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Overeating and binge eating in emerging adulthood: 10-year stability and risk factors

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Abstract

Objective—Overeating (eating an unusually large amount of food) and binge eating [overeating with loss of control (LOC)] predict adverse health consequences in adolescence. We aimed to characterize the stability of and risk factors for these distinct but inter-related constructs during critical developmental transitions.

Methods—A population-based sample ($n=1,902$) completed surveys at 5-year intervals spanning adolescence and young adulthood. The trajectories of no overeating, overeating, binge eating, and binge eating disorder (BED; recurrent binge eating with associated distress) were characterized using cross-tabulations. Body mass index, depressive symptoms, self-esteem, and body satisfaction were examined as risk factors for no overeating, overeating, and binge eating 5-years later using multinomial logistic regression.

Results—All overeating categories tended to remit to no overeating at 5-year follow-up. Although overeating had the lowest remittance rates at each time-point, binge eating and BED showed higher rates of persistence or worsening of symptoms during the transition from late adolescence/early young adulthood to early/middle young adulthood. Overeating and binge eating had similar risk factors, although for females, depressive symptoms, body satisfaction, and self-esteem in late adolescence/early young adulthood differentially predicted binge eating versus overeating in early/middle young adulthood ($ps<.05$).

Conclusions—While overeating with or without LOC tends to remit over time, problematic eating persists for a subset of individuals. Greater psychosocial problems in late adolescence/early

young adulthood predicted greater odds of binge eating relative to overeating in early/middle young adulthood among females, indicating that poorer psychosocial functioning in this developmental stage portends more severe eating-related psychopathology later in life.

Keywords

Overeating; binge eating; loss of control; course; risk factors

Overeating involves consuming an objectively large amount of food, and binge eating is characterized by overeating accompanied by a sense of loss of control (LOC) while eating (American Psychiatric Association, 2013). Overeating (without LOC) and binge eating (with LOC) each are reported by approximately 5–10% of adolescents in population-based samples (Goldschmidt et al., 2015; Sonnevile et al., 2013), marking them as among the most prevalent disordered eating behaviors in this age group. The experience of LOC while eating is associated with significant distress, impairment, and problematic eating patterns, independent of overeating, in both cross-sectional (Goldschmidt et al., 2008; Mirch et al., 2006; Shomaker et al., 2010) and prospective studies (Goldschmidt et al., 2012; Goldschmidt, Tanofsky-Kraff, & Wilfley, 2011; Hilbert, Rief, Tuschen-Caffier, de Zwaan, & Czaja, 2009; Tanofsky-Kraff et al., 2011). Binge eating is considered a more severe form of overeating behavior (given that binge eating is part of a clinical syndrome, whereas "pure" overeating is not; American Psychiatric Association, 2013; Wolfe, Baker, Smith, & Kelly-Weeder, 2009), thus in the absence of treatment, binge eating might be expected to remain stable or progress into a full-syndrome eating disorder (Stice, Marti, Shaw, & Jaconis, 2009), while overeating might be expected remit over time. Yet, little is known about whether the trajectories and precursors of these distinct yet related behaviors differ across development, which could inform screening and early intervention efforts.

Up to half of adolescents who report binge eating at baseline continue to engage in this behavior at 5- and 6-years follow-up, respectively (Goldschmidt, Wall, Loth, Bucchianeri, & Neumark-Sztainer, 2014; Goossens, Braet, Verbeken, Decaluwe, & Bosmans, 2011). Importantly, persistent binge eating is associated with poorer psychosocial outcomes over time (Goldschmidt et al., 2014), including full-syndrome eating disorders (Stice et al., 2009). While eating episodes characterized by LOC, regardless of episode size, are relatively stable in adults, significant crossover between large and not-large episodes has been observed over 2 years of follow-up (Peterson et al., 2012). However, among overweight youth, episodes involving both overeating and LOC were more stable than those involving LOC without overeating, and there was little evidence of crossover between these types of eating episodes at 6-year follow-up (Goossens et al., 2011). In contrast to the growing body of literature on the course and outcome of binge eating, it is currently unclear whether overeating tends to progress into more severe eating pathology over time or, conversely, remits in the absence of treatment, which could be meaningful in terms of identifying individuals in need of prevention services.

The cognitive behavioral model is a leading theory that has been used to describe the onset and maintenance of binge eating behaviors, and served as the framework for the current study. According to the most recent iteration of this model (Fairburn, 2008), poor self-

esteem manifests in extreme appearance-related concerns (potentially resulting from carrying excess body weight, which is inconsistent with Western society's emphasis on the "thin ideal;" Presnell, Bearman, & Stice, 2004; Stice & Whitenton, 2002), which give rise to rigid dieting efforts intended to change one's overvalued shape and weight. These restrictive eating practices result in binge eating upon the breaking of a dietary rule, the latter of which is often precipitated by the experience of low mood. This model may be especially applicable during the transition from adolescence to adulthood, given body-related changes that accompany puberty (Klump, 2013) as well as an increased emphasis on appearance coinciding with the initiation of dating and sexual relationships (Blodgett Salafia & Benson, 2013).

