The Relationship of Ethnicity, Socioeconomic Factors, and Overweight in U.S. Adolescents

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Abstract

GORDON-LARSEN, PENNY, LINDA S. ADAIR, AND BARRY M. POPKIN. The relationship of ethnicity, socioeconomic factors, and overweight in U.S. Adolescents *Obes Res.* 2003;11:121–129.

Objective: To examine the extent to which race/ethnic differences in income and education account for sex-specific disparities in overweight prevalence in white, African American, Hispanic, and Asian U.S. teens.

Research Methods and Procedures: We used nationally representative data collected from 13,113 U.S. adolescents enrolled in the National Longitudinal Study of Adolescent Health. Logistic regression models were used to examine the relationship of family income and parental education to overweight prevalence (body mass index $\geq$ 85th percentile of age and sex-specific cutoff points from the 2000 Centers for Disease Control and Prevention/National Center for Health Statistics growth charts). In addition, we used coefficients from our logistic regression models to project the effects on overweight prevalence of equalizing the socioeconomic status (SES) differences between race/ethnic groups.

Results: Keeping adolescents in their same environments and changing only family income and parental education had a limited effect on the disparities in overweight prevalence. Ethnicity–SES–overweight differences were greater among females than males. Given that overweight prevalence decreased with increasing SES among white females and remained elevated and even increased among higher SES African-American females, African-American/white disparity in overweight prevalence increased at the highest SES. Conversely, disparity was lessened at the highest SES for white, Hispanic, and Asian females. Among males, disparity was lowest at the average SES level.

Discussion: One cannot automatically assume that the benefits of increased SES found among white adults will transfer to other gender–age–ethnic groups. Our findings suggest that efforts to reduce overweight disparities between ethnic groups must look beyond income and education and focus on other factors, such as environmental, contextual, biological, and sociocultural factors.

Key words: health disparities, income, education, minority population, SES

Introduction

Obesity is a major public health issue contributing substantially to U.S. total mortality rates. National health objectives call for reducing ethnic disparities in health (1), with an emphasis on the fact that economic and racial inequality seems to have increased in recent decades (2–4). Research on chronic illness found increasing socioeconomic status (SES)[1]–health differentials with age (5). Type II diabetes, dyslipidemia, and other measures of chronic diseases are found among U.S. adolescents (6). SES-related differences in obesity emerge during adolescence (7–10).

The literature on race/ethnicity and obesity shows higher overweight prevalence among African Americans than whites of the same age and sex (11–14), with an inverse relationship between obesity and SES among white, but not African-American or Mexican-American youth (15–17). Whereas there has been considerable research on SES and overweight prevalence among adults, little is known about the impact of SES on lifestyle behaviors among youth (18). There are no national studies of ethnic differences in overweight prevalence, among large ethnically diverse samples, that take sociodemographic factors into account in a detailed manner. Indeed, a recent review of 20 years of U.S. cardiovascular disease studies concluded that only a small percentage included both SES and ethnicity in analysis (19).

Received for review June 3, 2002.
Accepted for publication in final form September 25, 2002.
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[1] Nonstandard abbreviations: SES, socioeconomic status; BMI, body mass index.

Our study examined the relationship of family income and parental education to overweight prevalence in the National Longitudinal Study of Adolescent Health (Add Health). We further investigated the extent to which race/ethnic differences in income and education account for disparities in overweight prevalence among white, African-American, Hispanic, and Asian teens; we also projected the effects on overweight prevalence of equalizing these SES differences between the groups.

Research Methods and Procedures

Survey Design

The study population consisted of >20,000 adolescents enrolled in Add Health, a longitudinal, nationally representative, school-based study of U.S. adolescents in grades 7 to 12, supplemented with minority special samples and collected under protocols approved by the Institutional Review Board of the University of North Carolina-Chapel Hill. For Add Health, a stratified (e.g., urbanicity, school size, school type), random sample of all high schools in the U.S. was selected, and >90,000 adolescents were surveyed. From this sample, adolescents were selected for a core, nationally representative sample, after which special samples were added for greater representation of selected groups (such as ethnic minorities). The survey design and sampling frame have been described elsewhere (20).

