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## Differences in risk factors for binge eating by socioeconomic status in a community-based sample of adolescents: Findings from Project EAT

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### Abstract

**Objective:** Binge eating is prevalent across socio-economic status (SES) groups, but it is unclear whether risk factors for binge eating vary by SES. This study examined the prevalence of several risk factors for binge eating by SES and SES as a potential moderator of these risk factors.

**Method:** Participants included 2,179 individuals involved in Project EAT during early/middle adolescence (EAT-I) and 5 years later during late adolescence/emerging adulthood (EAT-II). Risk ratios were computed using modified Poisson regression of incident EAT-II binge eating on EAT-I risk factors among participants of high and low SES. Interactions between each risk factor and SES were tested.

**Results:** Among higher SES adolescents, overweight/obesity (RR=3.2; 95% CI: 1.8, 5.7), body dissatisfaction (RR=2.6; 95% CI: 1.2, 5.5), dieting (RR=4.0; 95% CI: 2.0, 8.2), and family weight-teasing (RR=2.3; 95% CI: 1.3, 4.3) predicted increased risk for binge eating. Among adolescents from low SES backgrounds, overweight/obesity (RR=1.5; 95% CI: 0.9, 2.5), dieting (RR=2.2; 95% CI: 1.2, 3.9), and food insecurity (RR=1.4; 95% CI: 0.7, 2.7) predicted increased risk for binge eating. Moderator analyses revealed that overweight/obesity, body dissatisfaction, dieting, and family weight-teasing were stronger risk factors in the high SES group than the low SES group; interactions with food insecurity could not be examined given the low prevalence of food insecurity in the high SES group.

**Discussion:** Risk factors for binge eating may vary by SES, suggesting the potential utility of modifying intervention and prevention methods based on SES. In particular, the role of food insecurity must be addressed.

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## Keywords

Socioeconomic factors; risk factors; eating/psychology; obesity/psychology; child; adolescent

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## Introduction

Binge eating, defined as ingesting a large amount of food in a discrete time period while experiencing a sense of loss of control over what or how much one is eating (American Psychiatric Association, 2013), presents in approximately 10–15% of individuals in the community (Goldschmidt, Wall, Loth, & Neumark-Sztainer, 2015) and is associated with adverse medical and psychosocial consequences. These include depressed mood (Skinner, Haines, Austin, & Field, 2012; Johnson, Grieve, Adams, & Sandy, 1999), anxiety (Eddy et al., 2007), obesity (Stice, Cameron, Killen, Hayward, & Taylor, 1999; Field et al., 2012), excess weight gain (Fairburn, Cooper, Doll, Norman, & O'Connor, 2000), and the development of clinical eating disorders such as binge eating disorder and bulimia nervosa (Ackard, Fulkerson, & Neumark-Sztainer, 2011; Stice, Marti, Shaw, & Jaconis, 2009). Subclinical binge eating behaviors and accompanying weight-related concerns are prevalent among adolescents of varying sociodemographic classes (Mulders-Jones, Mitchison, Girosi, & Phillipa, 2017; Story, French, Resnick, & Blum, 1995; Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011), but it remains unclear as to whether risk factors for these outcomes differ by SES.

Binge eating has been found to be more prevalent among adolescents with greater body dissatisfaction (Stice, Presnell, & Spangler, 2002; Goldschmidt, Wall, Zhang, Loth, & Neumark-Sztainer, 2016) and concerns with body shape or weight (Haines, Kleinman, Rifas-Shiman, Field, & Austin, 2010; Ledoux, Choquet, & Manfredi, 1993). Sonnevile and colleagues (2012) found similar results prospectively, indicating that among adolescent girls who were overweight, those with higher levels of body satisfaction were less likely to begin binge eating. Additionally, numerous researchers have shown that dieting is associated with both concurrent binge eating (French, Story, Downes, Resnick, & Blum, 1995; Telch & Stice, 1998), and the development of binge eating behaviors (Field et al., 2008; Stice et al., 2002). Weight-related teasing has also been associated with increased binge eating in both cross-sectional (Haines et al., 2010; Neumark-Sztainer et al., 2002) and prospective studies (Neumark-Sztainer et al., 2007; Haines, Neumark-Sztainer, Eisenberg, & Hannan, 2006). Children with overweight/obesity are more likely to engage in binge eating than their non-overweight peers (Tanofsky-Kraff et al., 2004), although the temporal nature of this relationship remains unclear. Finally, exposure to stressful life events, including food insecurity, has been linked to binge eating (Loth, van den Berg, Eisenberg, & Neumark-Sztainer, 2008; Tester, Lang, & Laraia, 2016).