In support of the cognitive behavioral model, risk factors for binge eating include general factors (e.g., depressive symptoms, self-esteem), as well as disorder-specific factors (e.g., appearance-related concerns, excess weight status; Allen, Byrne, La Puma, McLean, & Davis, 2008; Stice, Presnell, & Spangler, 2002). By contrast, little is known about risk factors for overeating without LOC: to date, results from only one prospective study suggest that depressive symptoms also increase risk for overeating (Skinner, Haines, Austin, & Field, 2012). Importantly, in this study, mood-related risk factors for overeating with versus without LOC were not directly compared, and other potentially relevant risk factors (such as those mentioned above) were not examined. Since overeating and binge eating may represent relatively less and more severe ends of the "problematic eating" spectrum, respectively, it is possible that these behaviors are predicted by similar risk factors that vary in severity (i.e., with more severe impairments on the aforementioned risk factors predicting greater risk of binge eating relative to overeating). Identifying factors that distinguish risk for different types of eating pathology is critical for determining which types of preventive interventions at-risk youth should receive.

The primary objective of the current study was to characterize the longitudinal stability of four different eating-related categories [no overeating, overeating, binge eating, and binge eating disorder (recurrent binge eating with associated distress)] within a population-based sample followed over 10 years during the transition from adolescence to young adulthood. A secondary objective was to identify risk factors differentiating overeating and binge eating relative from one another, and from no overeating. Based on the existing literature (Skinner et al., 2012; Sonnevile et al., 2013), we predicted that binge eating episodes (characterized by *both* LOC and overeating) would be more stable than eating episodes involving only overeating, and would be preceded by more severe impairment in the following risk domains: elevated weight status, depressive symptoms, self-esteem, and body satisfaction.

Methods

Study Design and Population

Participants were drawn from three waves of Project EAT (Eating and Activity Among Teens and Young Adults), a 10-year longitudinal study of eating, weight and psychosocial factors among young people in the Minneapolis/St. Paul metropolitan area of Minnesota (Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011). Public schools and school districts serving socioeconomically and racially/ethnically diverse communities were invited

to participate. Data were collected during early/middle adolescence (Time 1; T1: 1998–1999) in classrooms; and at 5-year (Time 2; T2: 2003–2004; late adolescence/early young adulthood) and 10-year follow-up (Time 3; T3: 2008–2009; early/middle young adulthood) by mail or online. Consent procedures were completed in accordance with the request of each school district. All study protocols were approved by University of Minnesota's Institutional Review Board.

Of the original 4,746 EAT-I participants, 1,304 (27.5%) were lost to follow-up, primarily due to inability to contact participants (e.g., missing or outdated address information). The remaining 3,442 participants were mailed follow-up surveys at T2 and T3. Of these, 1,902 (55.3%) individuals completed surveys at all three time-points. A total of 75 participants were missing outcome overeating data, leaving 1,827 participants for the current analyses. Participants with ($n=1,827$) and without complete overeating data at all three time-points ($n=2,919$) did not differ with respect to baseline overeating category, depressive symptoms, body satisfaction, or self-esteem (all $ps>.05$).

Measures

The Project EAT survey assesses cognitions, behaviors, and attitudes related to eating and psychological functioning. To allow for longitudinal comparisons, key items were consistent across the three study waves. Test-retest data for the EAT-I survey were collected on 161 7th and 10th grade students who completed identical versions of the survey approximately two weeks apart. Further details on survey development are reported elsewhere (Larson, Neumark-Sztainer, Story, van den Berg, & Hannan, 2011; Neumark-Sztainer, Story, Hannan, & Croll, 2002; Neumark-Sztainer, Wall, Eisenberg, Story, & Hannan, 2006).

Anthropometric and Demographic Factors—Self-reported height and weight were used to determine body mass index (BMI; kg/m^2) percentiles, based on age- and sex-specific CDC normative data (Kuczmarski et al., 2000). Overweight was defined as a BMI 85th percentile. Self-report of height and weight was validated in a subsample of 125 Project EAT-III participants for whom height and weight were measured by trained research staff. Results showed very high correlations between self-reported and measured BMI in males ($r=.95$) and females ($r=.98$). Age, sex, and race/ethnicity (Eaton, Brener, Kann, & Pittman, 2007) were based on self-report. Five levels of socioeconomic status (SES) were based on the highest educational attainment by either parent. Where this information was missing, eligibility for public assistance, eligibility for free/reduced cost school meals, and parental employment status were used to infer SES (Neumark-Sztainer et al., 2002).

Eating Behaviors—Overeating was ascertained by an affirmative response to the question, “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?”; binge eating was ascertained by *additionally* responding affirmatively to the question, “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?” 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, Grieve, Adams, & Sandy, 1999; present study test-retest agreement=92% for overeating and

84% for LOC) and adults (published mean probability of reporting binge eating based on both questionnaire and self-monitoring data=49.5%; published kappa=.58; Nangle, Johnson, Carr-Nangle, & Engler, 1994). All participants were additionally asked how upset they were by overeating (“not at all,” “a little,” “some,” “a lot”) and participants who endorsed binge eating were additionally asked how often these episodes occurred (“nearly every day,” “a few times a week,” “a few times a month,” or “less than once a month”). Binge eating disorder (BED) was approximated by binge eating a few times a week or more, with “some” or “a lot” of associated distress. This relatively stringent binge eating frequency threshold (as compared to the current threshold of binge eating once per week to attain a diagnosis of bulimia nervosa or binge eating disorder) was selected to account for adolescents’ tendencies to over-report binge eating behaviors on self-report questionnaires (Decaluwe & Braet, 2004; Goldschmidt, Doyle, & Wilfley, 2007).