We used the Wave 2 sample (14,438 eligible adolescents measured between April and August, 1996). Exclusions include Native Americans (N = 178), because of small sample size, and adolescents without complete height, weight, and SES data. Our final analysis sample included 13,113 adolescents (12 to 20 years of age; mean 16.0 ± 0.11 years; 46.5% female) from four major ethnic groups: non-Hispanic whites (n = 7135; 54.41%), non-Hispanic African Americans (n = 2795; 21.31%), Hispanics (n = 2263; 17.26%), and Asians (n = 920; 7.02%).

Study Variables

Height and weight were measured in Wave 2 during in-home surveys and overweight status defined as a body mass index (BMI) ≥ 85th percentile of age and sex-specific cutoff points from the 2000 Centers for Disease Control and Prevention/National Center for Health Statistics growth charts (21). Whereas the 95th percentile may be associated with greater health risks, we used the 85th percentile to define overweight for three reasons: 1) to understand the full range of overweight during adolescence [see Must et al. (22)]; 2) to allow an analysis using the Asian sample, because there were very small numbers of Asian females with a BMI ≥ 95th percentile; and 3) because the pattern and direction of results were very similar using the 85th and 95th percentiles.

A combination of in-home surveys of parents and adolescents provided race/ethnicity, household income, and education data. Race/ethnicity was categorized as Hispanic, non-Hispanic white, non-Hispanic African American, or Asian American. For simplicity, we refer to these groups as Hispanic, white, African American, or Asian.

We examined income and education separately because they represent distinct dimensions of SES. Each is used differently in program and policy implementation (e.g., income qualification for many food welfare programs), and each represents different constraints or advantages that may affect behavior quite uniquely. Parental education was defined as the highest level of education achieved for either parent; our data showed that paternal education was higher than maternal education in 1229 cases. Although differences were minimal, we used parental, rather than maternal, education as a better indicator of household level SES. We initially tested continuous forms of income and education. In final models, we grouped the highest level of education achieved for either parent into the following categories: less than high school, high school/GED (reference), some college, and college degree and/or graduate or professional degrees. Income was reported in $1000 increments. Where income was missing (n = 1958; 14.9%), income was imputed using data on parental occupation, family structure, and school community. This method is similar to that used in other national surveys, such as the National Health and Nutrition Examination Survey. Income was used as a continuous variable or grouped into the following categories: $0 to $20,000, $20,000 to $40,000 (reference), $40,000 to $60,000, $60,000 to $80,000, and $80,000 or greater. Three interaction terms were used in specific models: income*less than high school, income*some college, income*college and/or professional degree, with income*high school/GED as the reference category. Control variables included age, whether income was predicted, and pregnancy status (for females).

Statistical Analysis

The intent of this paper was to examine the net effects of income and education on overweight by sex and ethnicity. Thus, we used race- and sex-stratified models that included only income, education, and key controls (e.g., age and pregnancy), and excluded more proximate determinants of overweight through which SES may operate. We reasoned that the net effects of income and education would be the same irrespective of pathway. Given the age range of our study sample and the understood relationship between maturation and overweight (23), we tested whether maturation was important for this analysis. Although the maturation coefficient was itself significant, inclusion of maturation did not change the relationship of SES to overweight. We therefore excluded maturation from the final models.

Statistical analyses were carried out using STATA Version 6.0 (24). We used the widely accepted series of STATA survey (SVY) procedures to correct for multiple

