# The Epidemiology of Overweight and Related Lifestyle Behaviors

## Racial/Ethnic and Socioeconomic Status Differences Among American Youth

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**Background:** Differences in the prevalence of youth at or above the 85th percentile of age- and gender-adjusted body mass index (BMI) by race/ethnicity and socioeconomic status were examined among youth in 8th and 10th grades. The possible role of a number of lifestyle behaviors and family/parenting factors in explaining these differences was then explored.

**Methods:** Cross-sectional survey data were used from nationally representative samples in the Monitoring the Future study from 1998 to 2003 (N=39,011 students). Data were analyzed in 2006.

**Results:** Minority, low-income males, and male youth were more likely have a BMI at or above the 85th percentile. Frequency of eating breakfast, eating fruits and vegetables, and exercising regularly were inversely associated with being at or above the 85th percentile. The number of hours youth spend per week watching television was positively associated with being at or above the 85th percentile. These lifestyle behaviors proved more important than the family/parenting variables examined.

**Conclusions:** The overrepresentation of youth at risk of overweight or overweight among racial/ethnic minority and low-income populations mimics the excess morbidity of overweight and obesity-related health conditions in these same populations. Differences in lifestyle behaviors and family characteristics might help to explain these subgroup differences starting at an early age. While there is growing need to modify these behaviors in the population at large, the need is greatest among minorities and low-socioeconomic status youth.

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## Introduction

Recent trends in overweight and obesity and related lifestyle behaviors indicate that more youth have become overweight and at risk for overweight and that many more engage in detrimental behaviors that are potentially linked to the current overweight and obesity epidemic.[1–5] Being overweight substantially and negatively impacts the present and future health of American youth.[6–11] Regrettably, the burden of disease is likely to fall more heavily on racial/ethnic minority youth and low-income populations because of the overrepresentation of being overweight in these populations.[12–15]

To enhance an understanding of the epidemiology of overweight among American youth, the present study investigates differences in the prevalence of overweight and of being at risk for overweight among white, black, and Hispanic youth by socioeconomic status (SES). The extent to which the associations among overweight, race/ethnicity, and SES are accounted for by differences in lifestyle behaviors that may be associated with obesity are also examined.[16–19] Prior research has found, for example, that youth from low-income families tend to eat fewer fruits and vegetables,[16] and that African-American youth spend more time watching television than white youth.[19] Also, in light of prior research documenting the importance of family-related factors in relation to risk of overweight,[5] it is also hypothesized that reduced parental supervision, as measured by the number of hours youth spend alone after school, is associated with increased risk of overweight. For example, less parental supervision after school may result in youth spending more time watching television or playing video games, snacking on foods high in fat and calories, not being provided with transportation to participate in after-school

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sports programs, and overall being more sedentary.[20] In turn, these differences in parental supervision may account for overweight differences between racial/ethnic groups and SES.[21]

Among minors, overweight is defined as being at or above the 95th percentile based on an age- and gender-adjusted body mass index (BMI), while being at risk for overweight is defined as being between the 85th and 95th percentile on the same scales. The current study examines whether the percentage of students who are at or above the 85th percentile (that is being at risk of overweight or overweight) differs by race/ethnicity and SES, controlling for population density, region, and the frequency with which students eat breakfast, fruits, and vegetables; get seven hours of sleep each night; exercise vigorously; and watch television; hereafter referred to as lifestyle behaviors. Whether the percentage of youth at or above the 85th percentile differs by race/ethnicity and SES is also examined controlling for the number of hours they spend after school each day at home with no adult present, whether or not they live with both parents, and whether the students' mothers have paid jobs, hereafter referred to as family/parenting variables. The study is based on large national representative samples of 8th and 10th graders living in the United States.

## Methods

### Sample

Data are utilized from 1998–2003 for 8th- and 10th-grade students who participated in the University of Michigan's Monitoring the Future project. Data for 12th-grade youth are not included in this study because several variables under investigation are not asked in the same format of a multiple-forms questionnaire, precluding multivariate analyses with all relevant variables. Data were analyzed in 2006.

The design and methods are summarized briefly below; a detailed description is available elsewhere.[22,23] The study employs a multistage sampling design to obtain nationally representative separate samples of 8th- and 10th-grade students from the 48 contiguous states, collected annually since 1991. The annual sampling procedures involve three stages[24]: (1) geographic regions are selected; (2) schools are randomly selected with probability proportionate to size (approximately 290 each year); and (3) roughly 31,000 to 33,000 students are sampled from within those schools. Sample weights are assigned to each student to take into account variations in selection probabilities that occur at the various stages of sampling. From 1991 to 2004, an average of 55% of the original schools agreed to participate, and either an original school or a replacement school was obtained in 98% of the sample units, or "slots." Students complete a self-administered, machine-readable questionnaire during a normal class period. Student response rates average 90% for 8th graders and 86% for 10th graders. Absence on the day of data collection was the primary reason that students were missed.