Psychosocial Factors—Depressive symptoms were assessed via Kandel and Davies’ scale for adolescents (Kandel & Davies, 1982), which inquires about the frequency of dysphoric mood, tension/ nervousness, fatigue, worry, sleep disturbance, and hopelessness during the past year. Scores range from 6–18, with higher scores indicating greater depressive symptoms (present study α =.84). This scale has good reliability and validity in adolescents (Kandel & Davies, 1982). Body satisfaction was measured using a modified version of the Body Shape Satisfaction Scale (Pingitore, Spring, & Garfield, 1997), in which respondents rate their satisfaction with 10 aspects of their body (e.g., height, weight, body shape, thighs). Scores range from 10–50 with lower scores reflecting lower satisfaction (published α =.88; present study α =.92). Self-esteem was assessed via six items from the Rosenberg Self-Esteem Scale (Rosenberg, 1965). Scores range from 6 to 24, with lower scores indicating lower self-esteem (present study α =.71). A study examining the validity of this shortened version in adolescents demonstrated that correlations with measures of body image and depression symptoms were nearly identical for the shortened and full versions (differences in correlation coefficients ranged from .006 to .037; van den Berg et al., 2007).

Statistical Analysis

Analyses were conducted in SAS 9.4 (SAS, Chicago, IL). First, ANCOVA and logistic regression [controlling for age cohort, race/ethnicity (categorized as non-Hispanic white versus all others), and SES] were used to compare those with and without complete overeating data on baseline characteristics. Next, cross-tabulations were used to examine the course of eating episodes from T1 to T2 and T3. Because we aimed to investigate how the severity of eating episodes changes over time, these analyses included four eating-related categories: no overeating; overeating (without LOC); binge eating; and BED (please note that the cross-tabulations were not stratified by gender due to the small sample sizes in many cells). Finally, separate multinomial logistic regression analyses, stratified by gender, were conducted to examine T1 predictors of T2 eating-related outcomes (no overeating, overeating, and binge eating) and T2 predictors of T3 eating-related outcomes (*note*: BED was combined with binge eating in these analyses due to small sample sizes). The decision to stratify by gender was based on evidence that the prevalence and correlates of overeating and binge eating differ among boys and girls (Ackard, Neumark-Sztainer, Story, & Perry, 2003; Sonnevile et al., 2013), and to facilitate comparisons with other studies that stratified

by gender or included only girls; however, we made no specific hypotheses about gender-related differences. Predictors included continuously-measured BMI; depressive symptoms; body satisfaction; and self-esteem. All models controlled for prior eating-related category, age cohort, race/ethnicity, and SES. Because participants with follow-up data were more likely to be female, Caucasian, and from a higher socioeconomic category ($ps < .05$), frequencies and regression models were weighted with the inverse of the estimated probability that an individual responded at all three time points (Little, 1982). The use of non-response sampling weights along with subpopulation analysis generates estimates that represent the demographic composition of the original Project EAT sample corresponding to the analytic subgroups. For ease of interpretation, all reported *ns* are raw; however, percentages are weighted by non-response weights to assist with generalizability to population-based samples.

Results

Descriptive Characteristics

The sample consisted of a younger cohort that was in middle school at baseline (30.3%; M baseline age = 12.8 ± 0.7 y), and an older cohort that was in high school at baseline (69.7%; M baseline age = 15.9 ± 0.8 y); thus we were able to capture different developmental periods and transitions from these periods. Participants were 56.9% female ($n=1,040$), 66.5% Caucasian, and 54.9% fell in the middle and middle-high socioeconomic categories, with the remainder being categorized as low/low-middle (27.0%) or high (18.1%).

Stability of Eating Behaviors

At T1 (early/middle adolescence), 1,611 (86.8%) participants reported no overeating; 85 (4.8%) reported overeating; 96 (5.9%) reported binge eating; and 35 (2.5%) reported symptoms consistent with BED. As depicted in Figure 1, across T1 overeating categories, the majority of individuals tended to remit into no overeating by T2 (late adolescence/early young adulthood). The best course was observed for those with no overeating at T1, among whom 92.0% ($n=1,479$) continued to report no overeating at T2; 3.2% ($n=52$) transitioned to overeating; 4.0% ($n=66$) transitioned to binge eating; and 0.8% ($n=14$) transitioned to BED. Overeating at T1 showed the worst course, with 64.0% ($n=57$) remitting to no overeating at T2, compared to 78.9% ($n=69$) of those with binge eating and 80.1% ($n=24$) of those with BED.