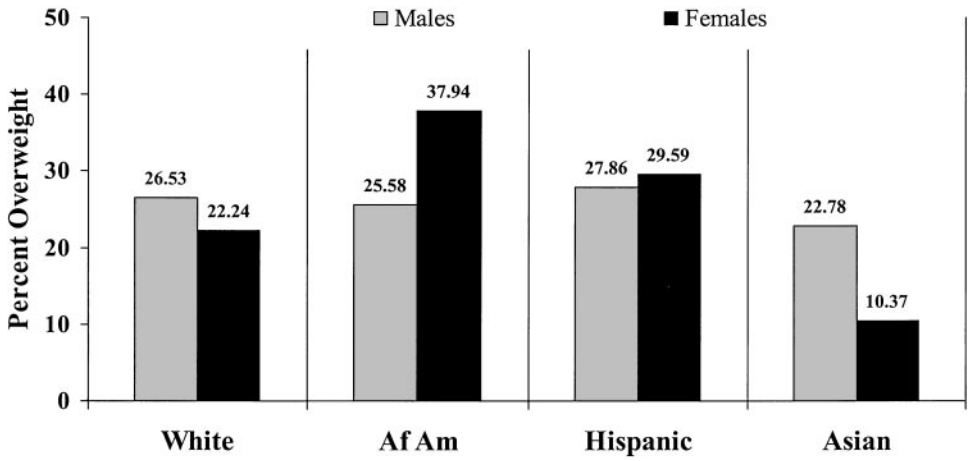

Figure 1: Overweight prevalence by ethnicity and sex. Af Am, African American.

stages of cluster sample design and unequal probability of selection to ensure that our results were nationally representative with unbiased estimates and standard errors. We used logistic regression models to investigate the association between overweight prevalence and ethnicity, income, and education. Initial logistic regression models confirmed that the factors associated with overweight prevalence are different for males and females and by ethnic group. Thus, models were stratified by ethnicity and sex.

Further analysis demonstrated that the shape of the relationship between income, education, and overweight prevalence differed by ethnicity and sex. Thus, different specifications were required to capture effects of income, education, and overweight prevalence by ethnicity. Essentially, we started with a basic model including continuous or categorical income (depending on shape of the relationship) and categorical education and education with income interaction terms. We then removed all nonsignificant interaction terms. The final models consisted of the following: 1) continuous income and categorical education (Hispanic males, Asian males and females, and African-American males and females); 2) continuous income, categorical education, and the income and education interaction terms (white males); and 3) categorical income and categorical education (white and Hispanic females). We present coefficients from the models because it is a general principle that odds ratios from models including interaction terms are not easily interpretable.

Results

What Are the Disparities between the Racial/Ethnic Groups?

Overweight was high among all U.S. adolescents (Figure 1). However, overweight prevalence was highest for African-American females, followed by Hispanics of both sexes and white males.

Table 1 shows the distribution of respondents by categories of family income and maternal education. More than half of whites, African Americans, and Asians had mothers with at least some college education, whereas parental education was substantially lower among Hispanic adolescents. Mean family income was lowest in African Americans and Hispanics, with a higher proportion of African Americans and Hispanics in the lowest income category.

The relationship between overweight prevalence and family income differed by ethnicity (Figure 2), with more pronounced differences among females. Overweight prevalence decreased linearly with increasing income among white males. Hispanic males had significantly higher overweight prevalence than whites at mid-to-high family incomes. Asian males had significantly lower overweight prevalence than whites at both low (less than $20,000) and high ($60,000+) income levels.

There was greater ethnic variation among females than males. Overweight prevalence declined with increasing income among whites. Overweight prevalence was lowest for African Americans in mid-income levels, but highest for those with lowest and highest family incomes, with statistically significant African-American/white differences at all income levels. Asians had significantly lower overweight prevalence than whites at $0 to $20,000 and $40,000 to $60,000 levels.

Results were similar for the relationship between parental education and overweight (Figure 3). Females showed greater variability in overweight by parental education than males. African-American females had significantly higher overweight than white females across all levels of parental education except the lowest level. There were no statistically significant differences in overweight by parental education for males.