Some studies have shown that risk factors for binge eating associated with drive for thinness, such as body dissatisfaction and dieting, are more prevalent among those of a higher SES (Drewnowski, Kurth, & Krahn, 1994; McLaren, 2007), although findings have been mixed (Striegel-Moore et al., 2000). Studies focused on body dissatisfaction among high and low SES groups have had varied results (McLaren & Gauvin, 2002; Robinson, Chang, Haydel, &

Killen, 2001; Story et al., 1995), with many finding no association between body dissatisfaction and SES (Niide et al., 2011; Wang, Byrne, Kenardy, & Hills, 2005). Of note, one study by van den Berg, Mond, Eisenberg, Ackard, and Neumark-Sztainer (2010) showed that although the prevalence of body dissatisfaction was higher in those from a low SES, the strength of the association between body dissatisfaction and self-esteem was weaker in the low SES group, compared to the high SES group. Given these findings, it is possible that SES moderates associations between other eating-related constructs as well.

Some studies, though not all (Neumark-Sztainer & Hannan, 2000), report a greater prevalence of dieting among those with higher SES (Drewnowski et al., 1994; Story et al., 1995; Wardle & Griffith, 2001). It is possible that dieting behaviors in higher SES adolescents may be more likely to reflect food restriction in pursuit of the thin ideal, and that this may be a more impactful risk factor for eating disorders (Stice et al., 2002). Likewise, the salience of weight-related teasing may be greater in contexts where there is greater emphasis on the thin ideal (Eddy et al., 2007). Adolescents from low SES backgrounds are more likely to have overweight/obesity than those from high SES backgrounds (O'Dea & Caputi, 2001). However, higher weight status has been found to be associated with attitudes and behaviors, such as body dissatisfaction and dieting (Goldfield et al., 2010), that might derive from an internalization of idealized thinness. Additional research is needed to clarify these associations and to evaluate whether the extent to which these risk factors are associated with binge eating may vary by SES.

Food insecurity is also a potential risk factor for binge eating. Previous research has found that parents from food insecure households were more likely to endorse binge eating than food secure parents (Bruening, MacLehose, Loth, Story, & Neumark-Sztainer, 2012; Becker, Middlemass, Taylor, & Johnson, 2017). In addition, those in lower SES positions are disproportionately exposed to stressful life events (Dohrenwend, 1973), including inconsistent food supply (Bove & Olsen, 2006; Coleman-Jensen, Rabbitt, Gregory, & Singh, 2017). As food availability becomes unreliable, physiological hunger and psychological deprivation may increase the propensity toward binge eating. Thus, it is important to examine whether food insecurity remains a risk factor for binge eating among those in a higher SES in an effort to modify prevention methods appropriately across diverse populations.

The current study aims to clarify the prevalence of risk factors for binge eating in high and low SES adolescents and to examine the extent to which SES moderates the association of a range of risk factors with binge eating in a community-based sample of adolescents. We hypothesize that overweight/obesity and food insecurity will be more prevalent in low vs. high SES. Further, we hypothesize that risk factors related to the thin ideal will be more strongly associated with binge eating among the higher SES group than among those with lower SES. These risk factors include body dissatisfaction, dieting, and weight-related teasing. As these risk factors often co-occur with excess weight status (Neumark-Sztainer et al., 2007), we expect adolescent overweight/obesity to be a more salient risk factor for binge eating in the high SES group. Conversely, we expect that food insecurity will be a more impactful risk factor for binge eating among the lower SES group compared to higher SES group.

## Methods

### Study design and population

Data for this study were drawn from Project EAT (Eating and Activity in Teens and Young Adults), a 15-year longitudinal study of dietary behavior, weight concerns, and psychosocial functioning among a heterogeneous group of young people (Neumark-Sztainer, Story, Hannon, & Croll, 2002). For the current study, initial survey data were collected during early/middle adolescence (EAT-I) and additional data were collected 5 years later during late adolescence/emerging young adulthood (EAT-II). Although Project EAT has 15 years of follow-up data across 4 time points, we chose to focus on the first two time points as SES is likely to change as adolescents progress further into young adulthood.

