

Binge Eating in Overweight Treatment-Seeking Adolescents

Deborah R. Glasofer,^{1,2} MA, Marian Tanofsky-Kraff,¹ PhD, Kamryn T. Eddy,^{3,4} MA, Susan Z. Yanovski,⁵ MD, Kelly R. Theim,¹ BA, Margaret C. Mirch,¹ BS, Samareh Ghorbani,^{1,6} BS, Lisa M. Ranzenhofer,^{1,6} BS, David Haaga,² PhD, and Jack A. Yanovski,¹ MD, PhD
¹Unit on Growth and Obesity, Developmental Endocrinology Branch, National Institute of Child Health and Human Development, ²Department of Psychology, American University, ³Center for Anxiety and Related Disorders, Boston University, ⁴Optimal Weight for Life Clinic, Children's Hospital, ⁵Division of Digestive Diseases and Nutrition, and ⁶Division of Nutrition Research Coordination, National Institute of Diabetes and Digestive Kidney Diseases, National Institutes of Health, DHHS

Objective To examine the frequency and recency of binge eating in relation to psychopathology in overweight, treatment-seeking adolescents. **Methods** We investigated psychological correlates of the frequency and recency of reported loss of control (LOC) eating episodes in 160 overweight (body mass index [BMI]: $40.7 \pm 8.8 \text{ kg/m}^2$) adolescents. On the basis of the responses to the eating disorder examination (EDE), participants were categorized into one of four groups: full-syndrome binge eating disorder (BED); recent but infrequent binge eating (episodes within the 3 months before interview; RECENT-BINGE); remote and infrequent LOC eating (episodes occurring >3 months before assessment; PAST-LOC), or no history of LOC episodes (NE). **Results** The BED group reported higher EDE scores (global, $p < .01$), and more negative mood and anxiety than all other groups (p 's $< .01$). Compared with NE, RECENT-BINGE also reported more anxiety and higher EDE scores (p 's $< .01$). **Conclusions** Overweight, treatment-seeking adolescents with BED are clearly distinguishable from teens without the disorder on measures of eating-related psychopathology, mood, and anxiety. RECENT-BINGE, but not PAST-LOC, is also associated with significantly greater eating-related and general psychopathology.

Key words adolescents; binge eating; binge eating disorder; obesity.

Binge eating disorder (BED), a provisional diagnostic category in DSM-IV-TR (American Psychiatric Association [APA], 2000), is characterized by recurrent binge eating episodes in the absence of inappropriate compensatory behaviors and is often associated with obesity (de Zwaan et al., 1994). When compared with non-binge-eating adults, those with BED suffer from greater eating-disordered cognitions (Crow, Stewart Agras, Halmi, Mitchell, & Kraemer, 2002; Masheb & Grilo, 2000; Striegel-Moore et al., 2001; Wilfley, Schwartz, Spurrell, & Fairburn, 2000), increased general psychopathology (Mussell et al.,

1996; Wilfley, Friedman, et al., 2000; Yanovski, Nelson, Dubbert, & Spitzer, 1993), and more health problems (Johnson, Spitzer, & Williams, 2001; de Zwaan et al., 2002).

The DSM-IV-TR description of BED identifies frequency and duration criteria that must be met to receive a diagnosis. The frequency criterion is binge eating (eating an objectively large quantity of food during which a loss of control [LOC] is experienced) on average at least twice per week; the duration criterion is that binge eating occurs consistently over a 6-month period (APA, 2000).

All correspondence concerning this article should be addressed to Marian Tanofsky-Kraff, PhD, Unit on Growth and Obesity, DEB, NICHD, NIH, 10 Center Drive, CRC, Room 1-3330 MSC 1103, Bethesda, Maryland 20892-1103. E-mail: tanofskm@mail.nih.gov.

However, there are few data demonstrating these thresholds identify the majority of individuals having significant difficulties with binge eating. Investigations comparing adults with BED to those with subthreshold BED (characterized by recurrent episodes of binge eating with an average frequency of once per week during the past 6 months) have found few differences between groups on measures of psychiatric distress, body weight, dieting, weight history, or body image disturbance (Striegel-Moore et al., 2000; Striegel-Moore, Wilson, Wilfley, Elder, & Brownell, 1998). A study employing an even less stringent frequency criterion for subthreshold BED (binge eating at least once per month during the past 6 months) also found few differences on measures of eating-related and general psychopathology between women with diagnostic and subthreshold BED (Crow et al., 2002). These data suggest that binge eating, even at lower frequencies, is a clinically significant problem. Moreover, the significance of *objectively large* overeating as an important characteristic of BED in adults has been questioned, suggesting that the experience of LOC may be the most salient factor associated with emotional distress (Niego, Pratt, & Agras, 1997; Pratt, Niego, & Agras, 1998).

Although few adolescents meet the criteria for full-syndrome BED (Johnson, Grieve, Adams, & Sandy, 1999; Stice, Killen, Hayward, & Taylor, 1998; Stice, Presnell, & Bearman, 2001), the prevalence of subthreshold binge eating, particularly among overweight adolescents, appears to be substantial (Johnson, Rohan, & Kirk, 2002), with estimates ranging from 20% (Isnard et al., 2003) to ~30% (Decaluwe, Braet, & Fairburn, 2003) in weight loss treatment-seeking samples. Consistent with the adult literature (Striegel-Moore et al., 1998, 2000), studies in adolescents seeking weight loss treatment have found that those who report subthreshold binge eating have greater eating-related distress and depressive symptomatology than those who do not report any binge eating (Berkowitz, Stunkard, & Stallings, 1993; Decaluwe et al., 2003; Isnard et al., 2003; Johnson et al., 1999). Nevertheless, the implications of subthreshold binge eating as compared with full-syndrome BED in adolescents are unclear. In a community sample of 10- to 18-year-olds, Johnson et al. (1999) found that children meeting full diagnostic criteria for BED by questionnaire reported significantly more depressive symptomatology and greater disturbed eating-related cognitions than children describing subthreshold binge eating. By contrast, another study of middle and high school students with BED and subthreshold BED found no substantial differences in depressed mood,

self-esteem, or body dissatisfaction (Ackard, Neumark-Sztainer, Story, & Perry, 2003). Although full-syndrome BED in childhood is rare, children reporting LOC episodes regardless of the amount of food eaten have greater adiposity and psychological distress than those with no LOC episodes (Morgan et al., 2002; Tanofsky-Kraff et al., 2004). In a study using structured clinical interviews, overweight children (6–13 years) who endorsed experiencing as few as one episode of LOC eating in their lifetime reported greater eating-disordered and general psychopathology compared with overweight children who reported no such episodes (Tanofsky-Kraff, Faden, Yanovski, Wilfley, & Yanovski, 2005).

