Published in final edited form as:

Appetite. 2017 July 01; 114: 275–281. doi:10.1016/j.appet.2017.03.042.

Secretive Eating among Youth with Overweight or Obesity

Andrea E. Kass, PhD^{a,*}, Denise E. Wilfley, PhD^b, Kamryn T. Eddy, PhD^c, Kerri N. Boutelle, PhD^d, Nancy Zucker, PhD^e, Carol B. Peterson, PhD^f, Daniel Le Grange, PhD^g, Angela Celio-Doyle, PhD^{h,i}, and Andrea B. Goldschmidt, PhD^j

^aDepartment of Psychiatry & Behavioral Neuroscience, The University of Chicago, 5841 South Maryland Avenue, MC 1000, Chicago, Illinois, 60637, USA

^bDepartment of Psychiatry, Washington University School of Medicine, 660 South Euclid Avenue, Box 8134, St. Louis, Missouri, 63110, USA

^cDepartment of Psychiatry, Massachusetts General Hospital and Harvard Medical School, 55Fruit Street, Boston, Massachusetts, 02114, USA

^dDepartment of Pediatrics and Psychiatry, University of California, San Diego, 9500 Gilman Drive, MC 0874, La Jolla, California, 92093, USA

^eDepartment of Psychiatry and Behavioral Sciences, Duke University Medical Center, P.O. Box3842, Durham, North Carolina, 27710, USA

^fDepartment of Psychiatry, University of Minnesota Medical School, F282/2A West, 2450Riverside Avenue South, Minneapolis, Minnesota, 55454, USA

^gDepartment of Psychiatry, University of California, San Francisco, 3333 California Street, Suite245, San Francisco, California, 94118, USA

^hEating Disorders Center at the Evidence Based Treatment Centers of Seattle, 1200 5th Avenue, Suite 800, Seattle, Washington, 98101, USA

ⁱDepartment of Psychology, University of Washington, Guthrie Hall (GTH), 119A 98195-1525, Seattle, Washington, 98105

^jDepartment of Psychiatry and Human Behavior, Warren Alpert Medical School of Brown University, Weight Control and Diabetes Research Center/The Miriam Hospital, 196 Richmond St., Providence, Rhode Island, 02903, USA

Abstract

Purpose—Secretive eating, characterized by eating privately to conceal being seen, may reflect eating- and/or body-related shame, be associated with depression, and correlate with binge eating,

* Address correspondence to: Andrea E. Kass, The University of Chicago, 5841 S. Maryland Ave., MC 1000, Chicago, Illinois, 60637, USA; Tel: (773) 702-4186; Fax: (773) 702-9929; akass@yoda.bsd.uchicago.edu.

Portions of this work have been presented at the Annual Meeting of The Obesity Society, Los Angeles, California, November 2-6, 2015.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

which predicts weight gain and eating disorder onset. Increasing understanding of secretive eating in youth may improve weight status and reduce eating disorder risk. This study evaluated the prevalence and correlates of secretive eating in youth with overweight or obesity.

Methods—Youth ($N=577$) presented to five research/clinical institutions. Using a cross-sectional design, secretive eating was evaluated in relation to eating-related and general psychopathology via linear and logistic regression analyses.

Results—Secretive eating was endorsed by 111 youth, who were, on average, older than youth who denied secretive eating (mean age= 12.07 ± 2.83 versus 10.97 ± 2.31). Controlling for study site and age, youth who endorsed secretive eating had higher eating-related psychopathology and were more likely to endorse loss of control eating and purging than their counterparts who did not endorse secretive eating. Groups did not differ in excessive exercise or behavioral problems. Dietary restraint and purging were elevated among adolescents (≥ 13 y) but not children (<13 y) who endorsed secretive eating; depression was elevated among children, but not adolescents, who endorsed secretive eating.

Conclusions—Secretive eating may portend heightened risk for eating disorders, and correlates of secretive eating may differ across pediatric development. Screening for secretive eating may inform identification of problematic eating behaviors, and understanding factors motivating secretive eating may improve intervention tailoring.

Keywords

Pediatric; Psychosocial; Eating behavior; Binge eating; Overweight; Obesity

Introduction

Pediatric obesity is a significant public health issue, with over one third of United States (US) youth meeting criteria for overweight or obesity (1). Overweight and obesity are associated with medical comorbidities and impaired psychosocial functioning and confer risk for serious diseases (2, 3). Moreover, obesity is associated with all-cause mortality compared to normal weight (4), and it is projected that this generation will “live sicker and die younger” than previous generations (5, 6). Thus, research is needed to understand problematic eating behaviors that may contribute to excess weight or weight gain over time.

Secretive eating, a problematic eating behavior characterized by eating privately to conceal being seen, is relatively common in children and adolescents, with rates of endorsement ranging from 18.1% to 27.2% in children (7, 8) and 34% in adolescents (9). Secretive eating may occur in response to eating- or body-related shame, is associated with depressive symptomatology in adolescents with overweight or obesity (9), and may correlate with binge eating (7, 10), which itself predicts excess weight gain and eating disorder onset (11, 12). Indeed, cognitive-behavioral theories of eating disorders posit that overvaluation and control of shape and weight lead to problematic eating behaviors (which perpetuate weight/shape concerns), the cycle of which can be exacerbated by negative affect or interpersonal events (13). Thus, increasing our understanding of secretive eating by evaluating its psychological correlates (using both cognitive and behavioral indices of eating-related pathology and general symptomatology) may help to identify intervention targets for addressing this

problematic eating behavior. Moreover, because secretive eating may be a marker for other forms of disordered eating and risk for weight gain, increasing understanding of secretive eating may facilitate efforts to improve weight outcomes and reduce eating disorder risk.