Project EAT-I included 4,746 participants who were students from 31 urban and suburban middle and high schools in the greater Twin Cities area of Minnesota during the 1998–1999 academic year. Trained research staff collected survey and anthropometric data during one 90-minute or two 50-minute class periods. The student response rate was 81.5% for completing the Project EAT-I survey. For Project EAT-II, original participants who had voluntarily provided addresses on their EAT-I survey ( $N=3672$ ) were mailed follow-up surveys to study how their initial attitudes and behaviors may have progressed during adolescence and young adulthood. The University of Minnesota's Institutional Review Board approved all protocols used in Project EAT at each of the time points. We included 2,516 participants who responded at both time points, minus those with missing data on SES at EAT-I ( $n=62$ ) or binge eating at EAT-I ( $n=50$ ), EAT-II ( $n=51$ ), or both ( $n=5$ ). To ensure a temporal order from risk factors to new onset of binge eating, we excluded those who endorsed binge eating at EAT-I ( $n=169$ ). The final sample for longitudinal analysis included 2,179 Project EAT participants from diverse ethnic/racial and SES backgrounds (47.2% boys, 52.8% girls). The mean age of the total sample was 14.9 years old ( $SD=1.6$ ), with similar ages across low ( $M=14.8$ ;  $SD=1.7$ ) and high ( $M=14.9$ ;  $SD=1.6$ ) SES participants. The mean BMI of the sample was 22.0 ( $SD=4.2$ ), with a significantly higher BMI in the low SES group ( $M=22.5$ ;  $SD=4.6$ ) compared to the high SES group ( $M=21.5$ ;  $SD=3.7$ ;  $p<0.001$ ).

**Survey Development**—The Project EAT-I survey contains 221 items exploring socio-environmental, behavioral, and personal factors relating to weight concerns and cognitions among adolescents and young adults. Age, sex, and race/ethnicity were self-reported. Key items used in this paper were consistent across the two study waves to facilitate examination of data longitudinally. To assess test-retest reliability for the EAT-I survey, 161 7<sup>th</sup> and 10<sup>th</sup> grade students were administered identical surveys approximately 2 weeks apart (Eisenberg, Neumark-Sztainer, & Story, 2003).

### Measures

**Socioeconomic Status.**—Socioeconomic status (SES) was based on a 5-point Likert scale of the parent's highest educational level attained. In cases where parent education was missing, other related variables including family eligibility for public assistance, eligibility for free or reduced-cost school meals, and parent employment status were used to impute the value (Neumark-Sztainer et al. 2002). In cases where reported parental education was

implausible based on other SES indicators, it was corrected based on an algorithm described previously (Sherwood et al., 2009). We dichotomized the responses into low SES, defined as neither parent having bachelor's degree or higher, and high SES, defined as at least one parent having a bachelor's degree or higher.

**Binge Eating.**—Binge eating was assessed via the following yes/no questions measuring overeating and loss of control: (1) “In the past year, have you ever eaten so much food in a short period of time that you would be embarrassed if others saw you?” (overeating); (2) [asked if participant responded affirmatively to overeating] “During the times when you ate this way, did you feel you couldn't stop eating or control what or how much you were eating?” (loss of control). These items were adapted from the adult version of the Questionnaire on Eating and Weight Patterns-Revised (Yanovski, 1993), which has good psychometric properties in adolescents (Johnson et al., 1999). Those who indicated both overeating and loss of control were defined as positive for binge eating. We examined binge eating at EAT-I (baseline) for exclusion purposes and EAT-II (5 years after baseline) for the dependent variable in our analyses.

**Weight Status.**—Height and weight were assessed by trained members of the research team in a private area of the school during EAT-I. Participants were measured in light clothing without shoes. Body mass index (BMI) was calculated by dividing weight in kilograms by height in meters squared ( $\text{kg}/\text{m}^2$ ). Adolescent overweight/obesity was defined as BMI 85th percentile for age and sex (Centers for Disease Control and Prevention, 2000).