### Measures

**Overweight.** Data on weight and height are based on students' self-reports. These data were used to calculate BMI by dividing weight (in kilograms) by height (in meters) squared (weight/height$^2$). Then, age- and gender-specific growth curves produced by the Centers for Disease Control and Prevention (CDC) were used to create the "at risk of overweight" or "overweight" category, defined here as a youth whose BMI was greater than or equal to the 85% percentile.[25,26] These growth curves were normed on data from several national health examination surveys conducted by the National Center for Health Statistics between 1963 and 1994.

**Eating behaviors.** Three separate questions meant to be indicative of the frequency of healthy eating behaviors were measured in the present study: How often do you eat breakfast? How often do you eat at least some green vegetables? and How often do you eat at least some fruit? The response categories were: (1) never, (2) seldom, (3) sometimes, (4) most days, (5) nearly every day, and (6) every day. A composite score was created by summing the students' responses to these questions with scores ranging from 3 to 18. Chronbach's alpha was 0.71 for girls and 0.75 for boys.

**Exercise behaviors.** A variable on frequency of exercising was created using the following question: How often do you exercise vigorously (jogging, swimming, calisthenics, or any other active sports)? The response categories were the same as for eating behaviors.

**Sleeping behaviors.** The question, How often do you get at least 7 hours of sleep? had the same answer scale as the eating behaviors questions.

**Television viewing.** The average number of hours that youth watch television in a week was determined based on the following two questions: How much TV do you estimate you watch on an average WEEKDAY? and How much TV do you estimate you watch on an average WEEKEND (both Saturday and Sunday combined)? The number of hours youth watch TV in a week (5 days) and weekend were added and could range from none to over 34 hours. The total was divided by seven to obtain the average number of hours youth watch TV in a given day.

**Parenting-related variables.** Three variables were included: The first variable was the number of hours youth spend after school each day at home with no adult present, counting the hours between the end of school and the time when the youth goes to bed. The response categories were none or almost none, less than 1 hour, 1–2 hours, 2–3 hours, 3–5 hours, and >5 hours. Also included was a dichotomous variable that measured whether or not youth lived with both parents and a variable that measured whether the students' mothers have paid jobs. The response categories were no, yes, part-time job, and full-time job.

**Demographic characteristics.** Gender was measured by the question What is your sex? with the following response categories: 1=male, 2=female. Race/ethnicity was measured by the question How do you describe yourself? For the present study, three groups were distinguished: (1) white, (2) black or African American, and (3) Hispanic; all other youth were excluded from the analyses due to inadequate

sample sizes for the proposed analyses. Parental education (as a proxy for SES) was defined as an average of father's and mother's educational attainment (with one missing data case permitted). Educational attainment for each parent was coded as follows: 1=completed grade school or less, 2=some high school, 3=completed high school, 4=some college, 5=completed college, 6=graduate or professional school after college. An ordinal measure of parental education, which serves as a proxy for SES, was created. However, the relationship between SES and the dependent variable overweight was not linear for black and Hispanic youth. These analyses indicated that a linear term would not capture the interaction between the race/ethnicity and SES variables. Thus, an SES variable with three levels—low, mid, and high—was created. Low SES corresponded to neither (or the only) parent having no more than a high school degree. High SES corresponded to both parents having a college degree. (No one-parent families were coded as high SES.) Remaining students were coded as having mid SES. Subsequently, nine dummy-coded variables were created to capture all the interactions between the three racial/ethnic groups and three levels of SES. Preliminary analyses revealed that the prevalence of overweight and obesity tended to be lowest among white youth of high SES; therefore, this group was defined as the reference category for analysis purposes.

Population density was determined by the U.S. Census Bureau's classification of the area in which the school is located: within a large metropolitan statistical area (MSA), other metropolitan statistical area, or nonmetropolitan statistical area. Region is determined by the geographic region of the country where the school is located (i.e., Northeast, North Central, South, and West).

### Analyses

In prior work, it was noted that the prevalence of youth at or above the 85th percentile varied by gender[1,27]; therefore, all analyses were conducted separately for boys and girls. Preliminary analyses indicated that there were no meaningful differences by grade in the prevalence of youth at or above the 85th percentile and in the associations between variables. Therefore, all analyses are based on the 8th- and 10th-grade data combined.

The bivariate association between each predictor and the dependent variable, youth at or above the 85th percentile, was estimated first, followed by multivariate logistic regression analyses to test three different models. Models 1 and 2 examined changes in the bivariate associations between race/ethnicity by SES categories and the dependent variable when the lifestyle behaviors and parenting-related variables were entered, respectively. Model 3 was the full model that includes all the variables in the study. Changes in odds ratios and 95% confidence intervals were examined across models to assess changes in the potential associations between sets of independent variables and the dependent variable. Also, because Models 1 and 2 were nested within the Full Model, the chi-square statistic was used to compare improvements in model fit. All analyses adjust for grade level and year in which the survey took place.