To date, studies of secretive eating in youth have focused on children or adolescents (7-9, 14); however, to our knowledge, no study has evaluated this construct across the developmental age spectrum of youth. It is possible that secretive eating is more common among adolescents than children. Rates of secretive eating are higher in past studies of adolescents than of children (7-9), although these groups have not been compared within the same sample. Developmental differences could be driven by the fact that adolescents may have increased capacity to obtain food without the assistance of caregivers (e.g., due to greater access to money and transportation to obtain food). Adolescents may also have a greater understanding of secretive eating as a problematic (e.g., shameful) behavior and therefore secretive eating in this age group may be more likely to be associated with adverse correlates.

Given these potential differences that may occur with pediatric development, examining secretive eating across a broader age range of children and adolescents may provide unique insight into differences in symptom profiles, thus improving our understanding of problematic eating behaviors in youth. Accordingly, this study aimed to evaluate the prevalence and psychosocial correlates of secretive eating among children and adolescents ages 6-18 with overweight or obesity. This multi-site investigation—using data drawn from five institutions of varying regions across the US—represents the largest sample of youth assessed for secretive eating to date. Moreover, this is the first evaluation of secretive eating using child-reported responses to semi-structured interviews, which enables a clear operationalization and objective rating of this construct compared to questionnaires or parent report. Although past literature on the association between secretive eating and psychopathology among youth is limited, we generated hypotheses based on the literature to date that guided our analysis of this aberrant eating behavior and its relation to psychopathology. Specifically, we hypothesized that youth who endorsed any secretive eating would have higher rates of eating-related and general psychopathology than youth who did not endorse secretive eating, given past associations between this behavior and clinical pathology (7, 9, 10). We also hypothesized that rates of secretive eating and pathology would be higher among adolescents than children, given that rates of secretive eating that have been documented in studies with adolescents are higher than the rates that have been documented in studies with children (7-9).

Methods

Participants

The sample was comprised of 577 youth ages 6 to 18 (mean age = 11.18 ± 2.45) who met criteria for overweight or obesity. Overweight was defined as BMI 85th and <95th percentile for age and sex, and obesity was defined as BMI 95th percentile for age and sex (15). Participants identified as primarily female (66%) and Caucasian (55%; see Table 1).

Data were derived from a convenience sample of youth presenting to research studies or for eating disorder or obesity treatment at five institutions across the US. Data from these locations were combined as all of these institutions had data from children and/or adolescents with overweight or obesity who completed a semi-structured interview assessing eating disorder pathology, including secretive eating. Combining these data allowed us to aggregate the largest sample of youth with varying ages who were assessed for secretive eating, which also increased generalizability. A brief description of the sample populations for each of the distinct studies is provided.

Washington University School of Medicine, Missouri—Data from this site were obtained from two research studies of children and adolescents with overweight or obesity. The first study assessed eating pathology in girls ($n = 51$) ages 6-12 years (16). Participants were excluded if they had a current diagnosis of bulimia nervosa; had a medical condition or were taking medications that impacted appetite, weight, or attention; had restricted or limited food preferences; or were psychotic or suicidal. The second study was comprised of adolescents ($n = 35$) ages 12-17 years presenting to enroll in an online weight loss intervention (17). Participants were excluded if they had a diagnosis of a full-syndrome eating disorder; had a medical condition precluding moderate physical activity or that altered weight; or were taking medication that affected weight.

Children's Hospital Boston, Massachusetts—Youth in this sample ($n = 122$) were ages 8-18 years presenting for behavioral weight loss treatment (18). Exclusion criteria included developmental disorders associated with cognitive impairment; obesity-related disorders associated with intellectual disability; and psychotic disorders.

San Diego State University/University of California San Diego, California—This sample was comprised of children ($n = 201$) ages 7-12 years entering a behavioral weight loss maintenance treatment trial (19). Participants were excluded if they had a medical condition precluding moderate physical activity or that altered weight; were taking medication that affected weight; or were receiving weight loss or psychological treatment.

University of Minnesota, Minnesota—Participants were children ($n = 105$) ages 8-12 years entering treatment to reduce overeating (20). Participants were excluded if they were receiving weight loss treatment; were taking medication that affected weight or eating; had dietary restrictions or food allergies; or had a medical condition requiring physician-supervised diet and physical activity.

The University of Chicago, Illinois—Youth in this sample ($n = 63$) were ages 7-18 years presenting for a clinical assessment at the University of Chicago's Eating and Weight Disorders Program (21, 22). Participants for the current study were excluded if they did not have overweight or obesity.

Procedure

For this study, data were drawn from baseline or intake assessments, prior to participants completing experimental or treatment protocols. This study was approved by the

Institutional Review Boards of all participating sites. Informed consent and assent were obtained by at least one parent and the participating child, respectively.