A notable limitation of most prior studies examining binge eating among adolescents is the lack of interview methodology to assess eating-disordered behaviors and cognitions (Ackard et al., 2003; Decaluwe et al., 2003; Isnard et al., 2003; Johnson et al., 1999; Morgan et al., 2002). To investigate the potential association of frequency and recency of binge eating episodes with eating-related cognitions and general psychopathology, we used an interview method to assess eating-disordered pathology in a cohort of overweight, treatment-seeking adolescents. We posited that the frequency and recency of binge eating would be related to higher levels of depressive and anxious symptomatology. Specifically, we hypothesized that (a) teens meeting DSM-IV-TR criteria for BED (high frequency and high recency) would report the highest levels of eating-related and general psychopathology and that (b) participants endorsing recent subthreshold binge eating in the 3 months before assessment (low frequency but high recency) would report more emotional disturbance than adolescents who reportedly had never experienced binge or LOC eating. Given the findings of Tanofsky-Kraff et al. (2005), we also expected adolescents who reported the experience of LOC eating *ever* in the past (low frequency and low recency) would report higher levels of eating-related, depressive and anxious symptomatology than adolescents who reportedly had never experienced binge or LOC eating.

Methods

Participants

We studied a sample of 160 overweight adolescents seeking weight loss treatment. Teens were 14.1 ± 1.4 years old, with a BMI of 40.7 ± 8.8 kg/m². The sample was composed of 87 African American teens (54.4%), 71 Caucasian teens (44.4%), and 2 Hispanic teens (1.3%). Ninety-three (58.1%) were females. Data were collected

from two sites. One hundred and twenty-nine participants were recruited through newspaper advertisements and letters to physicians practicing within 60 miles of Bethesda, MD, for a weight loss study involving medication. Inclusion criteria for the treatment were ages 12–17 years at study entry, meeting the national criterion for overweight in youth with a BMI greater than the NHANES II 95th percentile for age and sex (Must, Dallal, & Dietz, 1991), and the presence of at least one quantifiable obesity-related comorbidity, including hypertension, type 2 diabetes or impaired glucose tolerance, hyperinsulinemia (insulin ≥ 15 $\mu\text{U/L}$), hyperlipidemia (total triglyceride ≥ 200 mg/dL, total cholesterol > 200 mg dL⁻¹, or total LDL cholesterol ≥ 130 mg/dL), hepatic steatosis, or sleep apnea documented by a formal sleep study. Individuals were excluded if they had a major pulmonary, hepatic, cardiac, or musculoskeletal disorder unrelated to obesity, a history of substance abuse or other psychiatric disorder that would impair compliance with the study protocol, used an anorexiant in the past 6 months, or recently lost significant weight ($\geq 5\%$ of body weight). For a complete description of study requirements, see McDuffie et al. (2002). Thirty-one adolescents seeking weight loss treatment at a Boston, MA, hospital-based clinic, which used behavior modification and adherence to low glycemic index dietary recommendations, were also included in the current study. Inclusion criteria at this clinic were ages 12–17 years, overweight defined as BMI greater than the NHANES II 95th percentile for age and sex, and English conversant. Exclusion criteria included severe cognitive impairment or a psychotic disorder.

Procedure

Institutional review boards of both institutions approved the protocols. Each adolescent gave written assent, and a parent or guardian gave written consent for protocol participation.

Sixty-one percent of those screened in Bethesda, MD, met eligibility requirements and participated in all assessments. All adolescents seeking treatment at the Boston, MA, clinic were informed of the study by mail ($n = 140$). Ninety families with adolescents were successfully reached by telephone and provided additional information about the study. Of these, 45 (50%) declined participation. Of the interested families ($n = 45$), six did not meet eligibility criteria, and eight were unable to be scheduled. Thus, 31 adolescents participated in the present study (representing 34% of those contacted by telephone and 22% of adolescents receiving treatment at the clinic). There were no differences in

patient demographics between those participating and those not participating in the study.

All data were collected at baseline, before initiating treatment. To measure eating-related behaviors and cognitions, subjects completed the *Eating Disorder Examination version 12OD/C.2 (EDE)* (Fairburn & Cooper, 1993), which contains 21 items that assess disordered attitudes and behaviors related to eating, body shape, and weight and 13 items designed to diagnose specific DSM-IV-TR eating disorders (APA, 2000). Responses are coded via four subscales: restraint (cognitive and behavioral restriction), eating concern, shape concern, and weight concern. The global score represents the mean of the four subscale scores. The EDE identifies three types of eating episodes: objective binge episodes (OBE, overeating with LOC), subjective binge episodes (SBE, LOC without objective overeating as assessed by the interviewer but viewed as excessive by the interviewee), and objective overeating (overeating without LOC). The EDE has excellent internal consistency (Cooper, Cooper, & Fairburn, 1989), test–retest reliability (Rizvi, Peterson, Crow, & Agras, 2000), and both discriminant and concurrent validity (Fairburn & Cooper, 1993; Williamson et al., 1995). The EDE was administered to participants ≥ 15 years. The child version of the EDE (ChEDE) (Bryant-Waugh, Cooper, Taylor, & Lask, 1996) was administered to participants < 15 years ($n = 60$) as recommended by the authors of the measure. The ChEDE differs from the adult version only in that its script has been edited to make it more accessible to children ages 8–14 years and that two items that assess the critical overevaluation of shape and weight have been supplemented with a sort task. The ChEDE queries about binge episodes in the 3 months before assessment; therefore, interviewers reviewed DSM-IV-TR BED criteria for participants aged < 15 years who endorsed OBEs (APA, 2000). Following the overeating section of the EDE and ChEDE, an additional question assessing LOC eating history was included (for the complete series of questions, see Tanofsky-Kraff et al., 2005). Participants were asked whether they had ever experienced LOC (regardless of amount of food eaten) before the 6 months assessed by the EDE. Teens who endorsed an LOC experience before but not within the past 6 months were not asked to describe the specific eating episode in detail, but rather whether they recalled experiencing LOC while eating.