The majority of individuals across T2 overeating categories remitted to no overeating at T3 (early/middle young adulthood). Again, the best course was observed for those with no overeating at T2 ($n=1,629$; 89.6%), among whom 85.8% ($n=1,399$) reported no overeating at T3; 5.5% ($n=93$) progressed to overeating; 6.8% ($n=109$) progressed to binge eating; and 2.0% ($n=28$) progressed to BED. While participants reporting overeating at T2 had slightly lower rates of remittance to no overeating by T3 (46.2%; $n=31$) compared to binge eating (50.5%; $n=47$) and BED (53.7%; $n=11$), only 27.6% ($n=24$) of overeaters transitioned to binge eating or BED, while 40.3% ($n=45$) of binge eaters and 39.4% ($n=11$) of those with BED fell into the binge eating or BED categories at T3.

Predictors of Eating Behaviors

Males—BMI ($p=.039$), depressive symptoms ($p=.005$), and body satisfaction ($p=.025$) at T1 (early/middle adolescence) differentially predicted eating behaviors among boys at T2 (late adolescence/early young adulthood; see Table 1). Higher BMI and lower body satisfaction at T1 each were associated with significantly greater odds of reporting T2 overeating relative to no overeating ($ps<.05$), while higher T1 depressive symptoms predicted greater odds of T2 binge eating relative to no overeating ($p=.002$).

BMI ($p<.001$), depressive symptoms ($p=.003$), body satisfaction ($p<.001$), and self-esteem ($p=.002$) at T2 differentially predicted eating behaviors among boys at T3 (early/middle young adulthood). Greater impairments in these domains at T2 predicted greater odds of reporting T3 overeating relative to no overeating ($ps<.05$). Similarly, poorer functioning in these domains predicted greater odds of reporting T3 binge eating relative to no overeating ($ps<.05$). None of the constructs differentially predicted overeating relative to binge eating at T3 ($ps>.05$).

Females—Depressive symptoms ($p=.003$), body satisfaction ($p<.001$), and self-esteem ($p=.021$) at T1 (early/middle adolescence) differentially predicted eating behaviors among girls at T2 (late adolescence/early young adulthood; see Table 2). Greater depressive symptoms as well as lower body satisfaction and self-esteem at T1 predicted higher odds of reporting T2 binge eating relative to no overeating ($ps<.05$). Lower T1 body satisfaction was additionally associated with greater odds of reporting T2 overeating relative to no overeating ($p=.002$).

Depressive symptoms ($p<.001$), body satisfaction ($p<.001$), and self-esteem ($p<.001$) at T2 all differentially predicted eating behaviors at T3 (early/middle young adulthood). Greater depressive symptoms as well as lower body satisfaction and self-esteem at T2 predicted greater odds of reporting T3 binge eating relative to both overeating and no overeating (all $ps<.05$).

Discussion

This study investigated the etiology and course of eating episodes involving overeating with and without loss of control (LOC) in a population-based sample of adolescents and young adults, utilizing cognitive behavioral theory as a guiding framework. We found that stability and risk factors were largely similar across overeating categories, with some notable exceptions. Namely, while binge eating and binge eating disorder (BED; recurrent overeating with loss of control and associated distress) each had a high likelihood of remittance to no overeating across time-points, their courses were markedly worse from T2 to T3 relative to overeating. Moreover, for female participants, poorer psychosocial functioning in late adolescence/early young adulthood differentially predicted binge eating versus overeating in early/middle young adulthood, suggesting that young women exhibiting difficulties with their mood or general/body-related esteem may benefit from receiving preventive services. Overall, results support the important role of LOC in the stability and precursors of problematic eating during the transition from adolescence to young adulthood,

highlighting the importance of careful screening of eating patterns and related psychosocial symptoms in clinical settings serving young people.

The most common pattern of symptom change, regardless of earlier eating status, was to remit into no overeating by the following time-point (although recovery rates were slightly lower during the transition from T2 to T3 relative to the transition from T1 to T2, suggesting that overeating and binge eating may be more stable in later developmental stages, as behaviors become more ingrained and less amenable to change). However, a small but significant subset of participants developed new onset overeating or binge eating at the different time points (8.0% at T2; 14.3% at T3). This increased incidence in overeating and binge eating from T2 to T3 is consistent with previous literature suggesting that emerging adulthood is a critical risk period in the development and prevention of disordered eating (Fitzsimmons-Craft, 2011; Smink, van Hoeken, & Hoek, 2012).

Interestingly, individuals reporting overeating showed lower rates of remittance into no overeating across time-points relative to those reporting binge eating or BED. In parallel, they had higher rates of persisting or worsening in behavior than binge eating or BED, although it should be noted that overeaters also had more categories to persist or worsen *into* (e.g., overeaters could persist or worsen by reporting overeating, binge eating, or BED at follow-up, while binge eaters could only persist or worsen by reporting binge eating or BED). Conversely, while those with binge eating and BED had moderate-to-high rates of recovery (which could reflect increased treatment-seeking in these more severely affected individuals, although a measure of treatment-seeking was not available), particularly from T1 to T2, approximately 40% of individuals in each of these categories continued to engage in binge eating at T3. It is possible that persistence of overeating and binge eating is influenced differentially by factors that vary across development (e.g., peer group, living situation). Nevertheless, the poorer symptom courses for individuals engaging in binge eating in the current study, irrespective of frequency or distress, taken together with prior research suggesting that persistent eating pathology involving LOC is associated with poorer outcomes (including the onset of full-syndrome BED; Goldschmidt et al., 2014; Tanofsky-Kraff et al., 2011), highlights the clinical significance of binge eating compared to overeating in the spectrum of problematic eating behaviors.