Measures

Independent Variable

Secretive Eating: Secretive eating was assessed using the Eating Disorder Examination (EDE), a semi-structured interview used to evaluate eating disorder pathology (23). Participants completed the EDE or the adapted version for children (ChEDE; 24); the majority of participants in this study (89%) completed the ChEDE. These two assessments are nearly identical in form and content, with minor modifications to improve clarity of difficult-to-grasp concepts in younger children (e.g., use of more basic language, addition of a card-sort task to facilitate assessment of overvaluation of weight and shape). The EDE and ChEDE have demonstrated good reliability and validity in children as young as seven years old (24-28), and have been used in clinical research with youth as young as six years old (e.g., 29).

Secretive eating was evaluated via the prompt, “In the past 28 days, have you eaten in secret?” To be rated as secretive eating, episodes must have occurred “outside the times” of any episodes of objective or subjective binge eating (i.e., eating episodes involving a sense of loss of control while eating, with or without the consumption of an objectively large amount of food, respectively). Thus, any secretive eating that occurred in the context of binge eating was not included in the count of secretive eating.

Clarification was also provided to participants as needed to define secretive eating as eating episodes the participant “wishes to conceal because he or she does not want to be seen eating (i.e., it is not simply eating alone).” Secretive eating was also distinguished from episode in which the individual does not want to share food or be interrupted while eating. Participants reported the frequency of days in which secretive eating occurred over the past 28 days. This value was then recorded using a non-equivalent, ordinal, 0-6 rating scale, per the EDE/ChEDE instructions (i.e., 0=no days; 1=1-5 days; 2=6-12 days; 3=13-15 days; 4=16-22 days; 5=23-27 days; 6=28 days).

Dependent Variables

Eating-Related Psychopathology: The EDE/ChEDE was also used to assess eating disorder psychopathology. Participants reported on episodes of objective binge eating and subjective binge eating over the past 28 days. For this study, we examined the frequency of episodes of “loss of control eating” over the past 28 days (defined as the combination of episode of objective and subjective binge eating), given that the experience of loss of control eating, regardless of episode size, in youth is indicative of eating disorder pathology (30). Participants also reported on the presence or absence of episodes of purging (i.e., vomiting, laxative misuse, and diuretic misuse) and excessive exercise over the past 28 days. The EDE yields four subscale scores: Restraint, Eating Concern, Shape Concern, and Weight Concern. Scores range from 0 to 6, with higher scores indicating higher pathology. For this study, the Eating Concern subscale was calculated with the “Eating in Secret” variable removed to minimize concerns about the overlap between the independent and dependent variable. The

correlation between the EDE Eating Concern subscale scores derived by excluding versus including the secretive eating item was high ($r = 0.85$; $p < .001$).

Global Behavioral Problems: Parents reported on their children's functioning across behavioral domains via the Child Behavior Checklist (CBCL; 31). The total score, normed with T-score ratings between 0 and 100, provides an assessment of global behavioral problems. Previous research supports the reliability and validity of the CBCL (31-34).

Depressive Symptomatology: Depressive symptomatology was assessed using the Child Depression Inventory (CDI; 35). CDI total scores range between 0 and 54, with higher scores indicating higher depressive symptomatology. Psychometric properties for this measure are strong (36, 37).

Covariates—Demographics were obtained on participants' age, sex, and race/ethnicity (coded as Caucasian, African-American, Hispanic, or Other). In line with our study hypotheses, we also stratified the sample into children (ages <13 years) versus adolescents (ages ≥ 13 years). Height and weight measurements were used to calculate participants' BMI percentile scores based on CDC norms for age and sex (15).

Analysis Plan—Data were screened for normality, and skew and kurtosis were less than absolute values of 2 on dependent variables except the EDE Restraint subscale (skew=1.5; kurtosis=2.7) and EDE Eating Concern subscale (skew=2.4, kurtosis=6.7), which were log transformed. For analyses, secretive eating was dichotomized to assess endorsement of “any” episodes versus “none” (i.e., zero) in the past 28 days, which is consistent with past research using this construct (9). We also conducted analyses to evaluate this construct continuously, using the rating scale responses regarding frequency in the past 28 days, as an indicator of severity, and results were consistent in the full sample. Thus, we elected to present the results using the dichotomous variable to maintain consistency with previous work (9).

Chi-square, t-tests, and multivariate analysis of variance tests were used to evaluate differences in demographics between youth who endorsed any versus no secret eating, and in relation to eating-related and general psychopathology. To test the hypothesis that youth who endorsed any secretive eating would have higher rates of eating-related and general psychopathology than youth who did not endorse secretive eating, separate linear regression analyses were conducted to evaluate between-group differences in secretive eating (independent variable) and eating-related and general psychopathology (dependent variables, specifically: restraint, eating concern, weight concern, shape concern, behavioral problems, and depressive symptomatology), controlling for the covariates of study site and significant demographic variables. Separate logistic regression analyses were conducted to evaluate between-group differences in secretive eating (independent variable) and the presence/absence of loss of control eating (dependent variable), purging (dependent variable), or excessive exercise (dependent variable), controlling for the covariates of study site and significant demographic variables.

To test the hypothesis that rates of secretive eating and pathology would be higher among adolescents than among children, subsequent linear and logistic regression analyses were conducted to evaluate between-group differences in secretive eating and psychopathology among youth based on their developmental level. Specifically, linear and logistic regression analyses were conducted separately among the subset of the sample who were children (ages <13 years) and among the subset of the sample who were adolescents (ages ≥13 years). Analyses controlled for study site and age to observe any differences by age group above and beyond any effects of age. All analyses were conducted using SPSS version 23. Tests were two-tailed, and p-values less than .05 were considered statistically significant.

