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### Authors

Nagata, Jason M  
Garber, Andrea K  
Tabler, Jennifer  
[et al.](#)

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## Disordered Eating Behaviors and Cardiometabolic Risk among Young Adults with Overweight or Obesity

Jason M. Nagata, MD, MSc<sup>a</sup>, Andrea K. Garber, PhD, RD<sup>a</sup>, Jennifer Tabler, PhD<sup>b</sup>, Stuart B. Murray, PhD<sup>c</sup>, Eric Vittinghoff, PhD<sup>d</sup>, and Kirsten Bibbins-Domingo, MD, PhD, MAS<sup>d,e</sup>

<sup>a</sup>Division of Adolescent and Young Adult Medicine, Department of Pediatrics, University of California, San Francisco, San Francisco, CA

<sup>b</sup>Department of Sociology and Anthropology, University of Texas Rio Grande Valley, Edinburg, TX

<sup>c</sup>Department of Psychiatry, University of California, San Francisco, San Francisco, CA

<sup>d</sup>Department of Epidemiology and Biostatistics, University of California, San Francisco, San Francisco, CA

<sup>e</sup>Department of Medicine, University of California, San Francisco, San Francisco, CA

### Abstract

**Objective:** To determine if unhealthy weight control behaviors or binge eating behaviors among young adults with overweight/obesity are associated with BMI change and cardiometabolic risk at seven-year follow-up.

**Methods:** We used longitudinal cohort data from 5,552 young adults with overweight/obesity at baseline (18–24 years) with seven-year follow-up (24–32 years) from the National Longitudinal Study of Adolescent to Adult Health. Baseline predictors were: 1) unhealthy weight control behaviors such as vomiting, fasting, skipping meals, or laxative/diuretic use to lose weight or 2) binge eating behaviors. Participants reporting either unhealthy weight control behaviors or binge eating behaviors were considered to engage in any disordered eating behavior (DEB). Outcomes at seven-year follow-up were BMI change, incident diabetes, incident hypertension, and incident hyperlipidemia.

**Results:** Young adults with overweight/obesity reporting unhealthy weight control behaviors at baseline had higher BMI and weight at seven-year follow-up than those without unhealthy weight control behaviors. In regression models adjusting for baseline BMI, race/ethnicity, age, and education, unhealthy weight control behaviors were associated with greater change in BMI in both sexes and binge-eating behavior at baseline was associated with greater odds of incident hyperlipidemia (OR 1.90, 95% CI 1.29–2.79) at seven-year follow-up in males.

**Conclusions:** The higher risk for increased BMI (in both males and females) and incident hyperlipidemia (in males) over time in young adults with overweight/obesity who engage in DEBs

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**Corresponding Author Contact Info:** Jason M. Nagata. 3333 California Street, Suite 245, San Francisco, California 94143, [jasonnagata@gmail.com], +1 (626) 551-1932.

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underscores the need to screen for DEBs in this population and provide referrals and tailored interventions as appropriate.

### Keywords

eating behaviors; obesity; overweight; hyperlipidemia; young adult; body mass index

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### Introduction

By national estimates in the United States, 60.3% of younger adults aged 20–39 have a weight status classified as overweight or obese (Ogden, Carroll, Kit, & Flegal, 2014). Studies have also demonstrated that over 40% of female and over 20% of male young adults engage in disordered eating behaviors (DEBs) (Goldschmidt et al., 2018) including binge-eating behavior or unhealthy weight control behaviors such as vomiting, fasting, skipping meals, and laxative/diuretic use (Stephen, Rose, Kenney, Rosselli-Navarra, & Weissman, 2014). DEBs are associated with poor psychosocial health including increased risk for eating disorders (McKnight Investigators, 2003; Striegel-Moore & Bulik, 2007), alcohol and tobacco use (French, Story, Downes, Resnick, & Blum, 1995), and depression (Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011).

Longitudinal studies have the ability to determine long-term health consequences of DEBs, but data are limited in young adulthood. Prior longitudinal studies have focused on the adolescent age group and found that dieting in adolescence is associated with future weight gain (Field et al., 2003; Stice, Presnell, Shaw, & Rohde, 2005; Viner & Cole, 2006); however, findings have not been consistent across all studies (Klesges, Klem, Ekins, & Klesges, 1991; Tiggemann, 1994). One Minnesota-based longitudinal study found that adolescents using DEBs had increased body mass index (BMI) and a greater risk for being overweight at five-year (Neumark-Sztainer et al., 2006) and 10-year (Neumark-Sztainer, Wall, Story, & Standish, 2012) follow-up. The association between DEBs and cardiometabolic risk has not been well studied, particularly in the context of young adults with overweight/obesity. Young adulthood represents an under-researched developmental period that is distinct from adolescence (Stroud, Walker, Davis, & Irwin, 2015) during which persons can begin to develop cardiometabolic risk factors (Skinner, Perrin, Moss, & Skelton, 2015). Young adults have a worse health profile and are less likely to eat breakfast, exercise, and get regular physical and dental checkups than adolescents (Stroud et al., 2015).

The present study aims to fill the gap in scientific knowledge on the longitudinal effects of DEBs in young adulthood. The objective of this study is to determine the association in a large national sample of young adults with overweight/obesity between DEBs, BMI gain, and increased cardiometabolic risk at seven-year follow-up. We specifically examined associations with incident diabetes, hypertension, and hyperlipidemia.

## Methods

### Sample

We used data from the National Longitudinal Study of Adolescent to Adult Health (Add Health), a longitudinal cohort study of a nationally representative sample of adolescents in the United States who were followed into adulthood (Harris et al., July 2017). The original adolescent sample (1994–1995, 11–18 years old, Wave I) used systematic sampling methods and implicit stratification to ensure that the high schools (n=80) and middle schools (n=52) were representative of US schools with respect to region of country, urbanicity, size, type, and ethnicity. There have been five waves of data collection, which is coordinated by the Carolina Population Center. For this study, we used restricted-use data from Wave III (defined as baseline for this study), collected from 2001 to 2002 when subjects were 18–24 years old, and Wave IV (defined as seven-year follow-up for this study), collected in 2008 when subjects were 24–32 years old. Wave III was the only wave that collected detailed information about DEBs, and Wave IV was the only wave that collected laboratory data for diabetes and cholesterol. Further details about the study design can be found elsewhere (Harris et al., 2017). The University of North Carolina Institutional Review Board approved all Add Health study procedures, and the University of California, San Francisco Institutional Review Board deemed this specific project exempt.