All analyses were conducted with the Stata 8.0 statistical program to weight the data to permit generalizations to the general population of youth and to take into account the design effects in calculating standard errors resulting from the complex sampling design of the study.

## Results

### Sample Characteristics

Table 1 provides the numbers of cases for the demographic variables separately for each gender and the percentage of youth in the various categories who are at or above the 85th percentile. Across the 6 years, 1998–2003, there were a total of 39,011 participants completing the relevant questionnaire forms, 20,913 girls and 18,098 boys. The sample of youth was approximately 75% white, 13% black, and 12% Hispanic. The percent of students who are of low, mid, and high SES was approximately 15%, 58%, and 27%, respectively. Across all studied years, nearly 25% of youth were at or above the 85th percentile. Although comparable data from other national studies are not available, the percent of boys and girls in 10th grade who are at or above the 85th percentile was compared with data from the 2003 CDC Youth Risk Behavior Survey (YRBS). In the present study, the percent of boys and girls in 10th grade who were at or above the 85th percentile were 30.4% and 23.5%, respectively. The corresponding percents for boys and girls in 10th grade in the YRBS study were 30.3% and 23.0%, respectively.

Figure 1 shows the percentage of students at or above the 85th percentile by measure of race/ethnicity and SES. It indicates that higher percentages are found among boys, minority youth, and youth of lower SES. Table 1 indicates that for boys, there is a significantly greater proportion of youth at or above the 85th percentile living in nonmetropolitan areas and in the South.

### Bivariate Results

For girls, the odds ratios associated with being at or above the 85th percentile were significantly higher for all race/ethnicity by SES interactions when compared to white girls of high SES (see Table 2). Being at or above the 85th percentile was inversely associated with healthy eating, sleeping, and exercise frequency, and positively associated with the number of hours youth watched TV per day. Being at or above the 85th percentile was also positively associated with the number of hours youth spent at home with no adult present and inversely with living with both parents. Also, slightly more youth who live in the South were at or above the 85th percentile.

The findings for boys were similar to those for girls, with the exception that the number of hours they spent at home after school with no adult present was not associated with being at or above the 85th percentile, and there were no significant regional differences (see Table 2). However, boys who live in nonmetropolitan areas had a significantly higher odds ratio associated

**Table 1.** Percentage of youth at or above the 85th percentile by demographic characteristics among 8th- and 10th-grade students: MTF 1998–2003

| Characteristic | N | % at or above 85th percentile | Significance level[a] |
|---|---|---|---|
| **TOTAL** | 39,011 | 24.9 | * |
| **GIRLS** | 20,913 | 20.3 | |
| **Grade level** | | | |
| 8th | 9,857 | 20.7 | |
| 10th | 11,056 | 20.0 | |
| **Race/ethnicity by SES** | | | *** |
| White of high SES | 4,641 | 11.9 | |
| White of mid SES | 9,147 | 17.7 | |
| White of low SES | 1,791 | 26.7 | |
| Black of high SES | 534 | 25.7 | |
| Black of mid SES | 1,841 | 34.6 | |
| Black of low SES | 548 | 29.8 | |
| Hispanic of high SES | 261 | 18.8 | |
| Hispanic of mid SES | 1,138 | 25.0 | |
| Hispanic of low SES | 1,012 | 30.7 | |
| **Population density** | | | |
| Large MSA | 6,504 | 19.9 | |
| Other MSA | 9,703 | 20.1 | |
| NonMSA | 4,706 | 21.2 | |
| **Region** | | | |
| Northeast | 4,403 | 19.2 | |
| North Central | 5,387 | 19.7 | |
| South | 7,511 | 21.9 | |
| West | 3,612 | 19.2 | |
| **BOYS** | 18,098 | 30.1 | |
| **Grade level** | | | |
| 8th | 8,510 | 29.8 | |
| 10th | 9,588 | 30.3 | |
| **Race/ethnicity by SES** | | | *** |
| White of high SES | 4,527 | 21.3 | |
| White of mid SES | 8,018 | 30.7 | |
| White of low SES | 1,269 | 37.6 | |
| Black of high SES | 517 | 31.1 | |
| Black of mid SES | 1,423 | 34.0 | |
| Black of low SES | 295 | 33.0 | |
| Hispanic of high SES | 262 | 32.5 | |
| Hispanic of mid SES | 1,048 | 38.5 | |
| Hispanic of low SES | 739 | 40.3 | |
| **Population density** | | | ** |
| Large MSA | 5,448 | 28.9 | |
| Other MSA | 8,494 | 29.5 | |
| NonMSA | 4,156 | 32.3 | |
| **Region** | | | ** |
| Northeast | 3,791 | 30.1 | |
| North Central | 4,711 | 28.0 | |
| South | 6,430 | 31.9 | |
| West | 3,166 | 29.5 | |

[a]Indicates if differences in percent of youth at or above the 85th percentile among the response categories of each variable are statistically significant.
*$p<0.05$; **$p<0.01$; ***$p<0.001$.
MTF, Monitoring the Future; MSA, metropolitan statistical area; SES, socioeconomic status.

with being at or above the 85th percentile when compared to those who live in large cities.