Interviewers were graduate clinical psychology students and post-undergraduate research associates who attended 15–20 hr of training. Before conducting interviews, each interviewer was trained by listening to

audiotapes of sample interviews, conducting a practice EDE, observing the trainer conducting an EDE, and then conducting an EDE while the trainer observed. Training was continued until at least 95% agreement between trainer and trainee ratings was demonstrated. To ensure quality, all interviews were taped, and weekly meetings were held to review every interview throughout data collection. At the weekly meetings, responses that were difficult to code (e.g., presence or absence of LOC experience) and the coding of eating episode sizes were determined by consensus. To examine what constitutes a large amount of food for adolescents, we asked all participants, whether or not they described disordered eating, to describe the *largest* amount eaten in the last 28 days. Using this information, team members discussed the amount eaten and came to a unanimous consensus regarding whether the amount was unambiguously large or subjectively large given the circumstances for the child's age and sex.

Interrater reliability was obtained on ~15.5% (20 interviews) of randomly selected EDE tapes from the Bethesda sample. EDE interrater reliability analyses revealed that raters achieved very good reliability, with intraclass correlations ranging from .87 to .98 on the subscale and total scores (all $ps < .01$).

Participants were categorized into one of four groups: full-syndrome BED; recent but infrequent binge eating (episodes of overeating during which LOC is experienced within the 3 months before interview; RECENT-BINGE); remote and infrequent LOC eating (episodes of eating, regardless of the amount of food consumed during which LOC is experienced, occurring >3 months before assessment; PAST-LOC), or no history of LOC episodes (NE).

Because previous studies have shown no differences between children with no eating psychopathology and those who endorse objective overeating without LOC (Morgan et al., 2002; Tanofsky-Kraff et al., 2004), the current study included children who reported objective overeating into the NE group.

The *Children's Depression Inventory (CDI)* (Kovacs, 1982) was used to assess cognitive, affective, and behavioral signs of depression. The CDI generates five subscales—negative mood, interpersonal problems, ineffectiveness, anhedonia, and negative self-esteem—and a total score. The CDI has demonstrated adequate internal consistency, test–retest reliability, and discriminant validity (Costello & Angold, 1988; Curry & Craighead, 1993). The *State-Trait Anxiety Inventory for Children (STAIC)* (Spielberger, 1973) was used as a measure of trait anxiety. The STAIC has been shown to have high internal consistency,

stability for trait anxiety, and adequate validity (Spielberger, Gorsuch, & Lushene, 1970). The Child Behavior Checklist (CBCL) (Achenbach & Elderbrook, 1991) assesses child behavioral/emotional problems as reported by parents/guardians and generates internalizing and externalizing problems subscales. The CBCL is a well-validated screen for child and adolescent psychopathology (Connor et al., 2003). Items querying parents' current occupations are included in the CBCL. Responses to these items were coded according to the *Hollingshead Socioeconomic Status (SES)*, which is a widely used measure of social and economic level based on career and education status (Hollingshead, 1975).

Physical Measures

For the Bethesda, MD, cohort, weight was obtained to the nearest 0.1 kg using a calibrated digital scale (Scale-Tronix, Wheaton, IL), and height was obtained in triplicate to the nearest 1 mm using a stadiometer calibrated before each set of measurements (Holtain Ltd., Crymmych, Wales). BMI (kg/m^2) was calculated. All participants underwent a medical history and a physical examination performed by an endocrinologist or trained nurse practitioner. Breast and pubertal hair development were assigned according to the stages of Tanner (Marshall & Tanner, 1969, 1970), and testicular volumes were measured (in cc) according to Prader (Tanner, 1981). Pubertal stage and testicular volume indicate neurocognitive and physical maturity (Marshall & Tanner, 1969, 1970).

Participants at the Boston, MA, clinic were weighed on a calibrated nondigital balance beam scale (Detecto, Webb City, MO), and height was obtained to the nearest 1 mm using a calibrated stadiometer. With the exception of three participants who self-reported Tanner stage, pubertal stage was assessed by an endocrinologist or nurse practitioner during a physical examination.

Analyses

On the basis of prior studies that found the diagnosis of BED to be relatively rare among overweight adolescents (Johnson et al., 1999; Stice et al., 1998, 2001), we anticipated that only 6% of our study sample would meet the EDE criteria for BED. Therefore, to ensure a cell size ≥ 10 for the group diagnosed with BED, which we estimated would give 80% power to detect 0.5 point differences in EDE subscale scores between groups (with alpha set at .05), we sought to recruit 160 adolescents to the study.

Comparisons between groups were performed using one-way analysis of variance (ANOVA) with Bonferroni–Hochberg's correction, a conservative test accounting for multiple comparisons applied to each family of post hoc

means. A z score (Frisancho, 1990) standardized for age, sex, and race was used for BMI (BMI-SD). Age, sex, BMI-SD, SES, and pubertal stage were considered relevant covariates for ANOVA models, because these variables have been identified as potentially confounding factors of outcome in studies of body weight and growth among youth (Johnson, Figueroa-Colon, Huang, Dwyer, & Goran, 2005; Sun et al., 2001). Since differences were identified between the Bethesda and Boston samples, clinic site (Bethesda or Boston) was also considered as a potential covariate.

Means adjusted for covariates are reported for these analyses. Means \pm SD are reported, and nominal probability values are shown. Differences and associations between groups were considered significant when p -values after correction for multiple comparisons were $\leq .05$, and all tests were two-tailed. Regression was used to evaluate the association between log of LOC/binge eating frequency and scores on measures of psychopathology. Because the log-transformation required recoding for those with no LOC or binge episodes within the last 3 months, teens in the NE group were arbitrarily coded to have had 0.05 episodes. Because teens in the PAST-LOC group generally reported a single episode within the past year, they were coded as having had 0.25 LOC/binge episodes in the past 3 months. For the RECENT-BINGE and BED groups, the total number of binge episodes in the 3 months before assessment was used. The number of binge eating episodes was log-transformed for analyses.

Results

Sixty-seven male and 93 female adolescents participated (Table I). Teens from Bethesda (14.3 ± 1.5 years, 41.7 ± 9.2 kg/m²) were significantly older and heavier than

teens in the Boston group (13.4 ± 1.1 years, 36.6 ± 5.5 kg/m²; $ps < .01$); however, there were no significant differences between samples in BMI-SD score ($t = 1.9$, $p = .06$). Groups did not significantly differ in SES ($t = -1.1$, $p = .20$) and pubertal stage ($t = 1.8$, $p = .08$), or sex ($\chi^2 = 1.5$, $p = .22$); however, there were significant differences in race between samples ($\chi^2 = 14.3$, $p < .01$). In the Bethesda sample, 59.7% of teens were African American and 40.3% were Caucasian. In the Boston group, 32.3% of participants were African American, 61.3% were Caucasian, and 6.5% were Hispanic. Teens in the Boston group reported significantly greater depressive symptomatology (CDI total scores, 19.87 ± 14.42) than those in the Bethesda group (6.46 ± 5.61 , $t = -5.50$, $p < .01$). In the Boston group, participants also reported significantly more eating-related psychopathology on the EDE global score ($t = -3.54$, $p < .01$) and all subscales (p 's $< .05$), with the exception of the EDE weight concern subscale, than teens in the Bethesda sample. CBCL scores did not differ by group.