**Body Dissatisfaction.**—Body dissatisfaction was assessed using a modified version of the Body Shape Satisfaction Scale (Pingitore, Spring, & Garfield, 1997). The modified scale used in the present study included body features that are likely not affected by weight change, but that may be a source of body dissatisfaction (e.g. height), as well as upper body characteristics for appropriate use with males (Mond, van den Berg, Boutelle, Hannan, & Neumark-Sztainer, 2010; van den Berg et al., 2010). Participants rated their satisfaction with ten different body characteristics, including height, weight, body shape, waist, hips, thighs, stomach, face, body build, and shoulders (Cronbach's  $\alpha=0.92$ ). Responses to each body part were summed to create an overall score ranging from 10–50, with higher scores indicating greater body dissatisfaction. For our analyses, high body dissatisfaction was defined as scores above the gender-specific median of 22 for boys and 28 for girls.

**Dieting.**—Dieting was measured by asking the participant how often they had dieted in the past year. Dieting was defined as “changing the way you eat so you can lose weight.” Responses included: (1) never; (2) 1–4 times; (3) 5–10 times; (4) more than 10 times; and (5) I am always dieting. We classified participants who reported any dieting in the past year as dieters.

**Weight-Related Teasing.**—Participants were asked whether they had ever experienced weight-related teasing from family and friends, via the following questions: “Have you ever been teased or made fun of by family members because of your weight?” and “Have you ever been teased or made fun of by other kids because of your weight?” Response options were “Yes” and “No” (Thompson, Cattarin, Fowler, & Fisher, 2010). For each type of

teasing, participants were further asked, “If yes, how much did this bother you?” Response options were: “I have not been teased because of my weight,” “Not at all,” “A little bit,” “Somewhat,” and “Very much.” Participants were defined as being bothered by a given type of teasing if they answered affirmatively to the question about occurrence of that type of teasing (friend or family) and indicated that this teasing bothered them a little bit, somewhat, or very much.

**Food Insecurity.**—Food insecurity was assessed by a hunger frequency scale, adapted from the 1999 US Department of Agriculture Food Security/Hunger Core Module, Three Stage Design with Screeners (ERS, 1999), which asked “How often during the last 12 months have you been hungry because your family couldn’t afford food?” Responses categories were (1) almost every month, (2) some months, but not every month, (3) only one or two months, and (4) I have not been hungry for this reason. We defined food insecurity as any reported hunger in the past 12 months.

### Statistical Analysis

Modified Poisson regressions (Zou, 2004) were used to estimate risk ratios and 95% CIs for binge eating comparing those with versus those without each risk factor, stratified by high and low SES. To establish the temporal order between risk factors and binge eating, we examined the longitudinal association of each risk factor at EAT-I in relation to new onset binge eating at EAT-II in a sample restricted to those who denied binge eating at EAT-I. In addition to stratifying by SES, we also tested the interaction between each risk factor and SES in order to compare the risk ratios between groups directly. We first included risk factors in separate models. As a secondary analysis, we then included all risk factors in the same model to estimate each risk factor’s independent association with binge eating. While these analyses are important for identifying the most robust of these correlated risk factors, they are likely interrelated in complex ways such that the inclusion of all risk factors in a single model may wash out important effects. Thus, we present two sets of models, both adjusting for and not adjusting for all six risk factors.

Analyses were adjusted for potential common causes of the association between identified risk factors and binge eating. These included age (continuous), gender (male/female), race (dichotomized as white/nonwhite), and BMI at baseline. We dichotomized race/ethnicity as white/non-white, as opposed to a finer-grained breakdown, in order to retain adequate cell sizes across all analyses. Reassuringly, in analyses that did allow for a 5-category race adjustment, estimates remained largely unchanged, suggesting that the cruder race categorization does not result in significant residual confounding. As the models would not converge with 5-category race adjustment in all groups, we decided to adjust for white/non-white for uniformity across strata. Results from the models that would converge with a more nuanced racial breakdown are presented in Supplement 1. To account for differential attrition from EAT-I to EAT-II across sociodemographic groups, data were weighted using the response propensity method (Little, 1986). Using this method, the inverse of the estimated probability that a participant responded at EAT-II was used as the weight, resulting in an estimated sample that was representative of the original demographic composition at EAT-I.