We included all young adults in Add Health with overweight or obesity at baseline. We excluded young adults who were missing data for the outcomes including BMI change, incident diabetes, hypertension, and hyperlipidemia (n=1,350). We also excluded women who were pregnant at seven-year follow-up (n=188) since this could affect their BMI change and other laboratory measurements.

### Procedures

At baseline and seven-year follow-up, an interviewer traveled to the home or another suitable location for the research subject. Written informed consent was obtained from the subject. Interviews lasted approximately 90 minutes. Computer-assisted self-interview technology was used by participants to answer potentially sensitive questions. At seven-year follow-up, immediately following the interview, interviewers took physical measurements and collected biological specimens.

### Measures

#### Baseline measures

**Unhealthy weight control behaviors:** Individuals who self-reported behaviors such as, “made yourself vomit, fasted or skipped meals, took laxatives, or diuretics” during the past seven days in order to keep from gaining weight (yes versus no) were coded as having unhealthy weight control behaviors. Exercise and dieting behaviors alone were not considered “unhealthy” weight control behaviors. Our measurement of unhealthy weight control behaviors mirrors previous studies using Add Health data (see Stephen et al., 2014; Tabler & Utz, 2015). These questions were adapted from validated eating behavior measures such as in the Adolescent Health Survey and similar to Project Eating Among Teens (85% agreement 1 behavior,  $r=0.76$ ) (Neumark-Sztainer, Story, Resnick, & Blum, 1998;

Neumark-Sztainer, 2010), except that the time frame was seven days to be consistent with the seven day time frame of other validated questions in the Add Health survey on nutrition and physical activity.

**Binge-eating behaviors:** Individuals who self-reported “eaten so much in a short period of time that [they] would have been embarrassed if others had seen them do it” in the past seven days were coded as having binge-eating behavior. This question was adapted from validated eating behavior measures such as in the Adolescent Health Survey and similar to Project Eating Among Teens (89% agreement) (Neumark-Sztainer et al., 1998; Neumark-Sztainer, 2010), except that the time frame was seven days to be consistent with the seven day time frame of other validated questions in the Add Health survey on nutrition and physical activity.

**Disordered eating behaviors (DEBs):** Participants who self-reported unhealthy weight control behaviors or binge-eating behaviors in the past seven days were considered to have DEBs.

### Seven-year follow-up measures

**Incident diabetes:** Respondents were classified as having incident diabetes if they had a fasting glucose  $\geq 126$  mg/dl, non-fasting glucose  $\geq 200$  mg/dl, hemoglobin A1c  $\geq 6.5\%$  (American Diabetes Association, 2014), self-reported history of diabetes except during pregnancy, or used anti-diabetic medication in the past four weeks at follow-up, and a negative self-reported history of diabetes, except during pregnancy, at baseline.

**Incident hypertension:** Incident hypertension was defined as a measured systolic blood pressure  $\geq 140$  mmHg or a measured diastolic blood pressure  $\geq 90$  mmHg (Chobanian et al., 2003) using the average of two measurements 30 seconds apart from a factory calibrated, Microlife BP3MC1-PC-IB oscillometric blood pressure monitor (MicroLife USA, Inc.; Dunedin, FL) or an affirmative response to the question “have you ever been diagnosed with high blood pressure or hypertension” at follow-up, and a negative response to the question “have you ever been diagnosed with high blood pressure or hypertension” at baseline.

**Incident hyperlipidemia:** Incident hyperlipidemia was defined as total cholesterol decile corresponding to the proportion of young adults with total cholesterol  $\geq 240$  mg/dL in the National Health and Nutrition Examination Surveys (Gooding et al., 2016; Shay et al., 2012) or an affirmative response to the question “have you ever been diagnosed with high cholesterol, triglycerides, or lipids” at follow-up, and a negative response to the question “have you ever been diagnosed with high cholesterol, triglycerides, or lipids” at baseline.

### Measured at both baseline and seven-year follow-up

**Body mass index (BMI)** was calculated using the standard formula weight (kilograms) divided by height (meters) squared ( $BMI = \text{weight}/\text{height}^2$ ). Weight (Health-o-meter 844KL High Capacity Digital Bathroom Scale; Jarden Corporation; Rye, NY) and height (Carpenter’s square, steel tape measure) were measured by the interviewer. Self-reported

height or weight was used if not measured by the interviewer (n=712). Change in BMI was defined as BMI at seven-year follow-up subtracted from baseline BMI.

**Weight status:** Young adults with underweight (BMI <18.5), normal weight (18.5 ≤ BMI < 25), overweight (25 ≤ BMI < 30), or obesity (BMI ≥ 30), including severe obesity (BMI ≥ 40), were classified in accordance with guidelines from the US Centers for Disease Control and Prevention (Centers for Disease Control (CDC), 2012).

## Covariates

**Age and sex** were based on self-report.

**Race/ethnicity** was based on self-report, based on the categories created by the Add Health survey design: non-Hispanic White; non-Hispanic Black/African American; Hispanic/Latino; non-Hispanic Asian or Pacific Islander; American Indian/Native American; or other.

**Education** was based on self-report and dichotomized into high school or less versus more than high school, similar to other large population-based studies in young adults (Hudson, Puterman, Bibbins-Domingo, Matthews, & Adler, 2013; Wang et al., 2009). Of socioeconomic markers (i.e., education, income, and occupation) education is found to be most robustly associated with a variety of mental and physical health outcomes. For this reason, education is often the standard socioeconomic proxy utilized in epidemiological studies (Araya, Lewis, Rojas, & Fritsch, 2003; Geyer, Hemstrom, Peter, & Vagero, 2006; Winkleby, Jatulis, Frank, & Fortmann, 1992) including in young adults (Hudson et al., 2013; Wang et al., 2009) and in eating disorders (Hay, Girosi, & Mond, 2015; Tabler & Utz, 2015).