We next used multivariate models, stratified by sex and ethnicity, to assess the relationship of family income and

Table 1. Number (percentage in parentheses) of adolescents at given levels of parental education and family income by ethnicity

Characteristic	Whites	African Americans	Hispanics	Asians
Parental education				
<HS	595 (8.96)	363 (17.66)	925 (41.90)	102 (17.29)
HS/GED	2253 (32.52)	787 (35.19)	566 (24.76)	172 (19.60)
Some College	2072 (29.20)	736 (24.51)	412 (17.70)	185 (17.00)
College Grad/Professional	1904 (25.30)	797 (18.65)	272 (11.59)	421 (41.07)
Family Income				
Mean Income	47,825	27,685	30,579	45,461
$0 to $20K	1067 (16.39)	1019 (46.39)	813 (38.17)	113 (15.41)
$20K to $40K	2213 (30.50)	938 (33.73)	924 (39.51)	352 (40.05)
$40K to $60K	2067 (28.94)	477 (11.63)	337 (13.78)	241 (23.72)
$60K to $80K	982 (13.79)	219 (5.32)	119 (5.02)	111 (10.24)
$80K+	806 (10.37)	142 (2.93)	70 (3.52)	103 (10.58)

<HS, no or some high school; HS/GED, high school/GED diploma.

parental education to overweight prevalence. The results show net effects of income and education, without consideration of more proximate determinants of overweight prevalence (such as diet and activity).

Coefficients from these models are shown in Appendix 1. We used the continuous income variable for African-American adolescents of both sexes and Hispanic males. The identical model using categorical income for Hispanic females yielded comparable results.

For white males, the main effects of income and education were not significant, although higher income was associated with increased overweight prevalence in households with lowest parental education. Among African-American and Hispanic males, neither income nor education was statistically significant. In Asian males, higher income and parental education were associated with lower overweight prevalence.

Among white females, incomes above $40,000 were significantly associated with lower overweight prevalence. For Af-

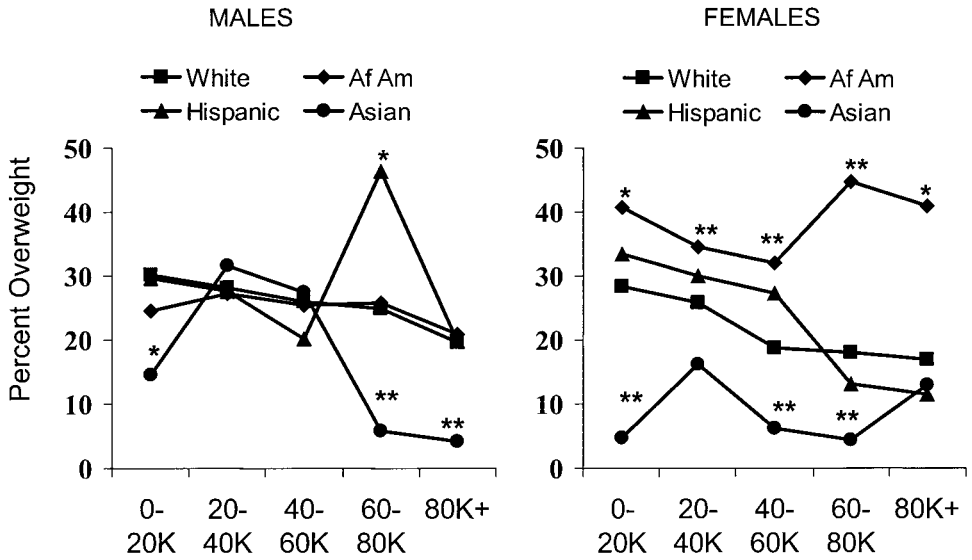

Figure 2: Overweight prevalence by category of family income. *White vs. given ethnic group, $p < 0.05$. **White vs. given ethnic group, $p < 0.01$. The *x* axes of both panels indicate parental income ranges. Af Am, African American.