In terms of risk factors, higher body weight and depressive symptoms, and lower self-esteem and body satisfaction, generally predicted a greater likelihood of later reporting overeating and (separately) binge eating versus no overeating. However, at most time-points, these risk factors did not differentiate later binge eating relative to overeating, which was contrary to our expectations. Generally, these results suggest that preventive interventions targeting excess weight, depressive symptoms, body satisfaction, and self-esteem (which are well-established risk factors for eating disorders and are frequently addressed in eating disorder prevention programs; Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004; Stice, Becker, & Yokum, 2013) may theoretically reduce risk for overeating either with or without LOC. Nevertheless, our hypotheses were partially confirmed by findings that greater depressive symptoms as well as lower body satisfaction and self-esteem measured in late adolescence/early young adulthood predicted greater odds of binge eating relative to overeating (but not overeating relative to no overeating) in early/middle young adulthood among females. These

findings may indicate that lower mood and self-image in this developmental stage portends more severe eating-related psychopathology later in life, and young women demonstrating difficulties in these domains should be referred for comprehensive interventions to minimize or prevent other negative health outcomes.

Overall, the tendency for binge eating to be more stable and associated with more potent risk factors from T2 to T3 suggests that the transition from adolescence to young adulthood may be especially important in the development and maintenance of binge eating. Generally, emerging adulthood presents numerous challenges, including greater independence in terms of self-care, finances, and family obligations (Shanahan, 2000), and is a period of vulnerability for many risky health behaviors (Bradley & Wildman, 2002). Individuals who are already experiencing mental health issues such as depression and poor self-image may have difficulties meeting these increased demands, and utilize binge eating as a coping strategy (although, of note, depression symptoms were also an important risk factor for both overeating and binge eating during the transition from early/middle adolescence to middle adolescence/early young adulthood, suggesting that *earlier* developmental stressors may interact with mood to promote problematic eating as well). Further research into the unique risk and maintaining factors associated with binge eating during this developmental timeframe is warranted.

The sex-related differences that emerged with regards to risk factors (i.e., the absence of unique risk factors for binge eating relative to overeating among males, while depressive symptoms, body satisfaction, and self-esteem uniquely predicted binge eating vs. overeating among females) extend previous findings suggesting that the prevalence and correlates of problematic eating differ for males and females (Ackard et al., 2003; Sonnevile et al., 2013). Sex differences in risk for disordered eating may reflect hormonal expression during puberty (Culbert, Breedlove, Sisk, Burt, & Klump, 2013), and girls with pre-existing psychosocial concerns may be particularly vulnerable to these effects. Future studies should examine interactions between pubertal status, hormonal profiles, and psychosocial status in order to better understand sex-specific risk for binge eating during adolescence and young adulthood.

The current study was marked by several important strengths, including the large, population-based sample, and longitudinal assessments occurring at regular 5-year intervals. Furthermore, this was the first study, to our knowledge, to comparatively examine the etiology and course of specific types of eating behaviors. Nevertheless, there were several limitations that should be considered. First, because of the epidemiological nature of the study, the use of “gold-standard” measures would have increased participant burden; thus, brief self-report measures were instead used to assess anthropometric and psychosocial variables (however, of note, self-reported and measured height and weight had excellent concordance in this sample; Himes, Hannan, Wall, & Neumark-Sztainer, 2005). Second, non-random loss to follow-up was observed from T1 to T2. However, there was minimal attrition from T2 to T3, and the longitudinal sample was weighted to correct for non-response bias such that the final analytic sample reflected the population-based composition of the original EAT sample. Third, overeating was characterized as eating “so much food in a short period of time that you would be embarrassed if someone saw you,” which

introduces an element of secrecy and shame that is not typically included in other studies of overeating and thus may limit cross-study comparisons. Finally, we were not able to examine the unique course and precursors of LOC in the absence of overeating, which will be important to establish in future studies.

In summary, our findings add to a growing literature indicating that LOC is a salient construct involved in problematic eating by additionally suggesting that binge eating has high rates of persisting or worsening in early young adulthood, and, for females, is associated with specific risk factors that differ from those associated with overeating. As such, clinicians are advised to thoroughly screen for binge eating (including frequency and related distress) in young people and provide tailored interventions addressing individual risk profiles.