## Statistical analysis

Data analysis was performed in 2017 using STATA 15.0. Given sex differences in the presentation of DEBs (Murray et al., 2017; Murray, Accurso, Griffiths, & Nagata, 2018), all analyses were stratified by sex. We compared unadjusted differences in outcomes at seven-year follow-up by baseline presence and absence of DEBs using independent samples t-tests for continuous variables and Chi-square tests for categorical variables. We assessed the association between DEBs and cardiometabolic risk at seven-year follow-up using regression models, adjusting for potential confounding variables. Linear regression analysis was used to identify the association between change in BMI as the continuous dependent variable, and 1) unhealthy weight control behaviors, 2) binge-eating behaviors, or 3) either unhealthy weight control behaviors or binge-eating behaviors (defined as DEBs) as the independent variables, adjusting for race/ethnicity, age, baseline BMI, and education. Logistic regression analysis was used to identify associations with incident diabetes, incident hypertension, and incident hyperlipidemia as the dependent variables, and DEBs, unhealthy weight control behaviors, or binge-eating behavior as the independent variables, adjusting for race/ethnicity, age, baseline BMI, and education. DEBs that were significantly associated with cardiometabolic outcomes after adjusting for the prior covariates were also adjusted for change in BMI (in addition to baseline BMI). In a sensitivity analysis, we performed multiple imputation of missing outcome data at seven-year follow-up (Sterne et al., 2009).  $P < 0.05$  was considered statistically significant.

## Results

Overall, 5,552 of 7,444 eligible young adults with overweight/obesity at baseline met inclusion criteria (Online Appendix A). Baseline demographic and health characteristics of the young adults included in the sample are presented in Table 1, by sex and absence or presence of DEBs. Overall, 23% reported DEBs, with 17.6% reporting unhealthy weight control behaviors to lose weight and 7.9% reporting binge-eating behaviors. Young adults with overweight/obesity reporting DEBs at baseline had higher BMI and higher weight at baseline than those without DEBs in both males and females. The prevalence of DEBs by weight status is shown in Figure 1 (unhealthy weight control behaviors) and Figure 2 (binge-eating behaviors). Persons of non-White race/ethnicity make up a majority of young men and women who engage in DEBs.

Unadjusted comparisons of cardiometabolic outcomes at seven-year follow-up by presence or absence of baseline DEBs are presented in Table 2. Male young adults with overweight/obesity reporting DEBs at baseline had greater BMI increase than males without DEBs at baseline (2.97 kg/m<sup>2</sup> versus 2.32 kg/m<sup>2</sup>,  $p=0.005$ , Figure 3) in unadjusted comparisons. Female young adults with overweight/obesity reporting DEBs at baseline had greater BMI increase than females without DEBs at baseline; however, the difference was not statistically significant in unadjusted comparisons (2.83 kg/m<sup>2</sup> versus 2.47 kg/m<sup>2</sup>,  $p=0.108$ ). There were no statistically significant differences in incident diabetes, hypertension, or hyperlipidemia by presence or absence of baseline DEBs in males or females in unadjusted comparisons.

Unadjusted comparisons of cardiometabolic outcomes at seven-year follow-up by presence or absence of baseline unhealthy weight control behaviors are presented in Table 3. Young adults with overweight/obesity reporting unhealthy weight control behaviors had greater BMI gain and higher rates of incident diabetes than those without unhealthy weight control behaviors in unadjusted comparisons. There were no statistically significant differences in incident hypertension or hyperlipidemia by presence or absence of baseline unhealthy weight control behaviors in males or females in unadjusted comparisons.

Unadjusted comparisons of cardiometabolic outcomes at seven-year follow-up by presence or absence of binge-eating behaviors are presented at the bottom of Table 3. There were no statistically significant differences in BMI gain, incident diabetes, or incident hypertension by presence or absence of baseline binge-eating behaviors in males or females in unadjusted comparisons. In unadjusted comparisons for BMI, 28.2% of males reporting binge-eating behavior had incident hyperlipidemia compared to 17.1% males who did not report binge-eating behavior (Pearson chi square 11.38,  $p=0.001$ , Figure 4). There were no statistically significant differences in incident hyperlipidemia by presence or absence of baseline binge-eating behaviors in females in unadjusted comparisons for BMI.

Regression models with type of disordered eating behavior as the independent variable and cardiometabolic risk as the dependent variable, adjusted for baseline BMI, race/ethnicity, age, and education, are presented in Table 4. In linear regression models, unhealthy weight control behaviors and any disordered eating behavior but not binge-eating behaviors at baseline were associated with greater BMI increase in males and females at seven-year

follow-up, adjusting for baseline BMI, race/ethnicity, age, and education (Table 4). In adjusted logistic regression models, there was no statistically significant association between unhealthy weight control behaviors, binge-eating behavior, or any DEB, and incident diabetes. In adjusted logistic regression models, there was no statistically significant association between unhealthy weight control behaviors, binge-eating behavior, or any DEB, and incident hypertension. In logistic regression models, binge-eating behavior at baseline was associated with greater odds of incident hyperlipidemia in males (OR 1.90, 95% confidence interval 1.29–2.79) but not in females (OR 0.81, 95% CI 0.52–1.24) at seven-year follow-up, adjusting for baseline BMI, age, race/ethnicity, and education (Table 4). Binge-eating behavior at baseline remained associated with greater odds of incident hyperlipidemia in males (OR 1.88, 95% confidence interval 1.28–2.76) at seven-year follow-up, even when adjusting for change in BMI and baseline BMI, in addition to age, race/ethnicity, and education.

The full regression models for the unhealthy weight control or binge-eating behaviors that had statistically significant associations with cardiometabolic outcomes are listed in Appendix B. Black/African American race/ethnicity was associated with greater change in BMI in males ( $B=0.52$ ,  $p=0.027$ ) and females ( $B=1.11$ ,  $p<0.001$ ) but protective of incident hyperlipidemia in males (OR 0.74, 95% CI 0.55–1.00) in models adjusting for DEBs, education, age, and baseline BMI. In a sensitivity analysis (not shown), results with multiple imputation of missing outcome data were consistent with results that excluded missing outcome data.

## Discussion

We find that young adults with overweight/obesity gain weight, regardless of whether or not they engage in DEBs, but engaging in DEBs at baseline is associated with greater BMI increase at seven-year follow-up in adjusted analyses. In particular, engagement in vomiting, fasting, skipping meals, or using diuretics/laxatives to lose weight were the DEBs that were specifically associated with higher BMI seven years later, not binge eating. These findings are important because many young adults engage in DEBs with the intention to lose weight in the long term. Furthermore, we find that young adult males with overweight/obesity who report binge-eating behaviors have greater odds of incident hyperlipidemia than those who do not report binge-eating behaviors. Identifying young adults who engage in these DEBs and providing interventions and referrals for support may therefore be important for their future adult health.