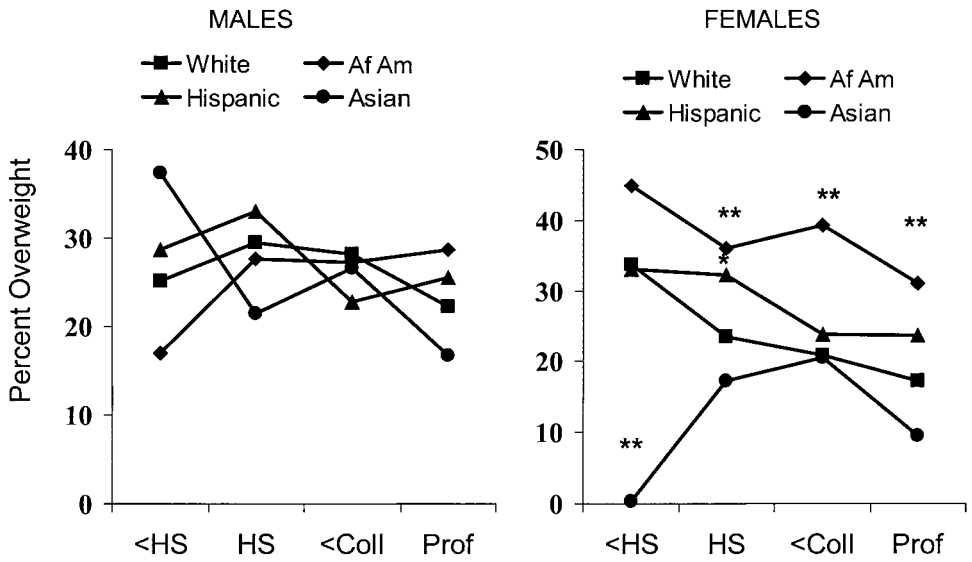

Figure 3: Overweight prevalence by category of parental education. *White vs. given ethnic group, $p < 0.05$. **White vs. given ethnic group, $p < 0.01$. <HS, no or some high school; HS, high school (or GED) diploma; <Coll, some college; Prof, college or professional degree; Af Am, African American.

rican-American and Hispanic females, there were no statistically significant reductions in overweight prevalence with increasing SES. Asians had significantly decreased likelihood of overweight prevalence at highest education.

Will Equalizing Income and/or Education Reduce or Eliminate Disparities in Overweight Prevalence?

In our final analysis, we examined the "experimental" effects of equalizing SES across the four ethnic groups. We used coefficients from our logistic regression models (Appendix 1) to predict overweight prevalence at specified income and education levels. For example, we estimated overweight prevalence in each group, assuming that all adolescents were from low-income households with parents of less-than-high school education. We repeated this exercise for other combinations of education and income. Results, in the form of predicted overweight prevalence, are shown in figures below.

Predicted overweight prevalence results for males are shown in Figure 4. While maintaining low parental education, raising the income from the lowest to the middle level (Figure 4, panels 1 and 2) increased overweight prevalence

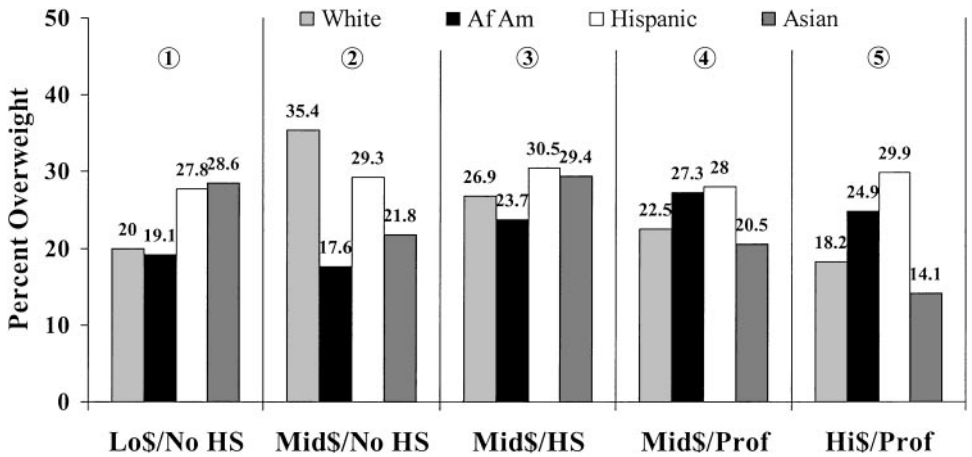

Figure 4: Predicted overweight prevalence among males by ethnicity and categories of family income and parental education. Low income (Lo$): $10,000 in continuous models; $0 to $20,000 in categorical models. Middle income (Mid$): $50,000 in continuous models; $40,000 to $60,000 in categorical models. High income (Hi$): $100,000 in continuous models; $80,000+ in categorical models. No HS, no high school; HS, high school (or GED) diploma; Prof, college or professional degree; Af Am, African American.