Eating Behaviors and Related Cognitions

On the basis of EDE interviews, 10 participants (6.3%) met the criteria for BED, with the number of binge days ranging from 23 to 80 (mean \pm SD: 35.0 ± 18.48) over the past 6 months. Thirty-eight adolescents (23.8%) were classified as RECENT-BINGE, with the number of binge days ranging from 1 to 13 (mean \pm SD: 3.7 ± 3.3) over the last 3 months. Twenty-four adolescents (15.0%) reported PAST-LOC; 88 participants (55.0%) had NE. Groups did not differ with regard to any measured demographic or physical variable (Table I). Analyses of the EDE global score controlled for clinic site. SES and clinic site were covariates for the EDE eating

Table I. Sample Demographics

	NE [$n = 88$ (55.0%)]	PAST-LOC [$n = 24$ (15.0%)]	RECENT-BINGE [$n = 38$ (23.8%)]	BED [$n = 10$ (6.3%)]	Range
Age (years)	14.0 ± 1.3	13.9 ± 1.5	14.3 ± 1.5	14.4 ± 2.0	11.9–18.0
Sex					
Male	36 (40.9%)	8 (33.3%)	20 (52.6%)	3 (30%)	
Race					
African American	49 (55.7%)	12 (50%)	23 (60.5%)	3 (30%)	
Caucasian	38 (43.2%)	12 (50%)	14 (36.8%)	7 (70%)	
Hispanic	1 (0.01%)		1 (2.6%)		
SES (<i>Mdn</i>)	3	3	3.5	3	1–7
Pubertal stage	3.4 ± 1.5	3.1 ± 1.2	3.7 ± 1.3	3.8 ± 2.2	1–5
BMI (kg/m ²)	40.6 ± 7.4	39.2 ± 12.4	42.8 ± 9.4	37.2 ± 6.9	23.8–87.0
Child BMI-SD	5.6 ± 2.6	5.2 ± 3.9	5.9 ± 2.6	4.6 ± 2.9	1.4–20.5

BED, binge eating disorder; BMI, body mass index; NE, no episode; PAST-LOC, loss of control eating in the past; RECENT-BINGE, binge eating in the past 3 months; SES, socioeconomic status.

For Children's Depression Inventory, $N = 155$. For Child Behavior Checklist, $N = 158$ and for the current occupation questions of this measure, from which SES was derived, $N = 147$. For the State-Trait Anxiety Inventory for Children, $N = 124$.

concern subscale. SES was also a covariate for the EDE restraint subscale. Participants with BED had significantly higher EDE eating (overall $F = 23.8, p < .01$), shape (overall $F = 19.4, p < .01$), and weight concern (overall $F = 13.3, p < .01$) subscale scores and global scores (overall $F = 19.0, p < .01$) compared with participants in the RECENT-BINGE, PAST-LOC, and NE groups (Fig. 1A). Compared with the NE group, the RECENT-BINGE group had higher scores on the eating, shape, and weight concern subscales and global scores. Teens in the RECENT-BINGE group also reported significantly more shape and concern than those in the PAST-LOC group. No significant differences were detected between groups on the EDE restraint subscale.

General Psychopathology

For the CDI, participants in the BED group had significantly higher negative mood scores compared with individuals in the other three groups after controlling for clinic site (overall $F = 10.2, p < .01$, Fig. 1B). Participants with BED had significantly higher total CDI scores than the NE group after controlling for clinic site (overall $F = 4.7, p < .01$). A significant main effect was

also revealed between groups on the measure of trait anxiety ($F = 9.49, p < .01$, Fig. 2A). Adolescents with BED reported significantly higher trait anxiety compared with participants in all other groups. In addition, participants with recent binge eating reported significantly higher trait anxiety scores than those in the NE group. Significant differences were detected on the internalizing subscale ($F = 5.66, p < .01$) and externalizing subscale of the CBCL, for which BMI-SD served as a covariate ($F = 6.34, p < .01$; Fig. 2B). Parents of teens with BED and recent binge eating reported significantly higher internalizing and externalizing behaviors in their children compared with parents of participants in the NE group.

Frequency of LOC and binge eating days was positively associated with eating-related psychopathology, anxiety, and depressive symptomatology (Fig. 3). There was a significant positive association between the number of LOC and binge eating episodes and scores on the EDE restraint ($r^2 = .05, p < .01$), eating concern ($r^2 = .29, p < .01$), shape concern ($r^2 = .27, p < .01$), and weight concern ($r^2 = .18, p < .01$) subscales and global score ($r^2 = .29, p < .01$). Frequency of LOC and binge eating episodes