## Multivariate Results

A comparison of the results of Models 1 (demographic variables plus lifestyle behaviors) and 2 (demographic variables plus parenting variables) shows that inclusion of the lifestyle behaviors variables reduced the magnitude of the association between being at or above the 85th percentile and race/ethnicity by the SES variable more than did the parenting variables (Table 2, Models 1 and 2). The coefficient for the "black/low SES" group of boys became nonsignificant when lifestyle behaviors were entered in the model (see Table 2, Model 1). In part, this is due to a loss of power to detect significant differences resulting from the small number (N = 295) of low-income black boys in the sample. For girls, all coefficients of the association between being at or above the 85th percentile and race/ethnicity and SES variables remained statistically significant. In subsequent analyses, the lifestyle variables—frequency of eating, exercising, and TV viewing—were identified as the variables that accounted for most of the reductions in the associations of race/ethnicity and SES with being at or above the 85th percentile between models among both boys and girls. The variables region and population density did not have an effect.

For girls, the exercise and TV-viewing variables remained significantly associated with being at or above the 85th percentile in the multivariate context, while eating and sleeping variables became nonsignificant (see Table 2, Model 1). Among boys, all lifestyle behaviors remained significantly associated with being at or above the 85th percentile, though the magnitude of the association decreased.

In the multivariate context, only one of the parenting variables that was significantly associated with being at or above the 85th percentile in the bivariate analyses remained significant. Specifically, girls living with both parents remained significantly less likely to be at or above the 85th percentile (see Table 2, Model 2).

In the full model, where both the lifestyle behaviors and parenting variables were included, the magnitude of the associations between being at or above the 85th percentile and the race/ethnicity by SES variable decreased slightly for both boys and girls when compared to the model that included lifestyle behaviors only. The attenuation of the magnitude of the association between being at or above the 85th percentile and race/ethnicity by SES variables between the bivariate and the full model is shown in Figure 2. It can also be observed that the odds ratios are approximately linearly associated with socioeconomic status among white youth and female Hispanics, but not black youth and male Hispanics.

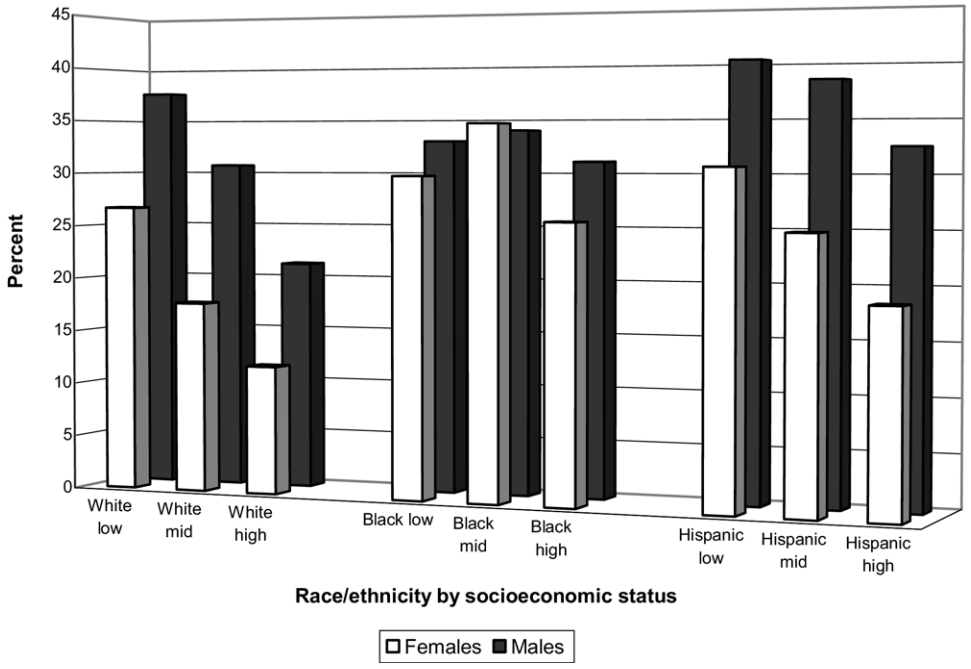


**Figure 1.** Percentage of students at or above the 85th percentile, 8th and 10th grades, by race/ethnicity and socioeconomic status.