## Results

### Prevalence of risk factors for binge eating by SES

Table 1 presents the descriptive characteristics by SES. Binge eating was prevalent among adolescents from both high (4.9%) and low (6.3%) SES backgrounds ( $p=.17$ ). A larger proportion of adolescents from a low SES background had overweight/obesity (26.1%) than those from a high SES background (18.9%,  $p<.001$ ). The proportion of low SES participants reporting high body dissatisfaction (50.7%) and dieting (43.3%) was larger than the proportion of high SES participants reporting those risk factors (40.7% and 33.6% respectively,  $p<.001$ ). A higher proportion of low SES participants reported being bothered by family weight teasing (15.2%), compared to the high SES participants (11.4%,  $p=.01$ ), although the prevalence of friend weight teasing was similar across the groups ( $p=.60$ ). Just over 9% of low SES participants reported food insecurity, in contrast to 3.4% of high SES participants ( $p<.001$ ).

### Association of risk factors with onset of binge eating in high and low SES adolescents

As hypothesized, several risk factors for binge eating were found to be more strongly related to onset of binge eating in high SES adolescents than in adolescents from a low SES background. These risk factors included overweight/obesity, body dissatisfaction, dieting, and family weight teasing. Adolescent overweight/obesity at EAT-I was more strongly related to binge eating at EAT-II in the high SES group (RR=3.2; 95%CI: 1.8, 5.7), than in the low SES group (RR=1.5; 95%CI: 0.9, 2.5; interaction  $p=.04$ ). High body dissatisfaction at EAT-I was associated with an almost three-fold higher risk for developing binge eating in the high SES group (RR=2.6; 95%CI: 1.2, 5.5), while it was unrelated to binge eating in the low SES group (RR=1.0; 95%CI: 0.6, 1.6). Interaction tests indicated that these differences across SES were statistically significant (interaction  $p<0.01$ ). The association of dieting with binge eating was also significantly different by SES (interaction  $p=.03$ ): In the high SES group, dieters had 4 times the risk of developing binge eating as non-dieters (95%CI: 2.0, 8.2), while in the low SES group, dieters had 2 times the risk for developing binge eating (95%CI: 1.2, 3.9). Finally, in the high-SES group, participants who experienced weight-related teasing from family had double the risk of binge eating compared to those who had not experienced family weight teasing (95%CI: 1.3, 4.23), but family weight teasing was unrelated to binge eating in the low SES group (RR=1.1; 95%CI: 0.6, 2.0; interaction  $p<0.03$ ). In contrast, friend weight teasing was not significantly associated with binge eating, and this did not differ by SES group (interaction  $p=.32$ ). Food insecurity at EAT-I was associated with an increased risk for endorsing binge eating at EAT-II in the low SES group (RR=1.4; 95%CI: 0.7, 2.8). Only 34 participants (3.4%) in the high SES group reported food insecurity, precluding calculation of an RR in this group.

In the mutually adjusted models, there was a suggestive though non-significant association between overweight/obesity and new onset binge eating in the high SES group (RR=2.0; 95%CI: 1.0, 4.1), but not the low SES group (RR=0.9; 95%CI: 0.4, 1.7). High body dissatisfaction remained a more salient predictor of binge eating in the high SES group (RR=1.7; 95%CI: 0.8, 3.9), compared to the low SES group (RR=0.8; 95%CI: 0.5, 1.3; interaction  $p=.02$ ). Dieting retained its association with binge eating in both the high

(RR=3.2; 95% CI: 1.4, 7.5) and the low (RR=2.2; 95% CI: 1.2, 4.3) SES groups. Family weight-related teasing remained associated with increased risk for binge eating in high SES (RR=1.9; 95% CI: 1.0, 3.6) but not low SES (RR=1.1; 95% CI: 0.6, 2.0) participants. The RRs for weight teasing from friends, and for food insecurity were hard to interpret, given that confidence intervals were wide and consistent with both elevated and decreased risks of binge eating associated with each risk factor.