Although previous longitudinal studies have shown that dieting and DEBs in adolescence may be predictive of weight gain in most (Neumark-Sztainer et al., 2006; Neumark-Sztainer et al., 2012; Stice et al., 2005; Viner & Cole, 2006) but not all (Klesges et al., 1991; Tiggemann, 1994) studies, these studies have not linked DEBs to cardiometabolic risk in young adulthood. This study examines this question in young adults, an understudied population who have been shown to have a worse health profile and to be less likely to eat breakfast, exercise, and get regular physical and dental checkups than adolescents (Stroud et al., 2015). Finally, we use a large national sample generalizable to young adult populations in the United States.



The mechanisms by which unhealthy weight control behaviors lead to weight gain may be multifactorial (Dulloo, Jacquet, Montani, & Schutz, 2015). Studies have found that unhealthy weight control behaviors themselves contribute to weight gain (Pietilainen, Saarni, Kaprio, & Rissanen, 2012). One study examined monozygotic twin pairs discordant for intentional weight loss, finding that the twin with at least one weight loss episode gained 0.4 kg/m<sup>2</sup> greater BMI than their non-dieting sibling at 25 years of age, despite similar baseline BMI levels (Pietilainen et al., 2012). Unhealthy weight control behaviors may themselves predispose to eating disorders, disinhibition, and compensatory eating, leading to weight gain (Neumark-Sztainer, Wall, Haines, Story, & Eisenberg, 2007; Viner & Cole, 2006). Dietary restraint and hunger are known to increase both the incentive salience and reward processing of food, particularly calorically dense foods, which turn can facilitate greater consumption of these foods (Epstein, Truesdale, Wojcik, Paluch, & Raynor, 2003; Siep et al., 2009).

We found that binge-eating behaviors among young adult males with overweight/obesity were associated with incident hyperlipidemia at seven-year follow-up. Binge-eating disorder has been shown to be associated with dyslipidemia in children (Tanofsky-Kraff et al., 2012) and older adults (Hudson et al., 2010; Succurro et al., 2015), but this has not been noted in young adults in non-clinical samples. The greater hyperlipidemia incidence in males but not females who reported binge-eating behavior may be explained by sex differences in eating disorders, DEBs, and cardiometabolic risk (Murray et al., 2017; Murray et al., 2018). Young adult males in the US (Shay et al., 2012) and in this sample have higher rates of hyperlipidemia than females overall. Males are also more likely to have truncal (abdominal) obesity than females, and abdominal obesity has been linked to higher triglycerides (Tresaco et al., 2009). Higher levels of triglycerides and metabolic syndrome have been reported in men compared to women with history of binge-eating disorder (Udo et al., 2013). This was thought to potentially be due to lower treatment seeking behavior in males and more active and earlier attempts to address health and weight status by females (Udo et al., 2013). Finally, since disordered eating is more common in females than males, perhaps the males who reported binge-eating behaviors were overall more disordered than the females who reported these behaviors (Murray et al., 2017). Better understanding the etiologies of sex differences in eating disorders and cardiometabolic risk is an important area of future research.

We found higher rates of diabetes in young adults with overweight/obesity reporting unhealthy weight control behaviors compared to those not reporting unhealthy weight control behaviors in comparisons not adjusted for BMI. However, this relationship was no longer significant after adjusting for BMI. Prior studies in middle-aged men and women found that the association between weight cycling and diabetes was no longer significant after adjustment for overall weight status (Field et al., 2004; Waring, Eaton, Lasater, & Lapane, 2010). While the effects of the eating behavior on diabetes may be explained by the greater weight gain in these individuals, it is unclear if there is a direct impact on worsening insulin resistance and degradation of beta cell secretory capacity.

We did not see an association between binge-eating behavior and diabetes or hypertension that has been reported in an older adult (mean age 47 years) sample with binge-eating

disorder (Hudson et al., 2010), possibly because 1) our sample was much younger and may develop more cardiometabolic risk later in life, 2) other studies examined clinical samples with binge-eating disorder whereas ours was a community sample with self-reported binge-eating behavior (but not binge-eating disorder), and 3) the seven-day timeframe may have been too short to develop cardiometabolic risk. Future research may examine the effect of DEBs over a longer time period on cardiometabolic risk. It is also possible that due to publication bias other studies with negative findings have not been published.

We found that Black/African American race/ethnicity was associated with greater BMI gain but protective of incident hyperlipidemia in males at seven-year follow-up. A larger proportion of Black/African American younger adults (ages 20–39) live with obesity but a smaller proportion have hyperlipidemia compared to White younger adults in the National Health and Nutrition Examination Surveys (Shay et al., 2012). We also found that persons of non-White race/ethnicity make up a majority of young adult men and women who engage in DEBs and may be important populations for screening and future research.

Given that DEBs are associated with important health consequences such as weight gain and hyperlipidemia in males, health care providers should screen for and discourage these practices particularly in adolescent and young adult populations. This is especially important as recent studies suggest that clinicians often overlook screening for DEBs, especially among young adults with overweight/obesity (Goldschmidt, Wall, Loth, & Neumark-Sztainer, 2015). Overweight/obesity and DEBs are often studied and treated separately as contrasting entities at opposite ends of the weight spectrum; however, DEBs are actually more common among adolescents and young adults with overweight/obesity compared to young adults with normal weight (Neumark-Sztainer et al., 2007). The American Academy of Pediatrics has recently published guidelines on preventing both obesity and eating disorders in adolescents, recommending discouraging DEBs, promoting a positive body image, encouraging more frequent family meals, encouraging families not to talk about weight but rather healthy eating, inquiring about a history of mistreatment or bullying, and carefully monitoring weight loss in an adolescent who needs to lose weight (Golden et al., 2016). However, we are unaware of similar guidelines specifically for young adults.