Finally, because Models 1 and 2 are nested within the Full Model, it was possible to test differences in the chi-square statistics of the Full Model with Models 1 and 2. Among female students, the Full Model accounts for variation in being at or above the 85th percentile better than Model 1 ($\chi^2$ difference=37.5, df difference=4, $p<0.001$) and Model 2 (difference in $\chi^2$=321.19, difference in df=4, $p<0.001$) (see Table 2). However, among boys, the Full Model accounts for variation in being at or above the 85th percentile better than Model 2 (difference in $\chi^2$=253.44, difference in df=4, $p<0.001$) but not Model 1 (difference in $\chi^2$=2.14, difference in df=4, $p>0.05$) (see Table 3). This finding suggests that for boys, adding the family/parenting variables did not contribute information that helped account for variation in the dependent variable.

## Discussion

A consistent pattern of more black and Hispanic youth being at or above the 85th percentile than white youth was found at every SES level, with only one exception (a slightly lower percentage of black boys of low SES at or above the 85th percentile than white boys of low SES at or above the 85th percentile). These findings are consistent with prior research that has found some health outcomes of educated African Americans to be of lower quality than that of equally educated whites, and to be very similar to that of whites with little or no education.[28] In the present study, evidence is provided of the importance of the individual's social location, the manifestation of health disparities at an early age, the identification of lifestyle behaviors, and parenting (primarily for girls) that can potentially influence the likelihood of youth becoming at risk of overweight or overweight. Clearly, racial/ethnic and SES differences in morbidity and mortality result from the complex interplay of multiple factors acting at many different levels.[29–36]

Before further discussing the study's findings, the following limitations should be considered. First, data on other potential predictors of BMI, such as detailed caloric intake and the family's eating and physical activity routines, were not available nor was information on environmental factors that might influence students' behaviors such as the widespread availability of junk foods and the reduction in physical education classes in schools across the nation. With funding from the Robert Wood Johnson Foundation, school-level data are being collected that should help to monitor and understand the effects of school policies regarding nutrition and physical activity on youth obesity.

Second, the potential effects that school dropouts may have on the findings cannot be determined because they are omitted. It is believed, however, that this is a minimal problem in 8th grade and only a modest one in 10th, because so few students have left school at those early points.

Third, the data are based on self-report. Prior research has found that some adolescents tend to underreport their weight by an average of 3.5 pounds and overreport their height by an average of 2.7 inches, leading to an underestimation of BMI when using self-reports.[37] Therefore, it is possible that the percentages of overweight youth are slightly underestimated in

**Table 2.** Results of multiple logistic regression analyses predicting being at or above the 85th percentile for female and male students: MTF 1998–2003