References

- Ackard DM, Neumark-Sztainer D, Story M, Perry C. Overeating among adolescents: Prevalence and associations with weight-related characteristics and psychological health. *Pediatrics*. 2003; 111:67–74. [PubMed: 12509556]
- Allen KL, Byrne SM, La Puma M, McLean N, Davis EA. The onset and course of binge eating in 8- to 13-year-old healthy weight, overweight and obese children. *Eating Behaviors*. 2008; 9:438–446. [PubMed: 18928907]
- American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 5th edition.. Washington, D.C.: 2013.
- Blodgett Salafia EH, Benson KE. Differences in Emerging-Adult Women's Body Image and Sexuality Outcomes According to BMI and Dating Status. *International Journal of Sexual Health*. 2013; 25:225–239.
- Bradley G, Wildman K. Psychosocial predictors of emerging adults' risk and reckless behaviors. *Journal of Youth and Adolescence*. 2002; 31:253–265.
- Culbert KM, Breedlove SM, Sisk CL, Burt SA, Klump KL. The emergence of sex differences in risk for disordered eating attitudes during puberty: a role for prenatal testosterone exposure. *Journal of Abnormal Psychology*. 2013; 122:420–432. [PubMed: 23713501]
- Decaluwe V, Braet C. Assessment of eating disorder psychopathology in obese children and adolescents: Interview versus self-report questionnaire. *Behaviour Research and Therapy*. 2004; 42:799–811. [PubMed: 15149900]
- Eaton DK, Brener ND, Kann L, Pittman V. High school student responses to different question formats assessing race/ethnicity. *Journal of Adolescent Health*. 2007; 41:488–494. [PubMed: 17950169]
- Fairburn, CG. Eating disorders: The transdiagnostic view and the cognitive behavioral theory. In: Fairburn, CG., editor. *Cognitive behavior therapy and eating disorders*. New York: Guilford Press; 2008. p. 7-22.
- Fitzsimmons-Craft EE. Social psychological theories of disordered eating in college women: review and integration. *Clinical Psychology Review*. 2011; 31:1224–1237. [PubMed: 21903047]
- Goldschmidt AB, Doyle AC, Wilfley DE. Assessment of binge eating in overweight youth using a questionnaire version of the Child Eating Disorder Examination with Instructions. *International Journal of Eating Disorders*. 2007; 40:460–467. [PubMed: 17497710]
- Goldschmidt AB, Engel SG, Wonderlich SA, Crosby RD, Peterson CB, Le Grange D, Mitchell JE. Momentary affect surrounding loss of control and overeating in obese adults with and without binge eating disorder. *Obesity*. 2012; 20:1206–1211. [PubMed: 21938073]
- Goldschmidt AB, Jones M, Manwaring JL, Luce KH, Osborne MI, Cunnig D, Taylor CB. The clinical significance of loss of control over eating in overweight adolescents. *International Journal of Eating Disorders*. 2008; 41:153–158. [PubMed: 18095271]

- Goldschmidt AB, Loth KA, MacLehose RF, Pisetsky EM, Berge JM, Neumark-Sztainer D. Overeating with and without loss of control: Associations with weight status, weight-related characteristics, and psychosocial health. *International Journal of Eating Disorders*. 2015
- Goldschmidt AB, Tanofsky-Kraff M, Wilfley DE. A laboratory-based study of mood and binge eating behavior in overweight children. *Eating Behaviors*. 2011; 21:37–43. [PubMed: 21184971]
- Goldschmidt AB, Wall MM, Loth KA, Bucchianeri MM, Neumark-Sztainer D. The course of binge eating from adolescence to young adulthood. *Health Psychology*. 2014; 33:457–460. doi:<http://dx.doi.org/10.1037/a0033508>. [PubMed: 23977873]
- Goossens L, Braet C, Verbeken S, Decaluwe V, Bosmans G. Long-term outcome of pediatric eating pathology and predictors for the onset of loss of control over eating following weight-loss treatment. *International Journal of Eating Disorders*. 2011; 44:397–405. [PubMed: 20872756]
- Hilbert A, Rief W, Tuschen-Caffier B, de Zwaan M, Czaja J. Loss of control eating and psychological maintenance in children: An ecological momentary assessment study. *Behaviour Research and Therapy*. 2009; 47:26–33. [PubMed: 19010458]
- Himes JH, Hannan P, Wall M, Neumark-Sztainer D. Factors associated with errors in self-reports of stature, weight, and body mass index in Minnesota adolescents. *Annals of Epidemiology*. 2005; 15:272–278. [PubMed: 15780774]
- Jacobi C, Hayward C, de Zwaan M, Kraemer HC, Agras WS. Coming to terms with risk factors for eating disorders: Application of risk terminology and suggestions for a general taxonomy. *Psychological Bulletin*. 2004; 130:19–65. [PubMed: 14717649]
- Johnson WG, Grieve FG, Adams CD, Sandy J. Measuring binge eating in adolescents: Adolescent and parent versions of the questionnaire of eating and weight patterns. *International Journal of Eating Disorders*. 1999; 26:301–314. [PubMed: 10441246]
- Kandel D, Davies M. Epidemiology of depressive mood in adolescents. *Archives of General Psychiatry*. 1982; 39:1205–1212. [PubMed: 7125850]
- Klump KL. Puberty as a critical risk period for eating disorders: a review of human and animal studies. *Hormones and Behavior*. 2013; 64:399–410. [PubMed: 23998681]
- Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, Flegal KM, Guo SS, Wei R, Johnson CL. CDC growth charts: United States. *Advance Data*. 2000; 314:1–27. [PubMed: 11183293]
- Larson NI, Neumark-Sztainer D, Story M, van den Berg P, Hannan PJ. Identifying correlates of young adults' weight behavior: Survey development. *American Journal of Health Behavior*. 2011; 35:712–725. [PubMed: 22251762]
- Little RJA. Models for non-response in sample surveys. *Journal of the American Statistical Association*. 1982; 77:237–250.
- Mirch MC, McDuffie JR, Yanovski SZ, Schollnberger M, Tanofsky-Kraff M, Theim KR, Yanovski JA. Effects of binge eating on satiation, satiety, and energy intake of overweight children. *American Journal of Clinical Nutrition*. 2006; 84:732–738. [PubMed: 17023698]
- Nangle DW, Johnson WG, Carr-Nangle RE, Engler LB. Binge eating disorder and the proposed DSM-IV criteria: Psychometric analysis of the Questionnaire of Eating and Weight Patterns. *International Journal of Eating Disorders*. 1994; 16:147–157. [PubMed: 7987349]
- Neumark-Sztainer D, Story M, Hannan PJ, Croll J. Overweight status and eating patterns among adolescents: Where do youths stand in comparison with the healthy people 2010 objectives? *American Journal of Public Health*. 2002; 92:844–851. [PubMed: 11988458]
- Neumark-Sztainer D, Wall M, Eisenberg ME, Story M, Hannan PJ. Overweight status and weight control behaviors in adolescents: Longitudinal and secular trends from 1999 to 2004. *Preventive Medicine*. 2006; 43:52–59. [PubMed: 16697035]
- Neumark-Sztainer D, Wall M, Larson NI, Eisenberg ME, Loth K. Dieting and disordered eating behaviors from adolescence to young adulthood: Findings from a 10-year longitudinal study. *Journal of the American Dietetic Association*. 2011; 111:1004–1011. [PubMed: 21703378]
- Peterson CB, Swanson SA, Crow SJ, Mitchell JE, Agras WS, Halmi KA, Berg KC. Longitudinal stability of binge-eating type in eating disorders. *International Journal of Eating Disorders*. 2012; 45:664–669. [PubMed: 22407944]
- Pingitore R, Spring B, Garfield D. Gender differences in body satisfaction. *Obesity Research*. 1997; 5:402–409. [PubMed: 9385613]