Results

Participant Demographics

In this sample, 111 (19.2%) youth endorsed secretive eating. Of those who endorsed secretive eating, the range of days in which this behavior was endorsed over the past 28 days was 1-5 days ($n = 55$), less than half the days ($n = 15$), half the days ($n = 7$), more than half the days ($n = 8$), almost every day ($n = 4$), and every day ($n = 5$). There was a significant difference in secretive eating by study site ($\chi^2 = 94.6$; $p < .001$), which was included as a covariate in subsequent outcome analyses. In addition, a follow-up analysis was conducted to better understand the relation between secretive eating and motivation for study enrollment by site. Study site was divided into three groups: sites who enrolled youth into weight loss treatment ($n = 358$), into treatment to address eating pathology (i.e., to address overeating, eating disorder pathology; $n = 168$), or for non-treatment research ($n = 51$). These groupings were derived based on the notion that individuals interested in addressing eating disorder pathology may have higher rates of secretive eating (a disordered eating behavior) than individuals presenting for weight loss treatment and individuals presenting solely to participate in research. Results evaluating rates of secretive eating across these three groups revealed higher rates of secretive eating among sites with youth who presented to address eating pathology (35.1%) than who presented for research (25.5%) or for weight loss treatment (10.9%) ($\chi^2 = 44.6$; $p < .001$).

Table 1 presents demographic information of the total sample, and then split by youth who endorsed any versus no secretive eating. Youth who endorsed any secretive eating were significantly older than youth who endorsed none ($p < .001$). Of the youth who endorsed secretive eating, 63.1% were children and 36.9% were adolescents. However, adolescents had a significantly higher proportion who endorsed any secretive eating versus no secretive eating compared to children ($p < .001$). There were no other significant between-group demographic differences between youth who endorsed any secretive eating versus none.

In multivariate analysis of variance tests, eating-related and general psychopathology were not related to age (Pillai's trace = 1.99; $F(4,406) = 2.14$; $p = .24$), sex (Pillai's trace = 0.04; $F(6,199) = 1.28$; $p = .27$), race/ethnicity (Pillai's trace = 0.13; $F(18,588) = 1.46$; $p = .10$), or weight status (Pillai's trace = 0.04; $F(6,199) = 1.41$; $p = .21$). However, eating-related and general psychopathology were related to study site (Pillai's trace = 0.91; $F(18,597) = 14.38$;

$p < .001$). Thus, subsequent analyses controlled for study site (given its relation to secretive eating and psychopathology) and age (given its relation to secretive eating).

Relation between Secretive Eating and Psychopathology

Table 2 presents differences in eating disorder and comorbid psychopathology between youth who endorsed any secretive eating versus none, controlling for study site and age. Youth who endorsed any secretive eating had significantly higher eating disorder pathology across the four EDE subscales (i.e., Restraint, Eating Concern, Shape Concern, and Weight Concern; p s $.004$). Youth who endorsed any secretive eating were also significantly more likely to endorse loss of control eating and purging in the past 28 days (p s $.002$), but were not significantly more likely to endorse excessive exercise compared to those who endorsed none ($p = .54$). No significant differences emerged in behavioral problems or depressive symptomatology between youth who endorsed any secretive eating versus none (p s $.11$).

Differences in Secretive Eating and Psychopathology among Children versus Adolescents

Dietary restraint was elevated among adolescents ($\beta = 0.23$; $t = 2.44$; $p = .02$) but not among children ($\beta = 0.08$; $t = 1.78$; $p = .08$) who endorsed any secretive eating, above and beyond any effects of age. Purging was elevated among adolescents ($\text{Exp}(B) = 11.58$; 95% CI = 2.24-59.83; $p = .003$) but not among children ($\text{Exp}(B) = 2.82$; 95% CI = 0.18-44.28; $p = .46$) who endorsed any secretive eating. Conversely, children who endorsed any secretive eating had higher depressive symptoms than children who endorsed none ($\beta = 0.20$; $t = 2.51$; $p = .01$), but among adolescents, there were no differences in depressive symptoms between those who endorsed any secret eating versus none ($\beta = 0.07$; $t = 0.83$; $p = .41$). No differences emerged based on youths' developmental level on the remaining variables.

Discussion

This study aimed to evaluate the prevalence and correlates of secretive eating in a sample of youth with overweight or obesity, given the association between secretive eating and psychopathology like depression, binge eating, and body-related concerns (7, 9, 10). Results showed that approximately one fifth of youth endorsed secretive eating, which aligns with previously-reported rates ranging between 18.1% to 34% among children and adolescents (7-9). As hypothesized, individuals who endorsed secretive eating were older and had elevated rates of eating-related psychopathology than youth who did not endorse secretive eating. However, groups did not differ in excessive exercise or behavioral problems. These results lend support to the premise that secretive eating may indicate heightened eating disorder risk and be a marker for additional eating disorder behaviors (10). Future work is warranted to evaluate whether secretive eating is a risk factor for eating disorder onset or implicated in the maintenance of disordered eating behaviors, as this may inform intervention targets.