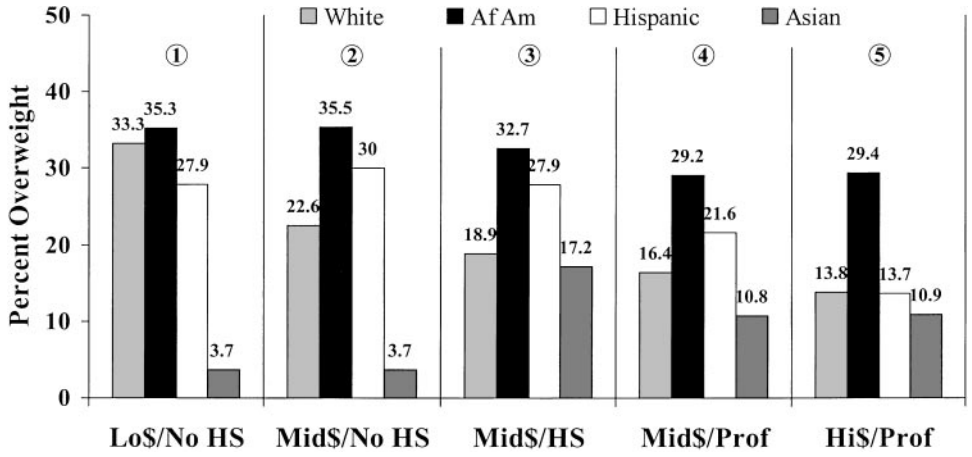

Figure 5: Predicted overweight prevalence among females by ethnicity and categories of family income and parental education. Low income (Lo$): $10,000 in continuous models; $0 to $20,000 in categorical models. Middle income (Mid$): $50,000 in continuous models; $40,000 to $60,000 in categorical models. High income (Hi$): $100,000 in continuous models; $80,000+ in categorical models. No HS, no high school; HS, high school (or GED) diploma; Prof, college or professional degree; Af Am, African American.

by 15.4 percentage points among whites and 1.5 percentage points among Hispanics and decreased overweight prevalence by 1.5 percentage points and 6.8 percentage points among African Americans and Asians, respectively.

Moving from middle income/no high school education (Figure 4, panel 2) to middle income/high school education (Figure 4, panel 3) among males—which is the pattern for the majority of whites—overweight prevalence decreased by 8.5 percentage points in whites and increased 6.1 percentage points in African Americans, 1.2 percentage points in Hispanics, and 7.6 percentage points in Asians. Moving from this average level to the highest levels of income and education (Figure 4, panels 3 and 5), overweight prevalence decreased by 8.7 percentage points in whites, 0.6 percentage points for Hispanics, and 15.3 percentage points for Asians, but increased 1.2 percentage points in African Americans.

African-American/white disparity in overweight prevalence among males would be the smallest at the lowest SES and greatest at the middle income/no high school level (whites were 17.8 percentage points higher than African Americans). The direction of African-American/white disparity reversed as SES increased. At the highest level, African Americans had a higher predicted overweight prevalence than whites. Hispanic/white disparity was lowest at the average SES (3.6 percentage points) and highest at the highest SES category (11.7 percentage points). Asian/white disparity was lowest at middle income/highest-education levels (−2.0 percentage points) and highest at the middle income/no high school level (−13.6 percentage points) (Figure 4).

Among females from low parental-education households, raising the income level from the lowest to middle level (Figure 5, panels 1 and 2) decreased overweight prevalence among white females (10.7 percentage points) and increased it among African-American (0.2 percentage points) and Hispanic (2.1 percentage points) females, whereas Asians remained the same.