- Presnell K, Bearman SK, Stice E. Risk factors for body dissatisfaction in adolescent boys and girls: a prospective study. *International Journal of Eating Disorders*. 2004; 36:389–401. [PubMed: 15558645]
- Rosenberg, M. *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press; 1965.
- Shanahan MJ. Pathways to Adulthood in Changing Societies: Variability and Mechanisms in Life Course Perspective. *Annual Review of Sociology*. 2000; 26:667–692.
- Shomaker LB, Tanofsky-Kraff M, Elliott C, Wolkoff LE, Columbo KM, Ranzenhofer LM, Yanovski JA. Salience of loss of control for pediatric binge episodes: does size really matter? *International Journal of Eating Disorders*. 2010; 43:707–716. [PubMed: 19827022]
- Skinner HH, Haines J, Austin SB, Field AE. A prospective study of overeating, binge eating, and depressive symptoms among adolescent and young-adult women. *The Journal of Adolescent Health*. 2012; 50:478–483. [PubMed: 22525111]
- Smink FR, van Hoeken D, Hoek HW. Epidemiology of eating disorders: incidence, prevalence and mortality rates. *Current Psychiatry Reports*. 2012; 14:406–414. [PubMed: 22644309]
- Sonneville KR, Horton NJ, Micali N, Crosby RD, Swanson SA, Solmi F, Field AE. Longitudinal associations between binge eating and overeating and adverse outcomes among adolescents and young adults: Does loss of control matter? *JAMA Pediatr*. 2013; 167:149–155. [PubMed: 23229786]
- Stice E, Becker CB, Yokum S. Eating disorder prevention: current evidence-base and future directions. *International Journal of Eating Disorders*. 2013; 46:478–485. [PubMed: 23658095]
- Stice E, Marti CN, Shaw H, Jaconis M. An 8-year longitudinal study of the natural history of threshold, subthreshold, and partial eating disorders from a community sample of adolescents. *Journal of Abnormal Psychology*. 2009; 118:587–597. [PubMed: 19685955]
- Stice E, Presnell K, Spangler D. Risk factors for binge eating onset in adolescent girls: A 2-year prospective investigation. *Health Psychology*. 2002; 21:131–138. [PubMed: 11950103]
- Stice E, Whitenton K. Risk factors for body dissatisfaction in adolescent girls: a longitudinal investigation. *Developmental Psychology*. 2002; 38:669–678. [PubMed: 12220046]
- Tanofsky-Kraff M, Shomaker LB, Olsen C, Roza CA, Wolkoff LE, Columbo KM, Yanovski JA. A prospective study of pediatric loss of control eating and psychological outcomes. *Journal of Abnormal Psychology*. 2011; 120:108–118. [PubMed: 21114355]
- van den Berg P, Paxton SJ, Keery H, Wall M, Guo J, Neumark-Sztainer D. Body dissatisfaction and body comparison with media images in males and females. *Body Image*. 2007; 4:257–268. [PubMed: 18089272]
- Wolfe BE, Baker CW, Smith AT, Kelly-Weeder S. Validity and utility of the current definition of binge eating. *International Journal of Eating Disorders*. 2009; 42:674–686. [PubMed: 19610126]
- Yanovski SZ. Binge eating disorder: Current knowledge and future directions. *Obesity Research*. 1993; 1:306–324. [PubMed: 16350580]

Figure 1.