Our study has several limitations that merit acknowledgement. Objective cardiometabolic measures were not collected at baseline; therefore, some subjects may have had hypertension, diabetes, or hyperlipidemia at baseline but been unaware of these diagnoses and therefore unable to self-report a previous diagnosis. However, we did have baseline and follow-up BMI and some young adults did have self-reported hypertension, diabetes, or hyperlipidemia at baseline that had been diagnosed by a physician. Total cholesterol was recorded in deciles, but we used procedures established by other Add Health investigators that corresponded to total cholesterol  $\geq 240$  mg/dL (Gooding et al., 2016). We only had blood pressure measurement from one day at seven-year follow-up, whereas three would be required for a medical diagnosis of hypertension. There was the possibility for selection bias since we excluded subjects with missing data on the outcome measures ( $n=1,350$ ) or due to pregnancy ( $n=188$ ). Although there were no statistically significant differences in age or baseline cardiometabolic measures of those included versus excluded (Appendix A), a higher proportion of White subjects compared to Black/African American or Hispanic/

Latino subjects and subjects with higher education compared to lower education (in males) were retained. This is a substantial limitation given that these data included a large portion of the racial/ethnic diversity in the sample. However, we performed a sensitivity analysis (not shown) and found consistent results when using multiple imputation versus exclusion of missing outcome data. While there are many strengths of longitudinal surveys, one pervasive issue is that of attrition, which was the primary driver of missing data at time of follow-up (outcome measures). Self-reported height or weight was used in 712 subjects (13% of sample); however the correlation between self-reported height and weight and clinician-administered measures is 0.98–0.99 in general population samples (Pursey, Burrows, Stanwell, & Collins, 2014). Due to the design of the Add Health survey, we were unable to measure the severity or duration of reported DEBs. DEBs were based on self-report, a method that is may be subject to reporting bias. The timeframe used for measuring DEBs in Add Health was shorter (past seven days) than is often asked in other measures of DEBs such as the Eating Disorder Examination Questionnaire (past 28 days) (Fairburn & Beglin, 2008), which may have underestimated the prevalence of DEBs compared to other measures. Although “overweight” and “obesity” are based on definitions from the CDC, these terms may be considered stigmatizing.

Nonetheless, the limitations were offset by several strengths. The study used national longitudinal data with over 5,000 young adults in the community, and therefore did not contain limitations inherent to studies of clinical samples. We used objective measures of the outcomes via direct measurement of laboratory, blood pressure, and anthropometric data.