| | Girls | | | | | | | | Boys | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bivariate | | Model 1 | | Model 2 | | Full model | | Bivariate | | Model 1 | | Model 2 | | Full model | |
| **Variables** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** |
| **Race/ethnicity by SES** | | | | | | | | | | | | | | | | |
| White of high SES | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — |
| White of mid SES | **1.60** | 1.42–1.80 | **1.42** | 1.26–1.61 | **1.54** | 1.37–1.73 | **1.40** | 1.24–1.59 | **1.64** | 1.49–1.81 | **1.49** | 1.34–1.64 | **1.60** | 1.45–1.76 | **1.48** | 1.33–1.63 |
| White of low SES | **2.72** | 2.30–3.21 | **2.15** | 1.81–2.56 | **2.56** | 2.16–3.02 | **2.11** | 1.77–2.51 | **2.23** | 1.92–2.59 | **1.77** | 1.51–2.07 | **2.10** | 1.80–2.44 | **1.75** | 1.49–2.05 |
| Black of high SES | **2.57** | 3.02–3.28 | **2.09** | 1.61–2.71 | **2.49** | 1.94–3.20 | **1.98** | 1.52–2.58 | **1.67** | 1.33–2.09 | **1.45** | 1.14–1.84 | **1.57** | 1.25–1.98 | **1.41** | 1.11–1.79 |
| Black of mid SES | **3.92** | 3.36–4.57 | **2.88** | 2.42–3.43 | **3.71** | 3.15–4.36 | **2.72** | 2.28–3.26 | **1.91** | 1.36–2.23 | **1.57** | 1.33–1.86 | **1.79** | 1.52–2.11 | **1.53** | 1.29–1.82 |
| Black of low SES | **3.16** | 2.45–4.08 | **2.22** | 1.68–2.93 | **2.95** | 2.29–3.82 | **2.09** | 1.59–2.76 | **1.82** | 1.35–2.46 | 1.37 | 0.99–1.88 | **1.68** | 1.23–2.28 | 1.33 | 0.96–1.84 |
| Hispanic of high SES | **1.70** | 1.11–2.59 | **1.55** | 1.02–2.36 | **1.76** | 1.15–2.69 | **1.54** | 1.01–2.34 | **1.79** | 1.31–2.44 | **1.64** | 1.19–2.25 | **1.80** | 1.32–2.46 | **1.63** | 1.19–2.23 |
| Hispanic of mid SES | **2.47** | 2.02–3.00 | **2.11** | 1.69–2.63 | **2.54** | 2.06–3.13 | **2.06** | 1.65–2.58 | **2.32** | 1.98–2.73 | **2.06** | 1.73–2.45 | **2.33** | 1.97–2.75 | **2.03** | 1.71–2.42 |
| Hispanic of low SES | **3.34** | 2.73–4.08 | **2.68** | 2.11–3.40 | **3.51** | 2.80–4.39 | **2.65** | 2.08–3.36 | **2.50** | 2.07–3.01 | **2.16** | 1.77–2.63 | **2.58** | 2.12–3.13 | **2.14** | 1.75–2.62 |
| **Population density** | | | | | | | | | | | | | | | | |
| Large MSA | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — |
| Other MSA | 1.01 | 0.89–1.15 | 1.09 | 0.98–1.21 | 1.09 | 0.98–1.21 | 1.09 | 0.98–1.21 | 1.03 | 0.94–1.14 | 1.04 | 0.96–1.14 | 1.03 | 0.95–1.13 | 1.04 | 0.96–1.14 |
| NonMSA | 1.08 | 0.94–1.25 | **1.15** | 1.04–1.33 | **1.18** | 1.04–1.33 | **1.17** | 1.03–1.33 | **1.18** | 1.06–1.30 | **1.16** | 1.04–1.28 | **1.15** | 1.03–1.27 | **1.15** | 1.04–1.28 |
| **Region** | | | | | | | | | | | | | | | | |
| Northeast | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — | 1.00 | — |
| North Central | 1.03 | 0.89–1.19 | 1.01 | 0.89–1.14 | 0.99 | 0.88–1.13 | 1.00 | 0.88–1.14 | 0.90 | 0.81–1.01 | **0.87** | 0.78–0.96 | **0.87** | 0.79–0.97 | **0.86** | 0.78–0.96 |
| South | **1.18** | 1.04–1.35 | 0.90 | 0.80–1.01 | 0.92 | 0.82–1.03 | 0.90 | 0.80–1.01 | 1.09 | 0.97–1.21 | 0.97 | 0.87–1.07 | 0.97 | 0.87–1.07 | 0.96 | 0.87–1.06 |
| West | 1.00 | 0.84–1.20 | 0.87 | 0.73–1.05 | 0.84 | 0.70–1.01 | 0.88 | 0.73–1.05 | 0.97 | 0.85–1.12 | **0.86** | 0.76–0.98 | **0.84** | 0.74–0.95 | **0.86** | 0.76–0.98 |
| **Lifestyle behaviors** | | | | | | | | | | | | | | | | |
| Eating frequency | **0.95** | 0.94–0.96 | 1.00 | 0.99–1.01 | — | — | 1.00 | 0.99–1.02 | **0.93** | 0.92–0.94 | **0.97** | 0.96–0.98 | — | — | **0.97** | 0.96–0.98 |
| Sleeping frequency | **0.94** | 0.91–0.96 | 0.97 | 0.94–1.00 | — | — | 0.97 | 0.94–1.00 | **0.90** | 0.88–0.92 | **0.96** | 0.94–0.99 | — | — | **0.96** | 0.94–0.99 |
| Exercise frequency | **0.80** | 0.78–0.82 | **0.85** | 0.83–0.87 | — | — | **0.85** | 0.83–0.88 | **0.85** | 0.83–0.87 | **0.90** | 0.88–0.92 | — | — | **0.90** | 0.88–0.92 |
| TV viewing frequency | **1.28** | 1.25–1.31 | **1.15** | 1.11–1.18 | — | — | **1.15** | 1.11–1.18 | **1.15** | 1.12–1.18 | **1.09** | 1.06–1.12 | — | — | **1.09** | 1.06–1.12 |
| **Family/parenting** | | | | | | | | | | | | | | | | |
| No. hrs. spent alone | **1.04** | 1.01–1.07 | — | — | 1.01 | 0.98–1.04 | 0.99 | 0.97–1.02 | 1.01 | 0.99–1.04 | — | — | 1.00 | 0.97–1.03 | 0.98 | 0.95–1.00 |
| Lives with two parents | | | | | | | | | | | | | | | | |
| No | 1.00 | — | — | — | 1.00 | — | 1.00 | — | 1.00 | — | — | — | 1.00 | — | 1.00 | — |
| Yes | **0.66** | 0.60–0.72 | — | — | **0.87** | 0.79–0.95 | **0.88** | 0.80–0.97 | **0.81** | 0.74–0.88 | — | — | 0.90 | 0.82–1.00 | 0.95 | 0.86–1.04 |
| Mother has paid job | | | | | | | | | | | | | | | | |
| No | 1.00 | — | — | — | 1.00 | — | 1.00 | — | 1.00 | — | — | — | 1.00 | — | 1.00 | — |
| Part-time | 0.90 | 0.78–1.03 | — | — | 0.95 | 0.83–1.10 | 0.98 | 0.85–1.13 | **0.87** | 0.76–0.99 | — | — | 0.93 | 0.82–1.06 | 0.94 | 0.82–1.07 |
| Full-time | 1.08 | 0.97–1.20 | — | — | 1.06 | 0.95–1.18 | 1.08 | 0.97–1.21 | 1.03 | 0.93–1.14 | — | — | 1.05 | 0.95–1.16 | 1.05 | 0.94–1.16 |
| | | | Wald$\chi^2(23)=802.17$ -Log PL=10059.40 | | Wald$\chi^2(23)=518.48$ -Log PL=10207.99 | | Wald$\chi^2(27)=839.67$ -Log PL=10051.94 | | | | Wald$\chi^2(23)=523.15$ -Log PL=10747.59 | | Wald$\chi^2(23)=271.85$ -Log PL=10898.97 | | Wald$\chi^2(27)=525.29$ -Log PL=10742.39 | |