Several developmental differences emerged. Adolescents who endorsed secretive eating were more likely than adolescents who did not endorse secretive eating to have elevated levels of dietary restraint and endorse purging, whereas no differences in these constructs emerged among children. The effect of secretive eating was present above and beyond the

association of age with these constructs, which is notable given that dietary restraint and purging are more common in adolescents than children (38, 39). Accordingly, secretive eating may precipitate or be a negative consequence of unhealthy weight control practices, which could exacerbate a problematic cycle of restraint and purging. It is possible that adolescents with overweight or obesity experience increased awareness of their body weight and shape with the onset of puberty and subsequently engage in unhealthy eating practices to influence their weight or shape. In particular, adolescents become more self-conscious about their weight or shape, leading to unhealthy (e.g., restrictive) eating patterns in public and secretive eating behaviors when alone.

Moreover, shape/weight concerns may have increased salience for youth with overweight or obesity, who commonly experience high rates of stigmatization and teasing because of their weight or shape (40, 41). Findings from this study showed that youth who endorsed secretive eating had higher levels of shape and weight concerns than their counterparts who did not endorse secretive eating. This result supports the cognitive-behavioral theory of eating disorder pathology (13), and aligns with past work among this sample of youth with overweight or obesity, which showed that youth with moderate or higher levels of weight/shape concerns and who engaged in problematic eating behaviors (i.e., loss of control eating) had the highest ratings of eating disorder pathology (42). However, our finding is in contrast to one past study that found eating in secret did not differentiate levels of body dissatisfaction among adolescents with overweight (14), although this discrepancy may be due to measurement differences in weight/shape satisfaction between the studies. Overall, results suggest that opportunities to promote positive body esteem and healthy eating practices may be critical for reducing secretive eating and related problematic eating behaviors.

Our finding that children, but not adolescents, who endorsed secretive eating were more likely to endorse depressive symptomatology than children who did not endorse secretive eating is in contrast to past literature showing an association between adolescent secretive eating and depression (9). It is possible that, among children, low mood precipitates this problematic eating behavior, or that engaging in secretive eating leads to feelings of low mood (e.g., guilt), which can increase risk for other problematic eating behaviors such as binge eating (43-46). Although the current study did not include state measures of negative affect, findings indicate the importance of future research using ecological momentary assessment or other strategies to examine the temporal relationship between mood and secretive eating. Understanding the mechanisms that contribute to secretive eating—including evaluating differences in mechanisms of this behavior between children and adolescents—may highlight targets for tailored interventions. For example, although Sonnevile and colleagues showed that parental control of feeding was not associated with sneaking or hiding food (8), parental control has not been tested in relation to mood and secretive eating and might be considered in future research to possibly explain this relationship.

Despite its defining characteristic of eating privately, secretive eating may be recognized before other eating disorder behaviors are identified due to the presence of food wrappers around the house or missing food from the kitchen. Accordingly, this behavior could serve

as an early warning sign for other eating disorder symptoms that may be more likely to gain parents' attention, and may be a point of early intervention for eating disorders. Findings also suggest that secretive eating may be a clinically meaningful construct for eating disorder screening efforts, as assessing secretive eating may be useful as a screening question that precedes administration of additional items to assess for eating disorder symptoms. Prospective research to evaluate whether secretive eating is a risk factor for eating disorder onset would help to clarify the temporal relationship between secretive eating and other disordered eating behaviors. Additionally, although our data are limited in that we do not know the types of foods youth eat in secret, future research evaluating the macronutrient content or amount of food consumed during episodes of secretive eating could have important implications for determining the extent to which habitual engagement in this behavior results in excess weight gain over time. Finally, efforts are warranted to replicate past work by Sonnevile and colleagues (8) evaluating the association between parent feeding behaviors and parenting style on secretive eating, and to extend such research across pediatric development.

Screening efforts for secretive eating could also inform treatment planning. Evidence suggests that youth with overweight who have heightened eating disorder pathology respond to family-based social facilitation weight loss maintenance treatment (47). Thus, encouraging families to establish regular eating habits and healthy family routines to increase social support for healthy lifestyle behaviors and to promote positive body esteem may improve eating pathology and weight outcomes within the context of a weight loss intervention.

Strengths of this study include the use of a large sample of children and adolescents with overweight or obesity, use of data from treatment-seeking and non-treatment seeking samples presenting to multiple research institutions in different regions of the country (which increases generalizability), and use of semi-structured interviews to assess eating disorder pathology. Study limitations include the use of a cross-sectional design, the absence of a control group of youth without overweight, and limited published literature on secretive eating to provide substantive theoretical justification for the study hypotheses. In addition, although we controlled for study site in the analyses, the differing exclusion criteria at the various study sites represents a methodological weakness for the analysis. Finally, the study is limited in that secretive eating is not scored as a continuous number on the EDE/ChEDE and is instead coded on a non-equivalent, ordinal rating scale. Future work should consider evaluating whether more frequent secretive eating is associated with heightened pathology using an assessment that includes a continuous rating for frequency of secretive eating episodes.

In conclusion, secretive eating was moderately prevalent and associated with older age and heightened eating-related psychopathology in a sample of children and adolescents with overweight and obesity, suggesting that this behavior may be a marker of heightened risk for eating disorders. Screening for secretive eating may be clinically useful in identifying eating disorder behaviors, although prospective studies are needed to evaluate the impact of secretive eating on weight outcomes and eating disorder risk, as this may inform intervention targets for addressing problematic eating behaviors in youth.