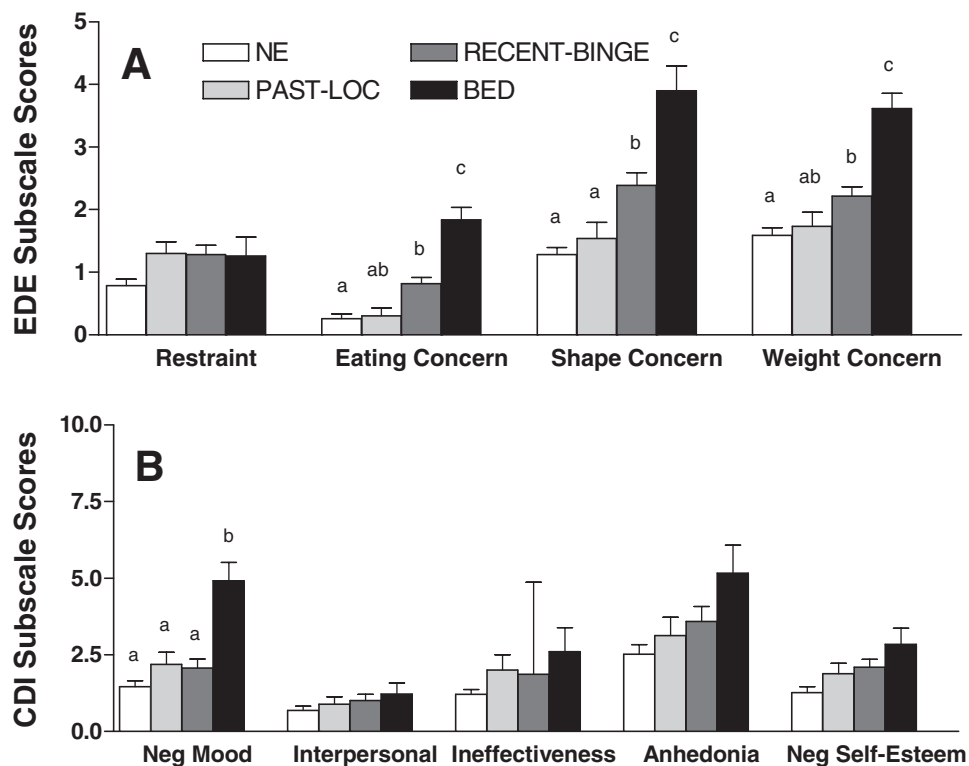


Figure 1. (A) Eating Disorder Examination (EDE) subscale scores of participants endorsing no episode (NE), loss of control eating in the past (PAST-LOC), binge eating in the past 3 months (RECENT-BINGE), and binge eating disorder (BED). Socioeconomic status (SES) was a significant covariate for the EDE restraint subscale. For the EDE eating concern subscale, SES and site served as covariates. (B) Children's Depression Inventory (CDI) subscale scores. For the CDI negative mood, interpersonal, and anhedonia subscales, site served as a covariate. Site and age were covariates for the CDI negative self-esteem subscale. Bars differing in letters are significantly different.

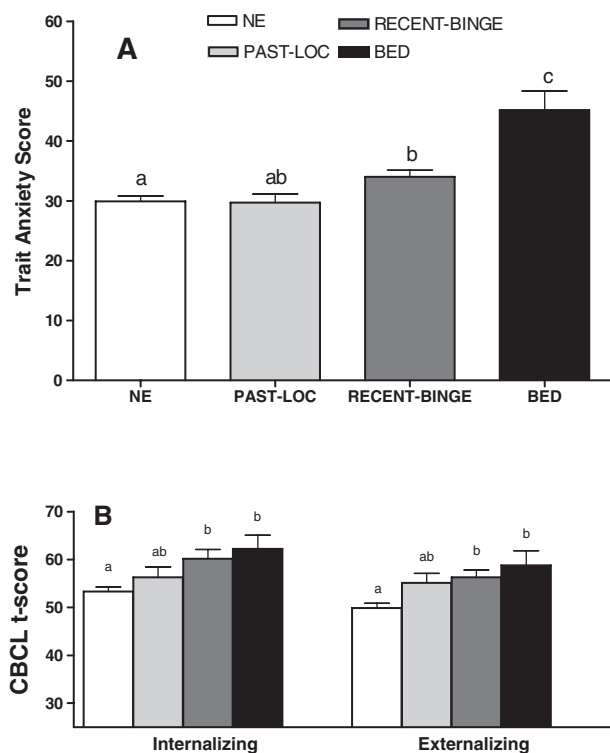


Figure 2. (A) STAIC trait anxiety scores and (B) Child Behavior Checklist (CBCL) internalizing and externalizing *t*-scores of participants endorsing no episode (NE), loss of control eating in the past (PAST-LOC), binge eating in the past 3 months (RECENT-BINGE), and binge eating disorder (BED). Body mass index (BMI-SD) was a covariate for the CBCL externalizing subscale. Bars differing in letters are significantly different.

was also significantly associated with all CDI scales; negative mood ($r^2 = .13$, $p < .01$), interpersonal ($r^2 = .03$, $p < .05$), ineffectiveness ($r^2 = .05$, $p < .01$), anhedonia ($r^2 = .08$, $p < .01$), and negative self-esteem ($r^2 = .09$, $p < .01$) subscale scores and CDI total scores ($r^2 = .10$, $p < .01$), as well as STAIC trait anxiety scores ($r^2 = .16$, $p < .01$). The number of LOC and binge eating episodes was not significantly associated with CBCL subscale or total scores.

Discussion

In this study of binge eating in overweight, treatment-seeking adolescents, 45% of teens reported they had engaged in binge or LOC eating at some time in their lives. Individuals diagnosed with full-syndrome BED were distinguishable from those reporting subthreshold levels of binge eating or no binge eating in that they experienced higher emotional distress and disturbed eating cognitions, equivalent to that experienced by adults with BED (Willfley, Schwartz et al., 2000). However, individuals who endorsed recent subthreshold binge

eating in the last 3 months were also distinguishable from those who reported no LOC eating whatsoever, with the former group reporting higher levels of disturbed eating cognitions and anxiety and their parents reporting more child behavior problems. In general, the number of binge episodes endorsed by adolescents was positively associated with measures of psychopathology.

In contrast to adult studies (Crow et al., 2002; Striegel-Moore et al., 1998, 2000), but consistent with one prior adolescent study (Johnson et al., 1999), participants with BED experienced significantly higher levels of eating-disordered attitudes, more negative mood, and anxiety compared to those with recent subthreshold binge eating in the last 3 months. This finding may be due to differences in the subthreshold criteria employed in adult studies. To be categorized in the RECENT-BINGE group, participants in our sample needed only to endorse engaging in a single binge eating episode in the past 3 months. In adult studies, the requirement for subthreshold BED ranges from once per week (Striegel-Moore et al., 1998, 2000) to once per month (Crow et al., 2002). A threshold less than once per month, but greater than one episode in 3 months, may warrant study to determine at what limit binge episodes become indicative of greater psychopathology in adolescents.

Despite lower scores on the EDE scales compared with the BED group, those with infrequent but recent binge eating episodes had significantly higher scores on the eating, shape and weight concern subscales, the global EDE scale, and trait anxiety than their overweight counterparts who did not report binge or LOC eating in the past. These findings support prior research that children and adolescents who engage in binge eating at any frequency in a recent period preceding assessment suffer from more disturbed eating cognitions and anxiety than those without a history of binge or LOC eating (Decaluwe et al., 2003; Johnson et al., 1999; Morgan et al., 2002; Tanofsky-Kraff et al., 2004). This study found a log-linear relationship between binge frequency and scores from the EDE, STAIC, and CDI, suggesting a continuous relationship between binge or LOC eating and psychopathology among teens in our sample.