Longitudinal course of eating-related outcomes over 10 years

Note: Time 1=early/middle adolescence; Time 2=late adolescence/early young adulthood; Time 3=early/middle young adulthood. BMI=body mass index (kg/m^2). Participants with missing overeating data at Time 1, Time 2, or Time 3 ($n=75$) are excluded. Rates of new onset overeating and binge eating are depicted by the lightest color of shading (no overeating) followed by darker colored shading (overeating, binge eating, and binge eating disorder). This figure does not take into account the weighting procedure.

Males: Adjusted odds ratios for eating behavior outcomes based upon levels of psychosocial factors measured at the previous time-point 5 years earlier

Table 1

Odds ratio (confidence interval) for Time 2 eating behavior outcome		Odds ratio (confidence interval) for Time 3 eating behavior outcome	
<i>Time 1 factors</i>		<i>Time 2 factors</i>	
<i>Eating outcome</i>		<i>Eating outcome</i>	
Binge eating vs. no overeating	Overeating vs. no overeating	Binge eating vs. no overeating	Overeating vs. no overeating
BMI	1.06 (0.95–1.18)	1.13* (1.02–1.25)	0.94 (0.81–1.08)
Depressive symptoms	1.31** (1.10–1.55)	1.11 (0.93–1.31)	1.18 (0.93–1.50)
Body satisfaction	0.97 (0.92–1.03)	0.93* (0.88–.98)	1.05 (0.97–1.13)
Self-esteem	0.96 (0.82–1.11)	1.01 (0.87–1.18)	0.95 (0.77–1.17)
		BMI	1.07* (1.01–1.13)
		Depressive symptoms	1.16** (1.05–1.28)
		Body satisfaction	0.96* (0.93–0.99)
		Self-esteem	0.89** (0.82–0.96)
			1.14*** (1.08–1.20)
			1.12* (1.01–1.24)
			0.94*** (0.91–0.97)
			0.90* (0.83–0.98)
			0.94 (0.88–1.01)
			1.04 (0.90–1.19)
			1.02 (0.97–1.07)
			0.98 (0.88–1.10)

Note: Time 1=early/middle adolescence; Time 2=late adolescence/early young adulthood; Time 3=early/middle young adulthood. BMI=body mass index (kg/m²). No overeating $n=770$ at Time 2, $n=721$ at Time 3; overeating $n=20$ at Time 2, $n=45$ at Time 3; and binge eating $n=16$ at Time 2, $n=51$ at Time 3. All analyses controlled for Time 1 age cohort, race/ethnicity, and socioeconomic status, and eating behavior category at the previous time-point.

* $p<.05$;

** $p<.01$;

*** $p<.001$

Females: Adjusted odds ratios for eating behavior outcomes based upon levels of psychosocial factors measured at the previous time-point 5 years earlier

Table 2

Odds ratio (confidence interval) for Time 2 eating behavior outcome		Odds ratio (confidence interval) for Time 3 eating behavior outcome	
Time 1 factors	Eating outcome	Time 2 factors	Eating outcome
	Binge eating vs. no overeating	Overeating vs. no overeating	Binge eating vs. no overeating
BMI	1.03 (0.99–1.08)	0.99 (0.92–1.07)	1.04* (1.01–1.08)
Depressive symptoms	1.16*** (1.06–1.26)	1.03 (0.91–1.16)	1.18*** (1.10–1.25)
Body satisfaction	0.97* (0.95–0.99)	0.94** (0.91–0.98)	0.95*** (0.93–0.98)
Self-esteem	0.92* (0.87–0.99)	0.92 (0.83–1.02)	0.85*** (0.80–0.90)
		BMI	1.01 (0.96–1.07)
		Depressive symptoms	1.04 (0.95–1.14)
		Body satisfaction	0.99 (0.96–1.02)
		Self-esteem	0.98 (0.91–1.06)

Note: Time 1=early/middle adolescence; Time 2=late adolescence/early young adulthood; Time 3=early/middle young adulthood. BMI=body mass index (kg/m²). No overeating $n=896$ at Time 2, $n=823$ at Time 3; overeating $n=55$ at Time 2, $n=83$ at Time 3; and binge eating $n=114$ at Time 2, $n=176$ at Time 3. All analyses controlled for Time 1 age cohort, race/ethnicity, and socioeconomic status, and eating behavior category at the previous time-point.

* $p<0.05$;

**

$p<0.01$;

*** $p<0.001$