Moving from middle income/no high school education to middle income/high school education (Figure 5, panels 2 and 3) among females—which is the pattern for the majority of whites—overweight prevalence would again decrease for whites (3.7 percentage points), African Americans (2.8 percentage points), and Hispanics (2.1 percentage points), but increase for Asians (13.5 percentage points). Moving from middle income/high education to high income/high education (Figure 5, panels 4 and 5), overweight decreased for whites (2.6 percentage points) and Hispanics (7.9 percentage points), but changed little for African Americans (+0.2 percentage points) and Asians (+0.1 percentage points). The decline in overweight prevalence with increasing SES was of greatest magnitude among whites, moderate among Hispanics, and minimal in African Americans, who maintained high levels of overweight prevalence at all SES levels (Figure 5).

African-American/white disparity, which was small at low SES, increased with higher SES, and peaked at the highest SES (15.6 percentage points). Hispanic/white disparity was highest at the average SES (9) and lowest at the highest SES (−0.1 percentage points). Asian-white disparity was greatest at lowest SES (−29.6 percentage points) and smallest at average (−1.7 percentage points) and highest SES levels (−2.9 percentage points).

Discussion

There was considerable ethnic disparity in adolescent overweight prevalence by SES, with a clear inverse relationship

only among white females. This is, to our knowledge, one of the first studies to document the variation in association between SES and overweight prevalence among large samples of adolescents from four major U.S. ethnic groups.

Will equalizing income and/or education reduce or eliminate disparities in overweight prevalence? To answer this question, we used coefficients from stratified logistic regression models and calculated, in each group, the predicted prevalence of overweight at selected income and education levels. This allowed us to see more clearly (given the relationships found in the Add Health sample) whether eliminating income and education disparities would also eliminate disparities in overweight prevalence. Because the coefficients from stratified models were used to estimate the effects, we accounted for some of the differences in the race-/ethnicity-specific effects of income.

We found that even if we were to equalize income and education, we would not eliminate health disparities. Based on our simulations, we determined that even at identical SES levels, there were large differences in overweight prevalence by ethnicity. For example, because overweight prevalence decreased with higher SES among whites, but increased with higher SES among African Americans at the highest level of parental education and income, African-American/white disparity in overweight prevalence among females actually increased. This suggests that factors other than SES are very important.

Our analysis strategy of examining only the net effects of income and education on overweight was designed to test the net effects of income and education on overweight, rather than undertake causal modeling of these relationships. Clearly, several other biological, sociocultural, and environmental factors associated with income and education are likely to affect overweight prevalence. For example, environmental factors such as community crime rates and provision of recreation facilities affect physical activity and overweight levels (25–27).

We did not consider the more proximate determinants of overweight prevalence (such as diet, activity, and maturation) that may vary with socioeconomic variables and may, in turn, affect risk of overweight. Failure to account for maturation status may result in misclassification of overweight among younger adolescents (28); early maturing females are more likely to be classified as overweight, whereas overweight is underestimated in late maturing females. However, the effect on estimates of overweight prevalence in the U.S. is small (28). Furthermore, the net effects of SES on overweight will be the same irrespective of the pathway. There is limited research on the relationship of SES to physical inactivity (25) and nutritional outcomes (29). Because there is limited empirical research on the associations between SES and these proximate determinants, further research is needed to clarify these relationships.

The strong inverse relationship of SES to overweight prevalence among white female adolescents in this study is similar to that found by other researchers (30–32). Winkleby et al. (33,34) found higher cardiovascular disease risk factors among African- and Mexican-American high SES females. More research has been done with adults; results in children and adolescents show weaker, less consistent findings. Although Must et al. (31), in a study of young adults (ages 16 to 28 years), found that poverty and parental education were not related to obesity in white, African-American, and Hispanic men or African-American women, the inverse relation was seen for white and Hispanic women. Importantly, there are different meanings to similar levels of SES based on ethnicity, in that ethnic minority youth do not receive the same economic and social benefits at identical SES levels as white youth (35–37).