## Discussion

In this study we examined how established risk factors may differentially contribute to risk for developing binge eating in higher vs. lower SES adolescents and young adults. Although the prevalence of body dissatisfaction and dieting were higher in youth from a low SES, we found that the association between body dissatisfaction and subsequent binge eating was significantly stronger in adolescents from high SES backgrounds. Dieting also carried a significantly higher relative risk for developing binge eating in the high SES group, compared to the low SES group. Similarly, we found that overweight/obesity was more strongly related to binge eating among adolescents from a high SES background, compared to those from a low SES background. It is possible that, given the higher prevalence rate of overweight/obesity in the low SES group, excess weight status is more conspicuous in the context of high SES and hence may more strongly drive body dissatisfaction, dieting, and other risk factors for binge eating. Further, these findings are consistent with the idea that preoccupation with the thin ideal and related attitudes and behaviors may be more impactful in those in a higher SES class, even if the related risk factors are less prevalent within this group.

Our findings partially supported our hypothesis that all weight-related teasing would carry a higher risk of developing binge eating in the higher SES group. Although prevalence rates for friend weight-related teasing did not differ by SES, we found that family weight-related teasing was more prevalent among adolescents from low SES backgrounds. However, we found that family, but not friend, weight-related teasing was associated with an increased risk for developing binge eating in the high SES group. Our group has previously found that adolescents whose parents engaged in conversations focused on weight were more likely to endorse binge eating (Berge et al., 2013). It is possible that parental preoccupation with their child's weight could co-occur with parental weight-related teasing, which has been found to be associated with binge eating (Haines et al., 2010). With regards to the lack of parallel effects for friend weight-related teasing, as children progress through adolescence the family unit is relatively stable, as compared to potentially shifting friend groups. Thus, the prolonged presence of family weight-related teasing could be more detrimental than weight-related teasing within the peer group.

Lastly, although food insecurity was associated with higher risk of binge eating in the low SES group, we were unable to compare this risk with the high SES group because of the low prevalence of food insecurity within the high SES group. A possible explanation for the elevated risk of binge eating in the low SES group is that food insecurity and deprivation related to not having enough food mimics the restrictive eating behaviors and dieting that are commonly believed to promote binge eating behaviors (and indeed were associated with risk



for binge eating in the high SES group). Further, it is possible that because those from a low SES are disproportionately exposed to stressful life events (Dohrenwend, 1973), including food insecurity, the relative importance of risk factors such as body dissatisfaction are washed out by SES-related factors. While the “paradoxical” association between food insecurity and obesity has been addressed, little attention has been given toward the association between food insecurity and binge eating. Our findings suggest the importance of reaching out to low-income communities, which may have little or no access to treatment facilities, with messages and interventions to prevent binge eating. Although the main drive needs to be to decrease food insecurity, there is a simultaneous need to provide accessible interventions aimed at treatment and prevention for those experiencing food insecurity.

As binge eating is a predictor of excess weight gain (Fairburn et al., 2000), it is possible that high obesity levels among food insecure populations (Franklin et al., 2012; Eisenmann, Gundersen, Lohman, Garasky, & Stewary, 2011) may stem from pressures related to limited food access. Therefore, among youth from low SES backgrounds, it is crucial to address the risk factor of food insecurity. Current federal programs focused on addressing sustained food availability include the Supplemental Nutrition Assistance Program (SNAP), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and the National School Lunch Program (Coleman-Jensen et al., 2017). However, among the 15.6 million U.S. households experiencing food insecurity, only 59% reported that they had participated in one or more of the above programs in the previous month (Coleman-Jensen et al., 2017). Further, in a recent review of the affordability of following the federal nutritional recommendations, Mulik and Haynes-Maslow (2017) found that the monetary benefits provided by the SNAP program may not be enough to match the federal nutrition guidelines. Although programs are available to assist youth and families suffering from food insecurity, they may not be accessible to all those in need. It is necessary to address these shortcomings and ensure that every household in need of federal assistance has the means to acquire adequate nutritional resources. Policymakers should focus on disseminating psychoeducation on healthy eating behaviors, and resources for federal nutrition assistance programs.