The higher weight concern scores of adolescents in the RECENT-BINGE group are particularly troubling because weight concern is believed to be a risk factor for the development of an eating disorder in healthy weight samples (Killen et al., 1994, 1996; Stice et al., 1998; Stice, Presnell, & Spangler, 2002). Although the Killen studies did not use the EDE subscale to measure concern, the two measures broadly capture worries and preoccupation with one's body weight. In addition to weight

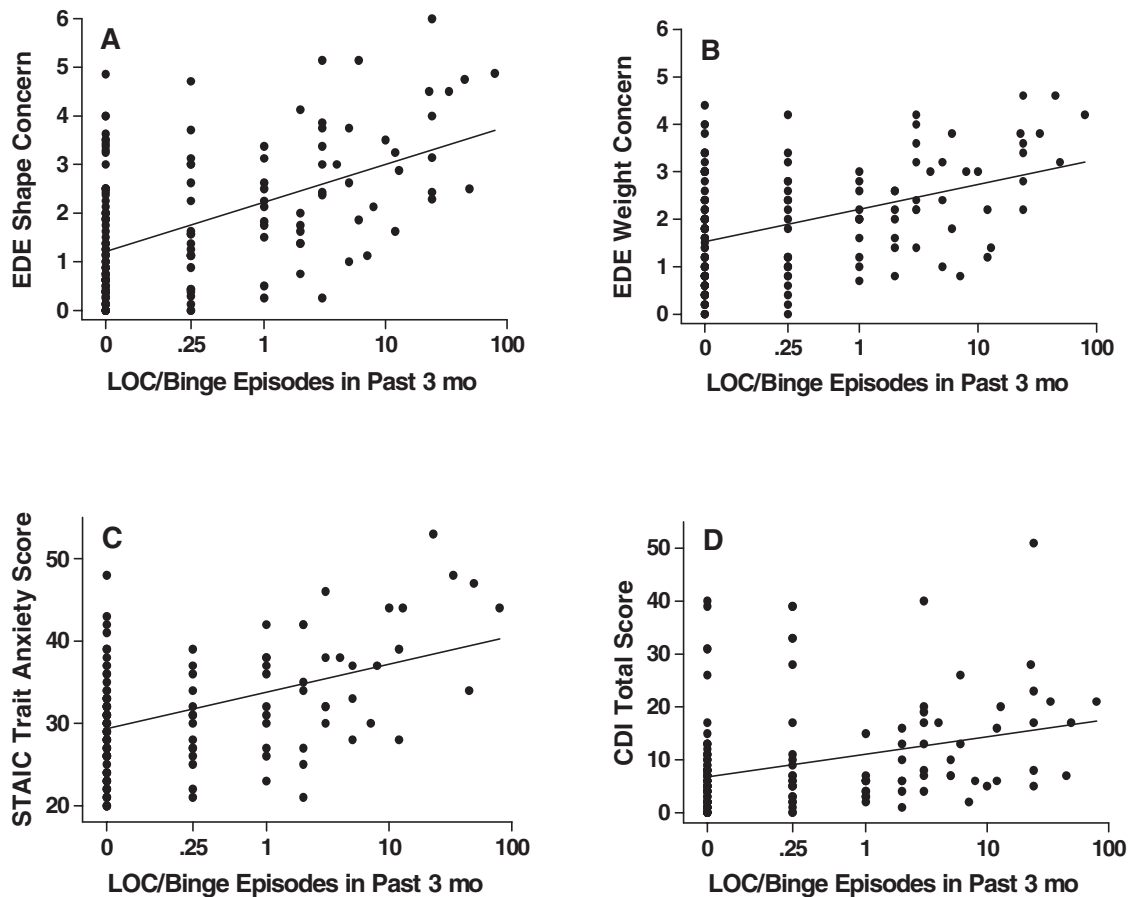


Figure 3. Number of loss of control (LOC)/binge eating episodes in the past 3 months versus (A) Eating Disorder Examination (EDE) shape concern subscale scores: $r^2 = .27, p < .01$; (B) EDE weight concern subscale scores: $r^2 = .18, p < .01$; (C) STAIC trait anxiety scores: $r^2 = .16, p < .01$; and (D) CDI total scores: $r^2 = .10, p < .01$. Number of LOC or binge eating episodes was log-transformed for analysis, with those having no episodes coded as having 0.05 episodes per 3 months and those with LOC eating in the past coded as having 0.25 episodes per 3 months.

concern, thin body preoccupation is a prospective predictor of eating disorders (McKnight Investigators, 2003), suggesting that a broader construct of disturbed eating cognitions may predict future eating disorders. Although it is unclear whether increases in eating and shape concern may also serve as risk factors for full-syndrome eating disorders among overweight teens, it is notable that in the current study, teens in the RECENT-BINGE group reported more shape concern than those in both lower threshold groups.

In addition to the potential risk of eating disorder development, participants who binge eat may be at risk for excessive weight gain. Binge eating has been associated with additional weight gain in three longitudinal studies of primarily healthy weight adolescents (Field et al., 2003; Stice, Cameron, Killen, Hayward, & Taylor, 1999; Stice et al., 2002). In a three-year longitudinal study of younger children at risk for adult obesity, binge eating has also been shown to predict weight and fat gain (Tanofsky-Kraff et al., 2006). Therefore, participants

with BED or recent but infrequent binge eating may be at risk for excessive weight gain compared with teens endorsing past LOC or never experiencing LOC eating. Future research is needed to determine whether binge eating is a risk factor for further weight gain in severely overweight treatment-seeking adolescents.

Our finding that almost half of the participants experienced binge or LOC eating, either presently or at some point in their lifetime, supports prior studies of overweight treatment-seeking adolescents (Decaluwe et al., 2003; Isnard et al., 2003) and suggests a higher frequency of binge eating among this population than those found in overweight and normal weight nontreatment-seeking youth. Among nontreatment-seeking overweight youth, prevalence estimates for LOC/binge eating are lower, from 14.6% (Tanofsky-Kraff et al., 2004) to 33.1% (Morgan et al., 2002) in children and ~18.5% in adolescents (Johnson et al., 2002). Binge eating estimates among normal weight non-treatment-seeking youth are lower than those reported by their overweight

counterparts (Tanofsky-Kraff et al., 2004). Our results suggest that binge or LOC eating is an experience shared by a substantial proportion of overweight treatment-seeking adolescents, and future research is required to investigate the potential impact of binge or LOC eating on the outcome of both medication and behavioral weight-loss interventions in this population.

Strengths of this study include the use of interview methodology for the investigation of eating-disordered pathology and the racially diverse sample. However, because many adolescents in this study were extremely overweight, our findings are limited in that they may not generalize to samples of less overweight teens or to healthy weight teens. The relatively small size of the BED group may also have provided potentially unstable estimates of the characteristics of overweight, treatment-seeking adolescents with BED. In summary, our findings suggest that a sizeable number of overweight teens seeking weight loss struggle with LOC and/or binge eating. Furthermore, although adolescents endorsing recent, subthreshold binge eating do not experience distress to the same degree as those with DSM-IV-TR BED, they do report greater distress than those who have not experienced LOC eating. Given this higher level of distress, overweight adolescents who report binge eating, even at subthreshold levels, may benefit from interventions focused on their LOC eating experiences in addition to traditional behavioral modification techniques for weight loss. Finally, frequent or recent binge eating may serve as an intervention target for the prevention of full-syndrome eating disorders and excessive weight gain.

