and obesity in children and adolescents. These findings call attention to the need for longitudinal studies to examine the importance of social context in which children and adolescents live while also accounting for race/ethnicity. Such studies could provide evidence to design programs and interventions to prevent and reduce childhood overweight and obesity.

CONFLICT OF INTEREST

No conflicts of interest to report.

AUTHOR CONTRIBUTIONS

Research concept and design: Borrell; Acquisition of data: Borrell, Graham; Data analysis and interpretation: Borrell, Graham, Joseph; Manuscript draft: Borrell, Graham, Joseph; Statistical expertise: Borrell; Administrative: Graham, Joseph

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