## Conclusion

We find that despite their efforts to lose weight, young adults with overweight/obesity who engage in vomiting, fasting, skipping meals, or using diuretics/laxatives to lose weight are likely to gain weight in the long-run, and binge-eating behaviors are associated with greater odds of incident hyperlipidemia in males. Given that DEBs are associated with serious medical consequences, health care providers should screen for and discourage these practices in young adults. This is particularly important given that DEBs may be under detected in young adults with overweight/obesity. Future research may compare the association between DEBs and cardiometabolic risk in young adults with normal weight versus overweight/obesity and explore what interventions may prevent the onset of both obesity and eating disorders, promoting healthful eating as a long-term lifestyle behavior.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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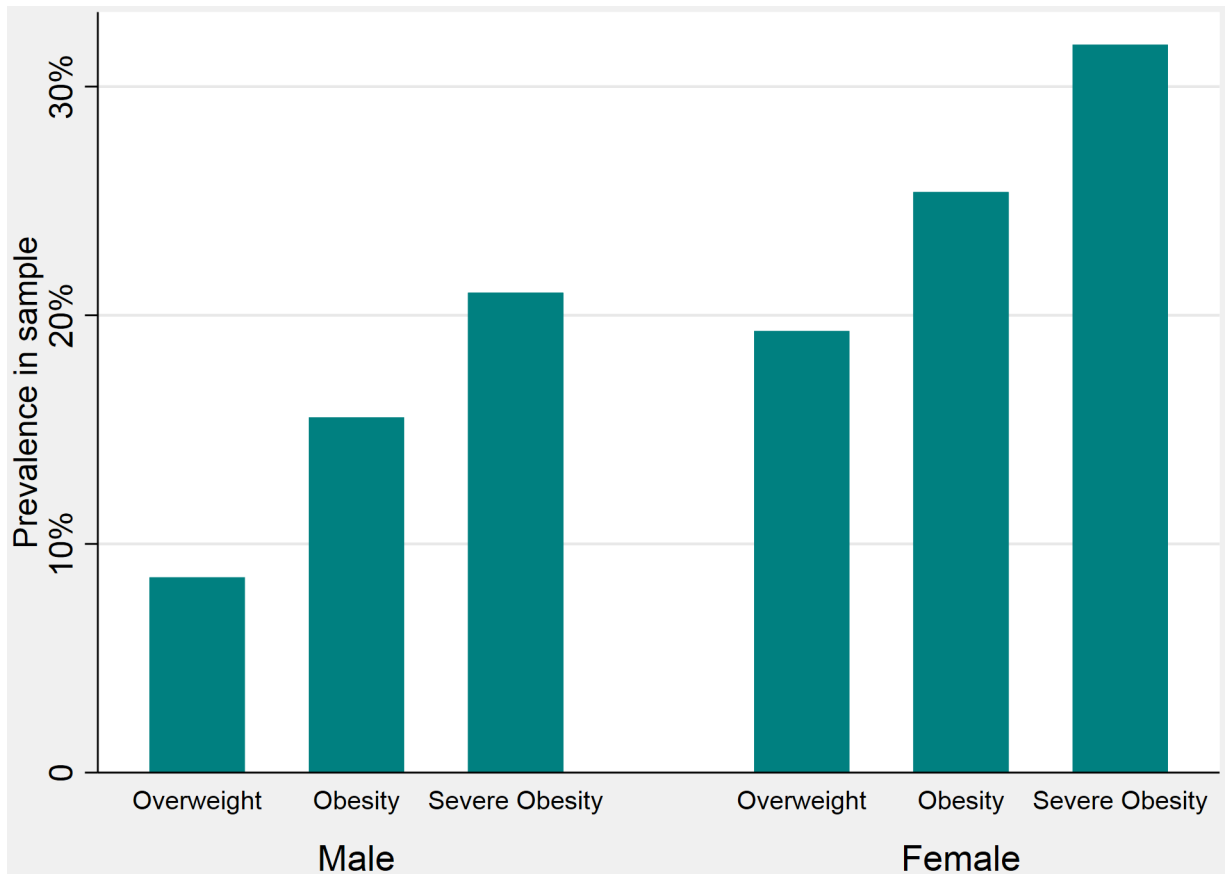
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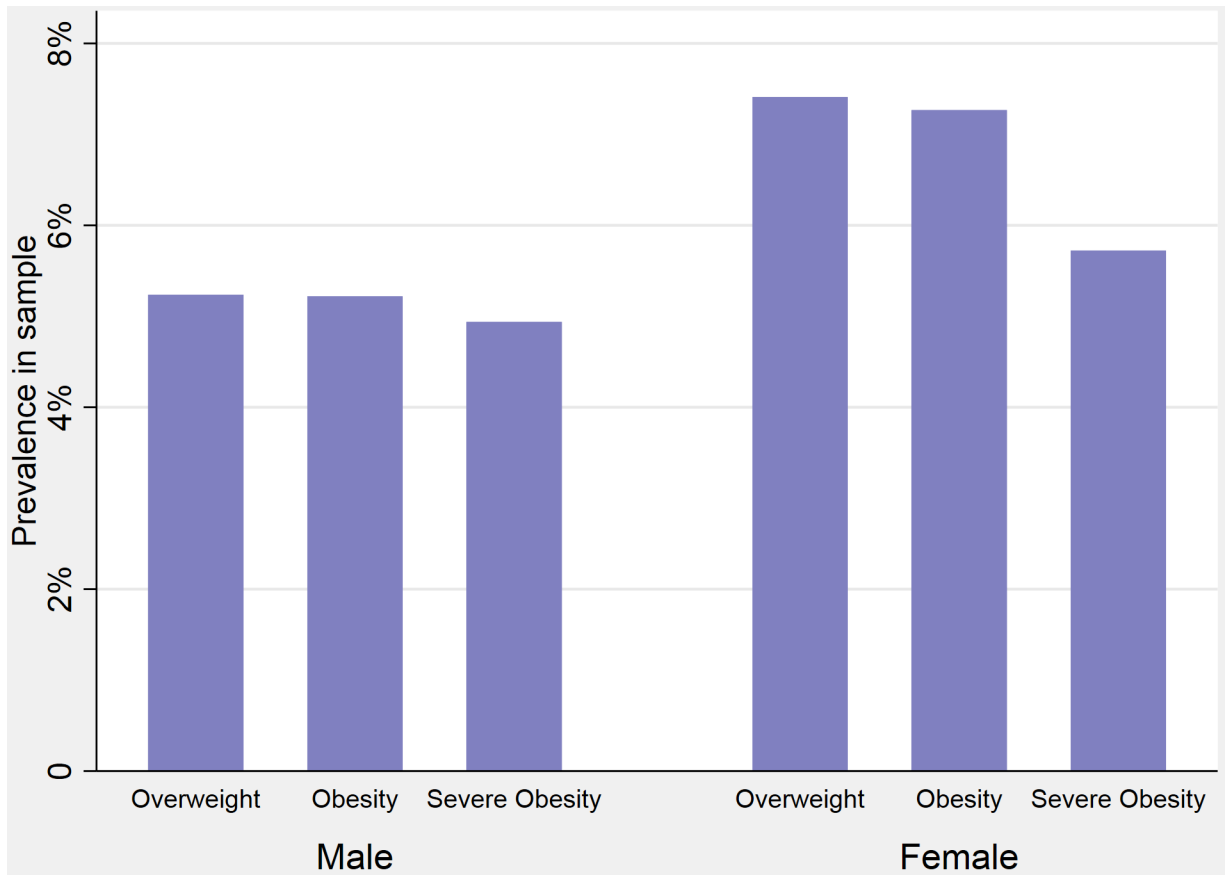
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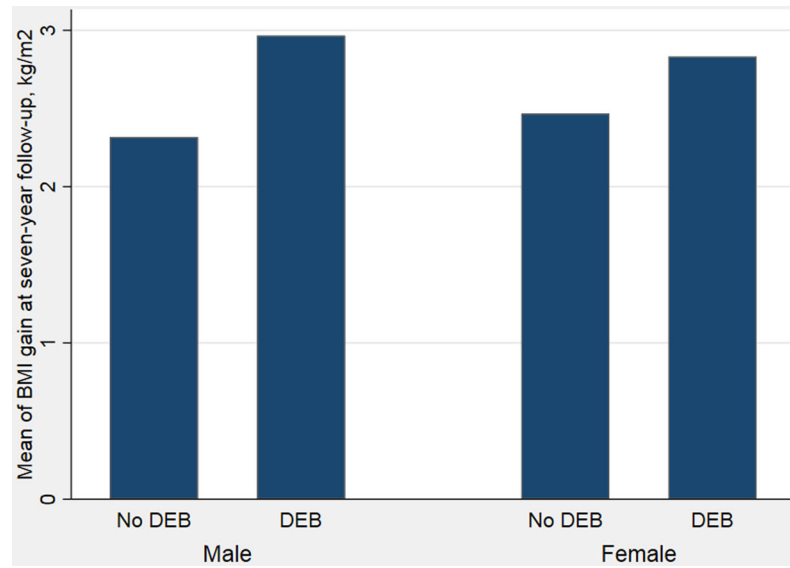


**Figure 1.** Prevalence of unhealthy weight control behaviors among young adults with overweight/obesity from the National Longitudinal Study of Adolescent to Adult Health, by weight status

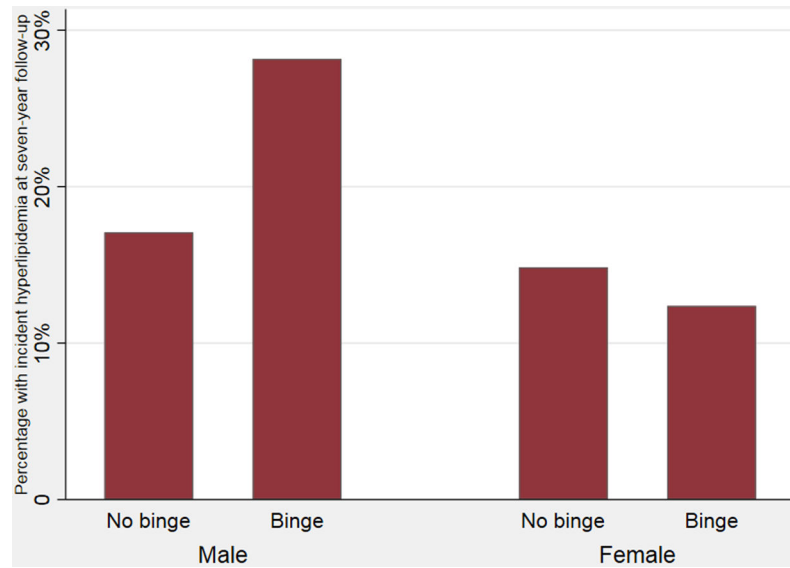




**Figure 2.** Prevalence of binge-eating behaviors among young adults with overweight/obesity from the National Longitudinal Study of Adolescent to Adult Health, by weight status