Acknowledgments

Portions of this manuscript were presented at the 2004 International Conference on Eating Disorders, Orlando, Florida. Supported by Z01-HD-00641 (J.A.Y.). Dr Yanovski is a Commissioned Officer in the United States Public Health Service.

Received July 29, 2005; revisions received December 26, 2005 and January 18, 2006; accepted February 19, 2006

References

- Achenbach, T. M., & Elderbrook, C. (1991). *Manual for the Child Behavior Checklist and Revised Child Behavior Profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Ackard, D. M., Neumark-Sztainer, D., Story, M., & Perry, C. (2003). Overeating among adolescents: Prevalence and associations with weight-related characteristics and psychological health. *Pediatrics, 111*, 67–74.
- American Psychiatric Association (APA). (2000). *Diagnostic and statistical manual of mental disorders—text revision* (4th ed.). Washington, DC: Author.
- Berkowitz, R., Stunkard, A. J., & Stallings, V. A. (1993). Binge-eating disorder in obese adolescent girls. *Annals of the New York Academy of Science, 699*, 200–206.
- Bryant-Waugh, R. J., Cooper, P. J., Taylor, C. L., & Lask, B. D. (1996). The use of the eating disorder examination with children: A pilot study. *International Journal of Eating Disorders, 19*, 391–397.
- Connor, D. F., Edwards, G., Fletcher, K. E., Baird, J., Barkley, R. A., & Steingard, R. J. (2003). Correlates of comorbid psychopathology in children with ADHD. *Journal of the American Academy of Child and Adolescent Psychiatry, 42*, 193–200.
- Cooper, Z., Cooper, P. J., & Fairburn, C. G. (1989). The validity of the eating disorder examination and its subscales. *British Journal of Psychiatry, 154*, 807–812.
- Costello, E. J., & Angold, A. (1988). Scales to assess child and adolescent depression: Checklists, screens, and nets. *Journal of the American Academy of Child and Adolescent Psychiatry, 27*, 726–737.
- Crow, S. J., Agras, W. S., Halmi, K., Mitchell, J. E., & Kraemer, H. C. (2002). Full syndromal versus subthreshold anorexia nervosa, bulimia nervosa, and binge eating disorder: A multicenter study. *International Journal of Eating Disorders, 32*, 309–318.
- Curry, J. F., & Craighead, W. E. (1993). Depression. In T. H. Ollendick & M. Hersen (Eds.), *Handbook of child and adolescent assessment* (pp. 251–268). Needham Heights, MA: Allyn and Bacon.
- de Zwaan, M., Mitchell, J. E., Howell, L. M., Monson, N., Swan-Kremeier, L., Roerig, J. L., et al. (2002). Two measures of health-related quality of life in morbid obesity. *Obesity Research, 10*, 1143–1151.
- de Zwaan, M., Mitchell, J. E., Seim, H. C., Specker, S. M., Pyle, R. L., Raymond, N. C., et al. (1994). Eating related and general psychopathology in obese females with binge eating disorder. *International Journal of Eating Disorders, 15*, 43–52.
- Decaluwe, V., Braet, C., & Fairburn, C. G. (2003). Binge eating in obese children and adolescents. *International Journal of Eating Disorders, 33*, 78–84.
- Fairburn, C. G., & Cooper, Z. (1993). The eating disorder examination. In C. G. Fairburn & G. T. Wilson

- (Eds.), *Binge eating, nature, assessment and treatment* (12th ed., pp. 317–360). New York: Guilford.
- Field, A. E., Austin, S. B., Taylor, C. B., Malspeis, S., Rosner, B., Rockett, H. R., et al. (2003). Relation between dieting and weight change among preadolescents and adolescents. *Pediatrics*, *112*, 900–906.
- Frisancho, A. R. (1990). *Anthropometric standards for the assessment of growth and nutritional status*. Ann Arbor, MI: The University of Michigan Press.
- Hollingshead (1975). *Four factor index of social status*. New Haven, CT: Yale University.
- Isnard, P., Michel, G., Frelut, M. L., Vila, G., Falissard, B., Naja, W., et al. (2003). Binge eating and psychopathology in severely obese adolescents. *International Journal of Eating Disorders*, *34*, 235–243.
- Johnson, M., Figueroa-Colon, R., Huang, T., Dwyer, J., & Goran, M. (2005). Longitudinal changes in body fat in African American and Caucasian children: Influence of fasting insulin and insulin sensitivity. *Journal of Clinical Endocrinology and Metabolism*, *86*, 3182–3187.
- Johnson, W. G., Grieve, F. G., Adams, C. D., & Sandy, J. (1999). Measuring binge eating in adolescents: Adolescent and parent versions of the questionnaire of eating and weight patterns. *International Journal of Eating Disorders*, *26*, 301–314.
- Johnson, W. G., Rohan, K. J., & Kirk, A. A. (2002). Prevalence and correlates of binge eating in white and African American adolescents. *Eating Behavior*, *3*, 179–189.
- Johnson, W. G., Spitzer, R. L., & Williams, J. B. (2001). Health problems, impairment and illnesses associated with bulimia nervosa and binge eating disorder among primary care and obstetric gynaecology patients. *Psychological Medicine*, *31*, 1455–1466.
- Killen, J. D., Taylor, C. B., Hayward, C., Haydel, K. F., Wilson, D. M., Hammer, L., et al. (1996). Weight concerns influence the development of eating disorders: A 4-year prospective study. *Journal of Consulting and Clinical Psychology*, *64*, 936–940.
- Killen, J. D., Taylor, C. B., Hayward, C., Wilson, D. M., Haydel, F., Hammer, L. D., et al. (1994). Pursuit of thinness and onset of eating disorder symptoms in a community sample of adolescent girls: A three-year prospective analysis. *International Journal of Eating Disorders*, *16*, 227–238.
- Kovacs, M. (1982). *The children's depression inventory*. Unpublished manuscript.
- Marshall, W. A., & Tanner, J. M. (1969). Variations in pattern of pubertal changes in girls. *Archives of Disease in Childhood*, *44*, 291–303.
- Marshall, W. A., & Tanner, J. M. (1970). Variations in the pattern of pubertal changes in boys. *Archives of Disease in Childhood*, *45*, 13–23.
- Masheb, R. M., & Grilo, C. M. (2000). Binge eating disorder: A need for additional diagnostic criteria. *Comprehensive Psychiatry*, *41*, 159–162.
- McDuffie, J. R., Calis, K. A., Uwaifo, G. I., Sebring, N. G., Fallon, E. M., Hubbard, V. S., et al. (2002). Three-month tolerability of Orlistat in adolescents with obesity-related comorbid conditions. *Obesity Research*, *10*, 642–650.
- McKnight Investigators. (2003). Risk factors for the onset of eating disorders in adolescent girls: Results of the McKnight Longitudinal Risk Factor Study. *American Journal of Psychiatry*, *160*, 248–254.
- Morgan, C. M., Yanovski, S. Z., Nguyen, T. T., McDuffie, J., Sebring, N. G., Jorge, M. R., et al. (2002). Loss of control over eating, adiposity, and psychopathology in overweight children. *International Journal of Eating Disorders*, *31*, 430–441.
- Mussell, M. P., Peterson, C. B., Weller, C. L., Crosby, R. D., de Zwaan, M., & Mitchell, J. E. (1996). Differences in body image and depression among obese women with and without binge eating disorder. *Obesity Research*, *4*, 431–439.
- Must, A., Dallal, G. E., & Dietz, W. H. (1991). Reference data for obesity: 85th and 95th percentiles of body mass index (wt/ht²) and triceps skinfold thickness. *American Journal of Clinical Nutrition*, *53*, 839–846.
- Niego, S. H., Pratt, E. M., & Agras, W. S. (1997). Subjective or objective binge: Is the distinction valid? *International Journal of Eating Disorders*, *22*, 291–298.
- Pratt, E. M., Niego, S. H., & Agras, W. S. (1998). Does the size of a binge matter? *International Journal of Eating Disorders*, *24*, 307–312.
- Rizvi, S. L., Peterson, C. B., Crow, S. J., & Agras, W. S. (2000). Test–retest reliability of the eating disorder examination. *International Journal of Eating Disorders*, *28*, 311–316.
- Spielberger, C. D. (1973). *Manual for the State-Trait Anxiety Inventory for Children*. Palo Alto, CA: Consulting Psychologists Press.
- Spielberger, C. D., Gorsuch, R. L., & Lushene, R. D. (1970). *STAI Manual for the State-Trait Anxiety Inventory* (“Self-Evaluation Questionnaire”). Palo Alto, CA: Consulting Psychologists Press.
- Stice, E., Cameron, R. P., Killen, J. D., Hayward, C., & Taylor, C. B. (1999). Naturalistic weight-reduction efforts prospectively predict growth in relative weight and onset of obesity among female