*Notes:* All analyses include grade level and the year (dummy-coded) in which the survey took place. Model 1 includes the following variables: Race/ethnicity by SES, population density, region, and lifestyle habits. Model 2 includes the following variables: Race/ethnicity by SES, population density, region, and family/parenting. The Full model includes all of the variables listed. Odds ratios in bold indicate they are statistically significant with $p<0.05$.

OR, odds ratio; CI, confidence interval; SES, socioeconomic status; MSA, metropolitan statistical area; MTF, Monitoring the Future study.

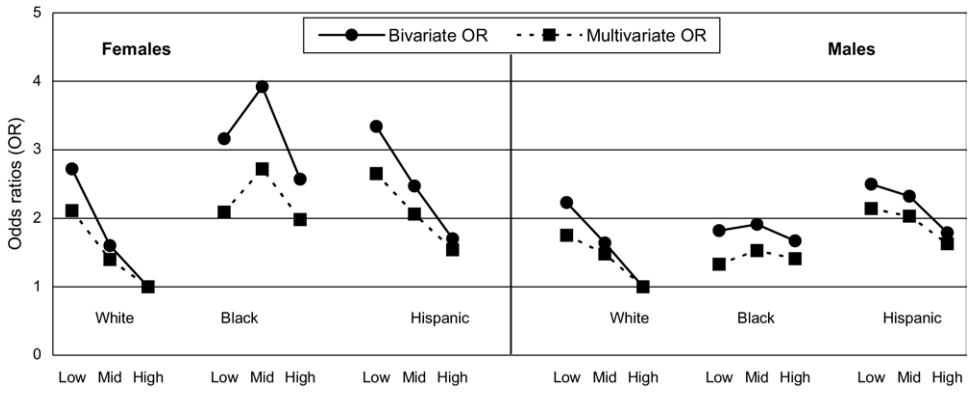


**Figure 2.** Bivariate and multivariate odds ratios between being at or above the 85th percentile and the interaction of race/ethnicity and socioeconomic status by gender.

this study, although it is not believed that this potential downward bias has had a substantial effect on the associations studied. If present, such biases are believed to be relatively constant across groups. Other studies also conclude that the slight bias towards underreporting weight is sufficiently small to reach reliable conclusions.[37–39] Also, it is believed that because most underreporting occurs among those with the highest BMIs,[37–39] most of these adolescents were probably correctly classified as being at or above the 85th percentile based on the definition utilized in the present study, thus reducing the likelihood that the estimated odds ratios are biased. The slight bias toward underreporting weight appears to be sufficiently small to reach reliable conclusions.[37–39]

Fourth, while the inverse association found between being at or above the 85th percentile and SES, as measured by parental education, is consistent with findings from prior studies,[40] to better understand how SES is associated with being at risk of overweight or overweight differences between racial/ethnic groups, additional research is needed with more comprehensive measures of SES (i.e., parental education, income, occupation), including measures of wealth. A more detailed discussion on the validity of self-reported height and weight to calculate BMI and the use of parental education as a proxy for SES is presented in another paper in this supplement.[41] Notwithstanding these limitations, the current study provides substantial information on the distribution of youth at or above the 85th percentile by racial/ethnic background and socioeconomic levels, and provides evidence of the influence that lifestyle behaviors have on being at risk of overweight or overweight using large national representative samples of youth.

As mentioned earlier, the lifestyle behaviors variables had a stronger effect than the parenting variables in reducing the magnitude of the association between being at or above the 85th percentile and the race/ethnicity by SES variables. This finding may indicate that parents and families who ensure that their children's nutritional and physical needs are adequately met and who regulate the amount of time youth spend watching television can reduce the risk of their children becoming at risk of overweight or overweight, despite familial and parenting circumstances. This finding holds for all racial/ethnic groups and socioeconomic levels under investigation in this study. A caveat of this finding is that the introduction of the lifestyle behaviors into the model attenuated, but did not eliminate, the observed association between being at or above the 85th percentile and race/ethnicity and SES.