**Figure 3.** Mean body mass index gain at seven-year follow-up among young adults with overweight/obesity from the National Longitudinal Study of Adolescent to Adult Health, by sex and baseline disordered eating behavior (DEB)



**Figure 4.** Incident hyperlipidemia at seven-year follow-up among young adults with overweight/obesity from the National Longitudinal Study of Adolescent to Adult Health, by sex and baseline binge-eating behavior

**Table 1.**

Baseline demographic, health, and eating behavior characteristics of sample, by sex and absence or presence of baseline disordered eating behaviors (DEB)

	n <sup>a</sup>	Total		Males		Females		p
		Mean ± SD / %	Mean ± SD / %	No DEB at baseline	DEB at baseline	Mean ± SD / %	No DEB at baseline	
<b>N</b>	<b>5,552</b>	<b>21.92 ± 1.78</b>	<b>22.23 ± 1.76</b>	<b>2,269</b>	<b>456</b>	<b>2,003</b>	<b>824</b>	
<b>Demographic characteristics</b>								
Age	5,552	21.92 ± 1.78	22.23 ± 1.76	22.23 ± 1.76	22.24 ± 1.75	21.94 ± 1.71	21.99 ± 1.76	0.461 <sup>b</sup>
Race/ethnicity	5,548							0.001 <sup>c</sup>
White (non-Hispanic)		57.5%	58.0%	58.0%	48.3%	53.8%	49.2%	
Black/African American (non-Hispanic)		20.0%	16.1%	16.1%	19.5%	25.7%	26.2%	
Hispanic/Latino		15.2%	18.4%	18.4%	19.7%	15.6%	17.7%	
Asian/Pacific Islander (non-Hispanic)		6.0%	5.9%	5.9%	10.1%	3.4%	4.3%	
American Indian/Native American		0.5%	0.6%	0.6%	0.9%	0.8%	1.1%	
Other		0.8%	1.1%	1.1%	1.5%	0.8%	0.4%	
Education	5,548							0.030 <sup>c</sup>
High school or less		54.2%	52.8%	52.8%	48.6%	51.4%	47.1%	
More than high school		45.8%	47.2%	47.2%	51.4%	48.6%	52.9%	
<b>Health characteristics</b>								
Body mass index (BMI), kg/m <sup>2</sup>	5,552	31.29 ± 5.64	30.22 ± 4.91	30.22 ± 4.91	31.70 ± 5.47	31.75 ± 5.89	32.89 ± 6.42	<0.001 <sup>b</sup>
BMI classification	5,552							<0.001 <sup>c</sup>
Overweight (25 ≤ BMI < 30)		53.0%	60.9%	60.9%	48.7%	49.8%	41.1%	
Obese (BMI ≥ 30)		47.0%	39.1%	39.1%	51.3%	50.2%	58.9%	
Weight, kg	5,552	91.43 ± 19.00	96.26 ± 17.93	96.26 ± 17.93	100.20 ± 19.23	85.16 ± 17.81	88.51 ± 18.99	<0.001 <sup>b</sup>
Diabetes diagnosis, self-report	5,552	1.5%	0.6%	0.6%	1.3%	1.9%	3.0%	0.063 <sup>c</sup>
Hypertension diagnosis, self-report	5,552	8.7%	6.8%	6.8%	12.1%	9.1%	10.9%	0.135 <sup>c</sup>
Hyperlipidemia, self-report	5,552	5.5%	5.3%	5.3%	7.5%	4.7%	6.9%	0.014 <sup>c</sup>
<b>Eating behaviors, self-report (whole cohort)</b>								

N	<sup>a</sup> n	Total		Males		Females		p
		No DEB at baseline	DEB at baseline	No DEB at baseline	DEB at baseline	No DEB at baseline	DEB at baseline	
	5,552	5,552	17.6%	2,269	456	2,003	824	
Unhealthy weight control behavior (UWCB)	5,552	5,552	17.6%	11.4% <sup>d</sup>		23.3% <sup>e</sup>		
Binge-eating behavior	5,552	5,552	6.2%	5.2% <sup>d</sup>		7.2% <sup>e</sup>		
Disordered eating behavior (DEB = UWCB or binge)	5,552	5,552	22.0%	15.8% <sup>d</sup>		28.0% <sup>e</sup>		

SD = standard deviation

<sup>a</sup>Group n may not sum to total N because of missing data

<sup>b</sup>Independent samples T-test

<sup>c</sup>Fisher's exact test

<sup>d</sup>Percentage among all included males

<sup>e</sup>Percentage among all included females

**Table 2.** Comparison of health outcomes at seven-year follow-up among young adults with overweight/obesity, by sex and absence or presence of baseline disordered eating behaviors (DEB)

	Males			Females		
	No DEB at baseline	DEB at baseline	p	No DEB at baseline	DEB at baseline	p
N	2,295	430		2,036	791	
<b>Health outcomes at seven-year follow up (24-32 years old)</b>	Mean ± SD / %	Mean ± SD / %		Mean ± SD / %	Mean ± SD / %	
Body mass index (BMI), kg/m <sup>2</sup>	32.56 ± 6.34	34.67 ± 7.12	<0.001 <sup>a</sup>	34.25 ± 7.27	35.69 ± 8.20	<0.001 <sup>a</sup>
Body mass index (BMI) change, kg/m <sup>2</sup>	2.32 ± 4.25	2.97 ± 5.20	0.005 <sup>a</sup>	2.47 ± 5.26	2.83 ± 5.80	0.108 <sup>a</sup>
BMI classification			<0.001 <sup>b</sup>			<0.082 <sup>b</sup>
Underweight (BMI <18.5)	0.0%	0.0%		0.1%	0.0%	
Normal weight (18.5 BMI < 25)	4.9%	2.6%		6.5%	5.2%	
Overweight (25 BMI < 30)	34.3%	25.1%		24.7%	21.5%	
Obese (BMI ≥ 30)	60.8%	72.3%		68.7%	73.3%	
Weight, kg	102.58 ± 21.42	108.32 ± 23.92	<0.001 <sup>a</sup>	91.59 ± 20.92	95.75 ± 22.85	<0.001 <sup>a</sup>
Weight change, kg	6.33 ± 12.54	7.86 ± 14.87	0.024 <sup>a</sup>	6.35 ± 13.45	7.31 ± 14.50	0.093 <sup>a</sup>
Incident diabetes (self-report or HbA1c ≥ 6.5) <sup>c</sup>	8.7%	11.6%	0.051 <sup>d</sup>	9.7%	11.8%	0.110 <sup>d</sup>
Incident hypertension (self-report or SBP ≥ 140 or DBP ≥ 90) <sup>c</sup>	35.4%	34.2%	0.634 <sup>d</sup>	19.4%	19.7%	0.847 <sup>d</sup>
Incident hyperlipidemia (self-report or total cholesterol ≥ 240) <sup>c</sup>	17.2%	20.2%	0.126 <sup>d</sup>	14.6%	14.8%	0.890 <sup>d</sup>