Acknowledgments

This work was supported by the National Institutes of Health (grants R01 HD036904, K24 MH070446, P30 DK50456, F31 MH071019, K23 DK105234; and F32 HD089586); the Agency for Healthcare Research & Quality (grant T32 HS000078); an Academy for Eating Disorders Graduate Student Research Grant; an American Psychological Association's Division 38 Student Research Award; and an RGA/Washington University Longer Life Foundation Research Award.

References

1. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA*. 2014; 311(8):806–14. [PubMed: 24570244]
2. Juonala M, Magnussen CG, Berenson GS, Venn A, Burns TL, Sabin MA, et al. Childhood adiposity, adult adiposity, and cardiovascular risk factors. *N Engl J Med*. 2011; 365(20):1876–85. [PubMed: 22087679]
3. BeLue R, Francis LA, Colaco B. Mental health problems and overweight in a nationally representative sample of adolescents: effects of race and ethnicity. *Pediatrics*. 2009; 123(2):697–702. [PubMed: 19171640]
4. Flegal KM, Kit BK, Orpana H, Graubard BI. Association of all-cause mortality with overweight and obesity using standard body mass index categories: a systematic review and meta-analysis. *JAMA*. 2013; 309(1):71–82. [PubMed: 23280227]
5. Olshansky SJ, Passaro DJ, Hershow RC, Layden J, Carnes BA, Brody J, et al. A potential decline in life expectancy in the United States in the 21st century. *N Engl J Med*. 2005; 352(11):1138–45. [PubMed: 15784668]
6. National Collaborative on Childhood Obesity Research. Childhood Obesity in the United States. 2009
7. Stice E, Agras WS, Hammer LD. Risk factors for the emergence of childhood eating disturbances: a five-year prospective study. *Int J Eat Disord*. 1999; 25(4):375–87. [PubMed: 10202648]
8. Sonnevile KR, Rifas-Shiman SL, Haines J, Gortmaker S, Mitchell KF, Gillman MW, et al. Associations of parental control of feeding with eating in the absence of hunger and food sneaking, hiding, and hoarding. *Child Obes*. 2013; 9(4):346–9. [PubMed: 23806073]
9. Knatz S, Maginot T, Story S, Neumark-Sztainer D, Boutelle K. Prevalence Rates and Psychological Predictors of Secretive Eating in Overweight and Obese Adolescents. *Childhood Obesity*. 2011; 7(1):30–5.
10. Marcus MD, Kalarchian MA. Binge eating in children and adolescents. *Int J Eat Disord*. 2003; 34(Suppl):S47–57. [PubMed: 12900986]
11. Sonnevile KR, Horton NJ, Micali N, Crosby RD, Swanson SA, Solmi F, et al. Longitudinal associations between binge eating and overeating and adverse outcomes among adolescents and young adults: Does loss of control matter? *JAMA Pediatr*. 2013; 167(2):149–55. [PubMed: 23229786]
12. Tanofsky-Kraff M, Shomaker LB, Olsen C, Roza CA, Wolkoff LE, Columbo KM, et al. A prospective study of pediatric loss of control eating and psychological outcomes. *J Abnorm Psychol*. 2011; 120(1):108–18. [PubMed: 21114355]
13. Fairburn CG, Cooper Z, Shafran R. Cognitive behaviour therapy for eating disorders: a “transdiagnostic” theory and treatment. *Behav Res Ther*. 2003; 41(5):509–28. [PubMed: 12711261]
14. Cromley T, Knatz S, Rockwell R, Neumark-Sztainer D, Story M, Boutelle K. Relationships between body satisfaction and psychological functioning and weight-related cognitions and behaviors in overweight adolescents. *J Adolesc Health*. 2012; 50(6):651–3. [PubMed: 22626496]
15. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, Flegal KM, Guo SS, Wei R, et al. CDC growth charts: United States. *Adv Data*. 2000; (314):1–27.
16. Goldschmidt AB, Tanofsky-Kraff M, Wilfley DE. A laboratory-based study of mood and binge eating behavior in overweight children. *Eat Behav*. 2011; 12(1):37–43. [PubMed: 21184971]