The findings that youth who eat breakfast, fruits, and vegetables more frequently are less likely to be at or above the 85th percentile are consistent with recent research demonstrating the positive effects of these behaviors.[42] These positive effects may result from youth receiving the proper nutrients that might prevent them from experiencing hunger that can lead to a pattern of overeating at meals and consuming snacks high in fat, calories, and salt (e.g., candies, sodas). The study also shows that youth who exercise less frequently and those who spend more time watching TV, a sedentary activity, are more likely to be at risk of overweight or be overweight. While the benefits of physical activity are well known,[43] the nation's middle and junior high schools fall short of the *Healthy People 2010* objectives related to physical education,[44] and little is known about the environmental factors that might be conducive to higher physical activity levels among youth in their communities.[45] A recent study indicates that communities with larger proportions of racial/ethnic minorities and individuals of low SES have fewer settings conducive to physical activity.[46] In light of the potential role that the physical environment plays in the development of obesity among youth and our increasing understanding that behaviors leading to obesity result from the complex interaction of individual and environmental factors, future research is needed to better measure the physical environment and to identify how these and other individual factors interact to increase or decrease the risk of obesity among youth.[47] This knowledge will then serve to better inform studies aimed at identifying which changes

in the physical environment can lead to increased physical activity and decreased obesity among youth.

The present study also adds evidence to the potential effect of television viewing on youth being at risk of overweight or overweight, although the magnitude and direction of the association between these variables has not been entirely clear.[18–19] The potential effects of TV may be more serious for individuals of lower SES and racial/ethnic minorities because these groups have been found to watch considerably more TV than individuals of higher SES and white youth.[19,27] The neighborhood context in which youth live may influence the amount of TV they watch, with youth living in dangerous neighborhoods spending more time indoors, safely watching TV. However, further analyses of our data showed that black and Hispanic youth of higher SES watch considerably more TV than white youth of similar status. Recent studies indicate that the overwhelming majority of food and beverage advertisements seen by children and adolescents are for products that are high in fat, processed sugars, and/or sodium.[48] Given these findings, there is a need to further understand the specific role of television marketing, and of the marketing industry in general, in influencing childhood obesity[49] among all youth, and particularly among racial/ethnic minorities and those of low SES, given the overrepresentation of these populations among the overweight and obese. In light of the immediate and long-term health consequences associated with sedentary activities,[50] further research is needed to understand these racial/ethnic differences that manifest themselves across the SES gradient.

The frequency at which youth get at least 7 hours of sleep each night was inversely associated with being at or above the 85th percentile in the bivariate analyses for girls and boys, but not in the multivariate analyses for girls. The change is due to the inclusion of frequency of eating and exercising variables, however, the change in magnitude in the OR is minimal, from 0.94 to 0.97. As is the case with the other lifestyle behaviors studied, significant differences were observed in the percentage of youth who get at least 7 hours of sleep between racial/ethnic backgrounds and levels of SES.[27] These differences, coupled with the steady decline over time in the percentage of youth who sleep at least 7 hours on a regular basis,[1] suggest the need for further investigation into the effects of decreased sleep on youth eating and physical activity patterns.

Finally, the findings are worth noting that male and female youth who spend more hours supervised after school and who live with both parents are less likely to be at or above the 85th percentile. In the multivariate context, however, these variables were no longer significantly associated with being at or above the 85th percentile, with the exception of girls who live with both parents. The Institute of Medicine recently suggested that preventing overweight and obesity among youth will require a strong commitment by parents to meet the nutritional and physical activity needs of youth,[51] a challenging task by itself that is further complicated by the aggressive marketing of non- or less than-nutritious foods aimed at families and children.[48,49] Further research is needed to understand the gender differences observed in this study and the mechanisms by which one- and two-parent households alike can prevent adolescents from becoming obese.

## Conclusion

These findings provide evidence of racial/ethnic and SES differences in becoming at risk of overweight or overweight by early adolescence. It also demonstrates that those differences are explainable in part by group differences in dietary and exercise behaviors. The results also show that children in certain family situations are at greater risk of becoming at risk of overweight or overweight.

The prevention of obesity and eventual elimination of racial/ethnic and socioeconomic disparities is likely to require action in multiple arenas, including (1) population-based interventions that can reach a large number of youth to target the potentially modifiable factors investigated in this study (e.g., eating and physical activity practices); (2) changes in the types of food advertising and marketing campaigns aimed at children[52]; (3) changes in the ways communities are built to facilitate more physical activity[46]; (4) changes in the amount of physical activity that schools provide during and after school hours[44]; and (5) changes in the beverage and food offerings provided to students at school.[53,54] A concerted and comprehensive effort is needed both to stop the obesity epidemic and to eliminate disparities related to this health problem.

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