Generalizability of our results may be affected by nonparticipation bias related to overweight, ethnicity, and SES distribution. For example, research with Danish men shows that the response rate on a health survey was associated with lower BMI and higher intelligence test score, educational level, and social class (38). However, nonparticipation is unlikely to bias our effect estimates significantly because it is unlikely that the relationship of SES to overweight differs in included and excluded adolescents. Attrition by SES, ethnicity, and overweight has not yet been examined in the Add Health dataset.

These results suggest that we cannot assume that the benefits of increased SES found among white adults will transfer to other age–gender–ethnic groups. Attention must be paid to national efforts to reduce and prevent overweight prevalence, particularly in light of national health objectives for reducing the substantial health disparities between ethnic groups in the U.S. Our analysis suggests that reducing disparities in income and education will not reduce disparities in overweight prevalence.

Acknowledgments

The analysis was supported in part by the National Institute of Child Health and Human Development (R01-HD39183 and P30-HD05798). The authors would like to thank Ms. Frances Dancy for her helpful administrative assistance and Mr. Tom Swasey for assistance with the graphics.

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Appendix 1. Coefficients for overweight for US adolescents*

	Whites		African Americans		Hispanics		Asians†	
Variables	**Coefficient**	**(*z* values)**	**Coefficient**	**(*z* values)**	**Coefficient**	**(*z* values)**	**Coefficient**	**(*z* values)**
Males								
Age	−0.10	(−3.33)‡	−0.15	(−4.25)‡	−0.06	(−1.63)	−0.01	(−0.12)
Continuous Income	−0.00	(−0.04)	−0.00	(−1.00)	0.00	(0.57)	−0.01	(−2.78)‡
Less than HS	−0.59	(−1.98)	−0.38	(−1.47)	−0.06	(−0.37)	−0.41	(−1.38)
HS/GED	Reference group for education variables							
Some College	0.10	(0.45)	0.11	(0.58)	0.03	(0.13)	−0.19	(−0.60)
College Grad/Prof	0.16	(0.06)	0.19	(0.98)	−0.12	(−0.50)	−0.48	(−2.24)§
Income* Less than HS	0.02	(2.56)‡						
Income* HS/GED	Reference group for interaction terms							
Income* Some College	−0.00	(−0.85)						
Income* Grad/Prof	−0.01	(−1.16)						
Females								
Age	−0.10	(−4.07)‡	−0.07	(−1.95)§	−0.16	(3.78)‡	−0.08	(−1.04)
Pregnancy Status	0.40	(1.43)	0.23	(0.84)	0.30	(1.08)	1.01	(1.37)
Continuous Income			0.00	(0.07)			0.00	(0.07)
Income Cat 1	0.17	(1.24)			−0.21	(−1.73)		
Income Cat 2	Reference group for analysis with categorical income							
Income Cat 3	−0.36	(−3.36)‡			−0.11	(−0.45)		
Income Cat 4	−0.32	(−1.99)§			−0.17	(−0.54)		
Income Cat 5	−0.57	(−2.70)‡			−0.66	(−1.35)		
Less than HS	0.22	(1.51)	0.12	(0.56)	0.11	(0.88)	1.69	(−1.58)
HS/GED	Reference group for education variables							
Some College	−0.08	(−0.72)	0.12	(0.69)	−0.27	(−1.45)	0.46	(1.84)
College Grad/Prof	−0.17	(−1.24)	−0.16	(−0.96)	−0.33	(−1.17)	−0.55	(2.80)‡

Less than HS, no or some high school; HS/GED, high school or GED diploma; College Grad/Prof, college or professional degree; Cat, category.

* Coefficients based on sex-ethnicity stratified models. Model corrects for survey design effects of multiple stages of cluster sampling.

† Asian females use <HS and HS/GED as the reference group because of a limited number of overweight Asian females in the <HS category.

‡ $p < 0.01$.

§ $p < 0.05$.