17. Doyle AC, Goldschmidt AB, Huang C, Winzelberg AJ, Taylor CB, Wilfley DE. Reduction of overweight and eating disorder symptoms via the Internet in adolescents: a randomized controlled trial. *J Adolesc Health*. 2008; 43(2):172–9. [PubMed: 18639791]
18. Eddy KT, Tanofsky-Kraff M, Thompson-Brenner H, Herzog DB, Brown TA, Ludwig DS. Eating disorder pathology among overweight treatment-seeking youth: clinical correlates and cross-sectional risk modeling. *Behav Res Ther*. 2007; 45(10):2360–71. [PubMed: 17509523]
19. Wilfley DE, Stein RI, Saelens BE, Mockus DS, Matt GE, Hayden-Wade HA, et al. Efficacy of maintenance treatment approaches for childhood overweight: a randomized controlled trial. *JAMA*. 2007; 298(14):1661–73. [PubMed: 17925518]
20. Boutelle KN, Zucker NL, Peterson CB, Rydell SA, Cafri G, Harnack L. Two novel treatments to reduce overeating in overweight children: a randomized controlled trial. *J Consult Clin Psychol*. 2011; 79(6):759–71. [PubMed: 22122291]
21. Eddy KT, Le Grange D, Crosby RD, Hoste RR, Doyle AC, Smyth A, et al. Diagnostic classification of eating disorders in children and adolescents: how does DSM-IV-TR compare to empirically-derived categories? *J Am Acad Child Adolesc Psychiatry*. 2010; 49(3):277–87. quiz 93. [PubMed: 20410717]
22. Stiles-Shields C, Goldschmidt AB, Lock J, Le Grange D. Are adolescent treatment studies of eating disorders utilizing clinically relevant samples? A comparison of RCT and clinic treatment-seeking youth with eating disorders. *Eur Eat Disord Rev*. 2013; 21(5):420–4. [PubMed: 23483619]
23. Fairburn, CG., Cooper, Z. The Eating Disorder Examination. In: Fairburn, CG., Wilson, GT., editors. *Binge Eating: Nature, Assessment and Treatment*. 12. New York: Guilford; 1993. p. 317–60.
24. Bryant-Waugh RJ, Cooper PJ, Taylor CL, Lask BD. The use of the eating disorder examination with children: a pilot study. *Int J Eat Disord*. 1996; 19(4):391–7. [PubMed: 8859397]
25. Berg KC, Peterson CB, Frazier P, Crow SJ. Psychometric evaluation of the eating disorder examination and eating disorder examination-questionnaire: a systematic review of the literature. *The International journal of eating disorders*. 2012; 45(3):428–38. [PubMed: 21744375]
26. Watkins B, Frampton I, Lask B, Bryant-Waugh R. Reliability and validity of the child version of the Eating Disorder Examination: a preliminary investigation. *Int J Eat Disord*. 2005; 38(2):183–7. [PubMed: 16134106]
27. Wade TD, Byrne S, Bryant-Waugh R. The eating disorder examination: norms and construct validity with young and middle adolescent girls. *Int J Eat Disord*. 2008; 41(6):551–8. [PubMed: 18433026]
28. O'Brien A, Watson HJ, Hoiles KJ, Egan SJ, Anderson RA, Hamilton MJ, et al. Eating disorder examination: Factor structure and norms in a clinical female pediatric eating disorder sample. *Int J Eat Disord*. 2016; 49(1):107–10. [PubMed: 26607776]
29. Tanofsky-Kraff M, Yanovski SZ, Schvey NA, Olsen CH, Gustafson J, Yanovski JA. A prospective study of loss of control eating for body weight gain in children at high risk for adult obesity. *Int J Eat Disord*. 2009; 42(1):26–30. [PubMed: 18720473]
30. Shomaker LB, Tanofsky-Kraff M, Elliott C, Wolkoff LE, Columbo KM, Ranzenhofer LM, et al. Salience of loss of control for pediatric binge episodes: does size really matter? *Int J Eat Disord*. 2010; 43(8):707–16. [PubMed: 19827022]
31. Achenbach, TM. *Manual for the child behavior checklist/4-18 and 1991 profile*. Burlington, VT: University of Vermont Department of Psychiatry; 1991.
32. Achenbach, TM., Elderbrock, C. *Manual for the child behavior checklist and revised child behavior profile*. Burlington, VT: University of Vermont Department of Psychiatry; 1991.
33. Achenbach TM, Edelbrock CS. Behavioral problems and competencies reported by parents of normal and disturbed children aged four through sixteen. *Monogr Soc Res Child Dev*. 1981; 46(1): 1–82.
34. Edelbrock C, Costello AJ. Convergence between statistically derived behavior problem syndromes and child psychiatric diagnoses. *J Abnorm Child Psychol*. 1988; 16(2):219–31. [PubMed: 3385085]
35. Kovacs, M. *Children's Depression Inventory manual*. North Tonawanda, NY: Multi-Health Systems, Inc; 1992.