SD = standard deviation

<sup>a</sup>Independent samples T-test

<sup>b</sup>Fisher's exact test

<sup>c</sup>Baseline information based on self-report only

<sup>d</sup>Pearson's chi square test

Comparison of health outcomes at seven-year follow-up among young adults with overweight/obesity, by sex and absence or presence of baseline unhealthy weight control behaviors (UWCB) or binge-eating behaviors

**Table 3.**

Health outcomes at seven-year follow up (24-32 years old)	Males			Females		
	No UWCB at baseline	UWCB at baseline	p	No UWCB at baseline	UWCB at baseline	p
	Mean ± SD / %	Mean ± SD / %		Mean ± SD / %	Mean ± SD / %	
Body mass index (BMI) change, kg/m <sup>2</sup>	3.07 ± 4.97	2.33 ± 4.33	0.005 <sup>a</sup>	2.42 ± 5.23	3.05 ± 5.96	0.010 <sup>a</sup>
Incident diabetes (self-report or HbA1c 6.5) <sup>b</sup>	8.7%	12.5%	0.026 <sup>c</sup>	9.5%	12.9%	0.011 <sup>c</sup>
Incident hypertension (self-report or SBP 140 or DBP 90) <sup>b</sup>	35.2%	34.3%	0.962 <sup>c</sup>	19.1%	19.5%	0.384 <sup>c</sup>
Incident hyperlipidemia (self-report or total cholesterol ≥ 240) <sup>b</sup>	17.6%	17.8%	0.936 <sup>c</sup>	14.3%	15.8%	0.336 <sup>c</sup>
	No binge eating at baseline	Binge eating at baseline	p	No binge eating at baseline	Binge eating at baseline	p
Body mass index (BMI) change, kg/m <sup>2</sup>	2.40 ± 4.34	2.82 ± 5.57	0.266 <sup>a</sup>	2.56 ± 5.43	2.74 ± 5.21	0.635 <sup>a</sup>
Incident diabetes (self-report or HbA1c 6.5) <sup>b</sup>	9.1%	10.6%	0.546 <sup>c</sup>	10.2%	10.4%	0.110 <sup>c</sup>
Incident hypertension (self-report or SBP 140 or DBP 90) <sup>b</sup>	35.4%	31.0%	0.284 <sup>c</sup>	19.8%	15.8%	0.172 <sup>c</sup>
Incident hyperlipidemia (self-report or total cholesterol ≥ 240) <sup>b</sup>	17.1%	28.2%	0.001 <sup>c</sup>	14.8%	12.4%	0.341 <sup>c</sup>

SD = standard deviation

<sup>a</sup>Independent samples T-test

<sup>b</sup>Baseline information based on self-report only

<sup>c</sup>Pearson's chi square test

Table 4.

Cardiometabolic risk at seven-year follow-up for young adults with overweight/obesity, by sex and type of disordered eating behavior at baseline

	Change in BMI, adjusted <sup>d</sup>		Incident diabetes, adjusted <sup>d</sup>		Incident hypertension, adjusted <sup>d</sup>		Incident hyperlipidemia, adjusted <sup>d</sup>		P
	B (SE) <sup>c</sup>	P	OR (95% CI) <sup>d</sup>	P	OR (95% CI) <sup>d</sup>	P	OR (95% CI) <sup>d</sup>		
<b>Males</b>									
Unhealthy weight control behavior (UWCB)	<b>0.85 (0.26)</b>	<b>0.001</b>	1.11 (0.75 - 1.63)	0.606	0.92 (0.71 - 1.18)	0.590	0.98 (0.72 - 1.34)	0.912	
Binge-eating behavior	0.43 (0.38)	0.254	1.10 (0.62 - 1.95)	0.746	0.81 (0.56 - 1.17)	0.130	<b>1.90 (1.29 - 2.79)</b>	<b>0.001</b>	
Any disordered eating behavior (UWCB or binge)	<b>0.72 (0.23)</b>	<b>0.002</b>	1.07 (0.76 - 1.52)	0.698	0.88 (0.71 - 1.10)	0.268	1.20 (0.93 - 1.57)	0.166	
<b>Females</b>									
Unhealthy weight control behavior (UWCB)	<b>0.80 (0.24)</b>	<b>0.001</b>	1.24 (0.94 - 1.63)	0.133	1.01 (0.80 - 1.26)	0.962	1.12 (0.88 - 1.44)	0.346	
Binge-eating behavior	0.17 (0.39)	0.656	1.02 (0.63 - 1.65)	0.934	0.77 (0.52 - 1.14)	0.192	0.81 (0.52 - 1.24)	0.329	
Any disordered eating behavior (UWCB or binge)	<b>0.51 (0.22)</b>	<b>0.024</b>	1.10 (0.84 - 1.44)	0.484	0.95 (0.77 - 1.17)	0.610	1.01 (0.80 - 1.28)	0.935	

**Bold** indicates p<0.05

<sup>a</sup>Analyses are adjusted for baseline BMI, race/ethnicity, age, and education

<sup>b</sup>Baseline information based on self-report only

<sup>c</sup>B = Estimated coefficient from linear regression; SE = standard error

<sup>d</sup>OR = odds ratio from logistic regression; CI = confidence interval