Collectively, these findings help to identify those at a higher risk for binge eating and point to the potential utility of tailoring intervention and prevention methods across diverse populations. Our results suggest that efficacious interventions for all adolescents should focus on reducing body dissatisfaction and dieting behaviors that may stem from perceived deviation from the thin ideal. However, our results also show that these risk factors may be less important than others, such as food insecurity, in low SES respondents. Those living in a low SES environment may benefit from programs providing education around healthier food choices in the context of budget concerns, and strategies for coping with inadequate food supply and controlling eating behaviors in the presence of food after a period of deprivation. Finally, the fact that these commonly-studied risk factors had more limited associations with binge eating in adolescents from low SES backgrounds than those from high SES backgrounds suggests a need for a more comprehensive understanding of the etiology of disordered eating in this high-risk but understudied population.

This study has several attributes that distinguish it from previous studies. First, survey data were collected from a large, ethnically diverse sample. Second, we were able to analyze survey data prospectively across two time points, allowing us to investigate how SES moderates risk for new onset of binge eating. Last, we chose to explore a broad range of risk factors in our analyses. Limitations include the use of brief self-report survey items in the place of gold-standard measures in assessing the variables used in this study. Additionally, limited sample sizes did not allow for stratification by weight status or a more nuanced breakdown of race/ethnicity across all analyses. Race and ethnicity are highly correlated with SES in the United States, and there may be racial/ethnic associations that we were not able to address due to the limited sample sizes within specific racial/ethnic groups. We believe that this is an area that should be addressed in future research.

In conclusion, overweight/obesity, body dissatisfaction, dieting, and family weight-related teasing were stronger predictors of binge eating behaviors in adolescents from a higher SES background than in adolescents from a lower SES background. Overweight/obesity, dieting, and food insecurity among adolescents living in a low SES environment were related to an increased risk in binge eating. Future research should explore other moderating factors relating to SES and binge eating that were not explored (e.g. poverty-related stress or adversity related to poverty status) in an effort to provide efficacious interventions to those of varying SES.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**Table 1.**

## Descriptive Statistics

Variable:	High SES Parental education college	Low SES Parental education < college	<i>p</i>
	% (N)	% (N)	
Gender			
<i>Male</i>	50.3 (499)	44.6 (529)	
<i>Female</i>	49.7 (493)	55.4 (658)	0.008
Ethnicity/race			
<i>White</i>	80.7 (795)	49.8 (587)	
<i>Black</i>	6.3 (62)	13.2 (156)	
<i>Hispanic</i>	1.9 (19)	5.7 (67)	
<i>Asian</i>	9.6 (96)	27.3 (322)	
<i>Other</i>	1.3 (13)	4.0 (47)	<0.001
Overweight/obesity (% BMI ≥ 85 <sup>th</sup> percentile)			
<i>Not overweight</i>	81.1 (768)	73.9 (816)	
<i>Overweight/obesity</i>	18.9 (179)	26.1 (289)	<0.001
High body dissatisfaction			
<i>gender-specific median</i>	59.3 (568)	49.3 (553)	
<i>&gt;gender-specific median</i>	40.7 (390)	50.7 (568)	<0.001
Dieting			
<i>Never in past year</i>	66.4 (657)	56.7 (670)	
<i>Ever in past year</i>	33.6 (333)	43.3 (511)	<0.001
Bothered by family weight teasing			
<i>None or not bothered</i>	88.6 (860)	84.8 (978)	
<i>Bothered by teasing</i>	11.4 (111)	15.2 (175)	0.01
Bothered by friend weight teasing			
<i>None or not bothered</i>	81.2 (788)	80.2 (926)	
<i>Bothered by teasing</i>	18.8 (183)	19.8 (228)	0.60
Food insecurity (hungry because could not afford more food)			
<i>Never in past year</i>	96.6 (953)	90.7 (1068)	
<i>Ever in past year</i>	3.4 (34)	9.3 (110)	<0.001
Binge eating with loss of control (time 2)			
<i>Never in past year</i>	95.1 (943)	93.7 (1112)	
<i>Ever in past year</i>	4.9 (49)	6.3 (75)	0.17