- adolescents. *Journal of Consulting and Clinical Psychology*, 67, 967–974.
- Stice, E., Killen, J. D., Hayward, C., & Taylor, C. B. (1998). Age of onset for binge eating and purging during late adolescence: A 4-year survival analysis. *Journal of Abnormal Psychology*, 107, 671–675.
- Stice, E., Presnell, K., & Bearman, S. K. (2001). Relation of early menarche to depression, eating disorders, substance abuse, and comorbid psychopathology among adolescent girls. *Developmental Psychology*, 37, 608–619.
- Stice, E., Presnell, K., & Spangler, D. (2002). Risk factors for binge eating onset in adolescent girls: A 2-year prospective investigation. *Health Psychology*, 21, 131–138.
- Striegel-Moore, R. H., Cachelin, F. M., Dohm, F. A., Pike, K. M., Wilfley, D. E., & Fairburn, C. G. (2001). Comparison of binge eating disorder and bulimia nervosa in a community sample. *International Journal of Eating Disorders*, 29, 157–165.
- Striegel-Moore, R. H., Dohm, F. A., Solomon, E. E., Fairburn, C. G., Pike, K. M., & Wilfley, D. E. (2000). Subthreshold binge eating disorder. *International Journal of Eating Disorders*, 27, 270–278.
- Striegel-Moore, R. H., Wilson, G. T., Wilfley, D. E., Elder, K. A., & Brownell, K. D. (1998). Binge eating in an obese community sample. *International Journal of Eating Disorders*, 23, 27–37.
- Sun, M., Gower, B. A., Bartolucci, A. A., Hunter, G. R., Figueroa-Colon, R., & Goran, M. I. (2001). A longitudinal study of resting energy expenditure relative to body composition during puberty in African American and white children. *American Journal of Clinical Nutrition*, 73, 308–315.
- Tanner, J. M. (1981). Growth and maturation during adolescence. *Nutritional Review*, 39, 43–55.
- Tanofsky-Kraff, M., Cohen, M., Yanovski, S. Z., Cox, C., Theim, K. R., Keil, M., et al. (2006). A prospective study of psychological predictors for weight change in children at high risk for adult obesity. *Pediatrics*, 117, 1203–1209.
- Tanofsky-Kraff, M., Faden, D., Yanovski, S., Wilfley, D., & Yanovski, J. (2005). The perceived onset and loss of control eating behaviors in overweight children. *International Journal of Eating Disorders*, 38, 112–122.
- Tanofsky-Kraff, M., Yanovski, S. Z., Wilfley, D. E., Marmarosh, C., Morgan, C. M., & Yanovski, J. A. (2004). Eating-disordered behaviors, body fat, and psychopathology in overweight and normal-weight children. *Journal of Consulting and Clinical Psychology*, 72, 53–61.
- Wilfley, D. E., Friedman, M. A., Douchis, J. Z., Stein, R. I., Welch, R. R., & Ball, S. A. (2000). Comorbid psychopathology in binge eating disorder: Relation to eating disorder severity at baseline and following treatment. *Journal of Consulting and Clinical Psychology*, 68, 641–649.
- Wilfley, D. E., Schwartz, M. B., Spurrell, E. B., & Fairburn, C. G. (2000). Using the eating disorder examination to identify the specific psychopathology of binge eating disorder. *International Journal of Eating Disorders*, 27, 259–269.
- Williamson, D. A., Netemeyer, R. G., Jackman, L. P., Anderson, D. A., Funsch, C. L., & Rabalais, J. Y. (1995). Structural equation modeling of risk factors for the development of eating disorder symptoms in female athletes. *International Journal of Eating Disorders*, 17, 387–393.
- Yanovski, S. Z., Nelson, J. E., Dubbert, B. K., & Spitzer, R. L. (1993). Association of binge eating disorder and psychiatric comorbidity in obese subjects. *American Journal of Psychiatry*, 150, 1472–1479.