36. Curry, JF., Craighead, WE. Depression. In: Ollendick, TH., Hersen, M., editors. Handbook of child and adolescent assessment. Nedham Heights, MA: Allyn and Bacon; 1993. p. 251-68.
37. Helsel WJ, Matson JL. The assessment of depression in children: the internal structure of the Child Depression Inventory (CDI). Behav Res Ther. 1984; 22(3):289-98. [PubMed: 6466279]
38. Field AE, Camargo CA, Taylor CB, Berkey CS, Frazier AL, Gillman MW, et al. Overweight, weight concerns, and bulimic behaviors among girls and boys. J Am Acad Child Adolesc Psychiatry. 1999; 38(6):754-60. [PubMed: 10361795]
39. Peebles R, Wilson JL, Lock JD. How do children with eating disorders differ from adolescents with eating disorders at initial evaluation? J Adolesc Health. 2006; 39(6):800-5. [PubMed: 17116508]
40. Hayden-Wade HA, Stein RI, Ghaderi A, Saelens BE, Zabinski MF, Wilfley DE. Prevalence, characteristics, and correlates of teasing experiences among overweight children vs. non-overweight peers. Obes Res. 2005; 13(8):1381-92. [PubMed: 16129720]
41. Puhl RM, Peterson JL, Luedicke J. Weight-based victimization: bullying experiences of weight loss treatment-seeking youth. Pediatrics. 2013; 131(1):e1-9. [PubMed: 23266918]
42. Goldschmidt AB, Wilfley DE, Eddy KT, Boutelle K, Zucker N, Peterson CB, et al. Overvaluation of shape and weight among overweight children and adolescents with loss of control eating. Behav Res Ther. 2011; 49(10):682-8. [PubMed: 21835393]
43. Ranzenhofer LM, Hannallah L, Field SE, Shomaker LB, Stephens M, Sbrocco T, et al. Pre-meal affective state and laboratory test meal intake in adolescent girls with loss of control eating. Appetite. 2013; 68:30-7. [PubMed: 23603224]
44. Elliott CA, Tanofsky-Kraff M, Shomaker LB, Columbo KM, Wolkoff LE, Ranzenhofer LM, et al. An examination of the interpersonal model of loss of control eating in children and adolescents. Behav Res Ther. 2010; 48(5):424-8. [PubMed: 20074702]
45. Goldschmidt AB, Wall MM, Loth KA, Neumark-Sztainer D. Risk Factors for Disordered Eating in Overweight Adolescents and Young Adults. J Pediatr Psychol. 2015
46. Goldschmidt AB, Wall M, Loth KA, Le Grange D, Neumark-Sztainer D. Which dieters are at risk for the onset of binge eating? A prospective study of adolescents and young adults. J Adolesc Health. 2012; 51(1):86-92. [PubMed: 22727082]
47. Goldschmidt AB, Best JR, Stein RI, Saelens BE, Epstein LH, Wilfley DE. Predictors of child weight loss and maintenance among family-based treatment completers. J Consult Clin Psychol. 2014; 82(6):1140-50. [PubMed: 24932567]

Table 1
Sample demographics

	Full Sample (<i>n</i> =577)	Endorsed Secretive Eating (<i>n</i> =111)	Denied Secretive Eating (<i>n</i> =466)	Test statistic and <i>p</i> -value
Race/Ethnicity, <i>n</i> (%)				$\chi^2 = 7.23; p = .07$
Caucasian	317 (54.9%)	56 (50.5%)	261 (56.0%)	
African-American	129 (22.4%)	35 (31.5%)	94 (20.2%)	
Hispanic	70 (12.1%)	12 (10.8%)	58 (12.4%)	
Other	54 (9.4%)	7 (6.3%)	47 (10.1%)	
Female, <i>n</i> (%)	380 (65.9%)	75 (67.6%)	305 (65.5%)	$\chi^2 = 0.18; p = .67$
Age in years, mean (SD)	11.18 (2.45)	12.07 (2.83)	10.97 (2.31)	$t(1,147) = -3.80; p < .001$
Child (vs. Adolescent), <i>n</i> (%)	466 (80.8%)	70 (63.1%)	396 (85.0%)	$\chi^2 = 27.71; p < .001$
With Obesity (vs. Overweight), <i>n</i> (%)	519 (89.9%)	95 (85.6%)	424 (91.0%)	$\chi^2 = 2.89; p = .09$
BMI percentile, mean (SD)	97.36 (2.48)	97.76 (2.75)	97.26 (2.41)	$t(1,575) = -1.90; p = .06$

Note: BMI = body mass index

Table 2
Eating-related and general psychopathology between those who endorsed versus denied secretive eating

	Full Sample (<i>n</i> = 577)	Endorsed Secretive Eating (<i>n</i> = 111) Mean (SD) / <i>n</i> (%)	Denied Secretive Eating (<i>n</i> = 466) Mean (SD) / <i>n</i> (%)	Test statistic and <i>p</i> -value
Eating-Related Psychopathology				
Restraint	1.11 (1.13)	1.50 (1.33)	1.03 (1.07)	$\beta = 0.12$; $t = 2.92$; $p = .004$
Eating Concern [†]	0.53 (0.89)	1.26 (1.26)	0.38 (0.69)	$\beta = 0.36$; $t = 9.31$; $p < .001$
Shape Concern	1.56 (1.26)	2.26 (1.48)	1.42 (1.16)	$\beta = 0.24$; $t = 5.78$; $p < .001$
Weight Concern	1.83 (1.19)	2.35 (1.31)	1.73 (1.14)	$\beta = 0.19$; $t = 4.61$; $p < .001$
LOC Episodes [*]	177 (30.7%)	71 (64.0%)	106 (22.7%)	Exp(B) = 3.36; 95% CI = 2.08-5.43; $p < .001$
Purging Episodes [*]	16 (2.8%)	11 (9.9%)	5 (1.1%)	Exp(B) = 8.74; 95% CI = 2.26-33.85; $p = .002$
Exercise Episodes [*]	25 (4.3%)	8 (7.2%)	17 (3.6%)	Exp(B) = 1.43; 95% CI = 0.46-4.42; $p = .54$
General Psychopathology				
Behavioral Problems	54.41 (10.20)	54.62 (10.60)	54.38 (10.15)	$\beta = 0.003$; $t = 0.60$; $p = .95$
Depressive Symptomatology	10.92 (8.59)	12.06 (7.17)	10.57 (8.96)	$\beta = 0.10$; $t = 1.61$; $p = .11$

[†] Subscale score calculated with the "Eating in Secret" variable removed

^{*} Endorsement of at least one episode in the past 28 days

Note: = Loss of control eating (objective binge eating + subjective binge eating); Purging = vomiting, laxative misuse, and diuretic misuse; Linear regression and logistic regression analyses were conducted controlling for study site and age.