Note: SES=socioeconomic status

**Table 2.**

Longitudinal analysis in separate models

Risk factor	High SES			Low SES			p <sup>†</sup>
	% with binge (n)	RR	(95% CI)	% with binge (n)	RR	(95% CI)	
Overweight/obesity (% BMI 85 <sup>th</sup> percentile) <sup>a</sup>	No	3.9% (30)	Ref	--	5.5% (45)	Ref	--
	Yes	9.5% (17)	3.2	(1.8, 5.7)	8.3% (24)	1.5	(0.9, 2.5) 0.04
High Body Dissatisfaction (> gender-specific median of 22 for boys and 28 for girls) <sup>b</sup>	No	2.5% (14)	Ref	--	5.8% (32)	Ref	--
	Yes	8.7% (34)	2.6	(1.2, 5.5)	6.3% (36)	1.0	(0.6, 1.6) 0.01
Dieting (ever/never over past year) <sup>b</sup>	No	1.8% (12)	Ref	--	3.7% (25)	Ref	--
	Yes	11.1% (37)	4.0	(2.0, 8.2)	9.8% (50)	2.2	(1.2, 3.9) 0.03
Bothered by family weight teasing <sup>b</sup>	No	3.7% (32)	Ref	--	6.0% (59)	Ref	--
	Yes	15.3% (17)	2.3	(1.3, 4.3)	9.1% (16)	1.1	(0.6, 2.0) 0.03
Bothered by friend weight teasing <sup>b</sup>	No	4.1% (32)	Ref	--	5.6% (52)	Ref	--
	Yes	9.3% (17)	1.7	(0.9, 3.0)	9.2% (21)	1.4	(0.7, 2.7) 0.32
Food Insecurity (reported any hunger in past 12 months) <sup>b</sup>	No	5.0% (48)	Ref	--	5.9% (63)	Ref	--
	Yes	0.0% (0)	-- <sup>‡</sup>	-- <sup>‡</sup>	9.1% (10)	1.4	(0.7, 2.8) -- <sup>‡</sup>

<sup>a</sup> Analyses adjusted for age, gender, and race/ethnicity.

<sup>b</sup> Analyses adjusted for age, gender, race/ethnicity, and body mass index (kg/m<sup>2</sup>).

SES = socioeconomic status; RR = relative risk; CI = confidence intervals; Ref = reference value



$\beta$  for interaction between risk factor and SES in sociodemographic and BMI adjusted models

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$\beta$  Sparse data; models would not converge

**Table 3.**

Longitudinal analysis in mutually adjusted models

<i>Risk factor</i>	High SES			Low SES			<i>p</i> <sup>†</sup>
	% with binge (n)	RR	(95% CI)	% with binge (n)	RR	(95% CI)	
Overweight/obesity (% BMI 85 <sup>th</sup> percentile)	No	3.9% (30)	Ref	--	5.5% (45)	Ref	--
	Yes	9.5% (17)	2.0	(1.0, 4.1)	8.3% (24)	0.9	(0.4, 1.7) 0.22
High Body Dissatisfaction (> gender-specific median of 22 for boys and 28 for girls)							
No	2.5% (14)	Ref	--	5.8% (32)	Ref	--	--
Yes	8.7% (34)	1.7	(0.8, 4.0)	6.3% (36)	0.8	(0.5, 1.3)	0.02
Dieting (ever/never over past year)							
No	1.8% (12)	Ref	--	3.7% (25)	Ref	--	--
Yes	11.1% (37)	3.4	(1.5, 7.8)	9.8% (50)	2.4	(1.3, 4.6)	0.27
Bothered by family weight teasing							
No	3.7% (32)	Ref	--	6.0% (59)	Ref	--	--
Yes	15.3% (17)	1.8	(0.9, 3.5)	9.1% (16)	1.1	(0.6, 2.0)	0.13
Bothered by friend weight teasing							
No	4.1% (32)	Ref	--	5.6% (52)	Ref	--	--
Yes	9.3% (17)	1.2	(0.6, 2.2)	9.2% (21)	1.2	(0.6, 2.5)	0.93
Food Insecurity (reported any hunger in past 12 months)							
No	5.0% (48)	Ref	--	5.9% (63)	Ref	--	--
Yes	0.0% (0)	-- <sup>‡</sup>	-- <sup>‡</sup>	9.1% (10)	1.1	(0.5, 2.6)	-- <sup>‡</sup>

*Note:* All analyses adjusted for age, gender, and race/ethnicity.

SES = socioeconomic status; RR = relative risk; CI = confidence intervals; Ref = reference value

<sup>†</sup> *p* for interaction between risk factor and SES in sociodemographic and BMI adjusted models

<sup>‡</sup> Sparse data; models would not converge