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## Weight-Related Correlates of Psychological Dysregulation in Adolescent and Young Adult (AYA) Females with Severe Obesity

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### Abstract

**Objective**—Severe obesity is the fastest growing pediatric subgroup of excess weight levels. Psychological dysregulation (i.e., impairments in regulating cognitive, emotional, and/or behavioral processes) has been associated with obesity and poorer weight loss outcomes. The present study explored associations of dysregulation with weight-related variables among adolescent and young adult (AYA) females with severe obesity.

**Methods**—Fifty-four AYA females with severe obesity ( $M_{BMI}=48.71$  kg/m<sup>2</sup>;  $M_{age}=18.29$ ,  $R=15-21$  years; 59.3% White) completed self-report measures of psychological dysregulation and weight-related constructs including meal patterns, problematic eating behaviors, and body and weight dissatisfaction, as non-surgical comparison participants in a multi-site study of adolescent bariatric surgery outcomes. Pearson and bivariate correlations were conducted and stratified by age group to analyze associations between dysregulation subscales (affective, behavioral, cognitive) and weight-related variables.

**Results**—Breakfast was the most frequently skipped meal (consumed 3–4 times/week). Eating out was common (4–5 times/week) and mostly occurred at fast-food restaurants. Evening hyperphagia (61.11%) and eating in the absence of hunger (37.04%) were commonly endorsed, while unplanned eating (29.63%), a sense of loss of control over eating (22.22%), eating beyond satiety (22.22%), night eating (12.96%), and binge eating (11.11%) were less common. Almost half of the sample endorsed extreme weight dissatisfaction. Dysregulation was associated with most weight-related attitudes and behaviors of interest in young adults but select patterns emerged for adolescents.

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**Conclusions**—Higher levels of psychological dysregulation are associated with greater BMI, problematic eating patterns and behaviors, and body dissatisfaction in AYA females with severe obesity. These findings have implications for developing novel intervention strategies for severe obesity in AYAs that may have a multidimensional impact on functioning (e.g., psychosocial health, weight loss behaviors).

### Keywords

Adolescents; Young adults; Females; Severe obesity; Eating behaviors; Dysregulation

Psychological dysregulation (i.e., impairments in the ability to regulate or manage processes of cognition, emotion, and/or behavior) is a factor receiving increased attention in relation to obesity due to its association with eating behaviors (Spinella & Lyke, 2004) and treatment success (Nederkoorn, Jansen, Mulken, & Jansen, 2007). Higher weight status and overweight/obesity in youth are also associated with various executive functioning impairments in attention, working memory, and mental flexibility (Faith & Hittner, 2010; Lokken, Boeka, Austin, Gunstad, & Harmon, 2009; Riggs, Huh, Chou, Spruijt-Metz, & Pentz, 2012), as well as difficulties with emotional regulation and emotional eating (Goossens, Braet, Van Vlierberghe, Mels, 2009). Emerging evidence suggests that toddlers' self-regulation skills, including emotional and behavioral regulation, are predictive of obesity and body image concerns in preadolescence (Graziano, Kelleher, Calkins, Keane, & Brien, 2013). Furthermore, behavioral and emotional dysregulation in youth who are overweight and obese have been linked to poorer treatment outcomes (i.e., less weight loss) (Nederkoorn et al., 2007; Wildes et al., 2010).

As dysregulation has been linked to disordered eating (Spinella & Lyke, 2004), and eating disorders tend to emerge during adolescence and young adulthood (Hoek & van Hoeken, 2003), the identification of maladaptive eating cognitions and behaviors are vital in these contexts, particularly as females with obesity are at increased risk for disordered eating (Neumark-Sztainer & Hannan, 2000; Presnell, Bearman, & Stice, 2004). While it has been demonstrated that impairments exist across cognition, behavior, and emotion in youth who are obese, adolescents and young adults (AYAs) with severe obesity have been less studied, yet remain a high risk group in serious need for immediate and novel intervention. Moreover, adolescence and young adulthood is a period of development for neurobiological mechanisms with particular relevance to dysregulation, as response inhibition increases so do reward and risk processing (Bjork, Smith, Danube, & Hommer, 2007; Luna, Garver, Urban, Lazar, & Sweeney, 2004). As such, manifestations of dysregulation may differ as a function of age and specific individual or environmental risk/protective factors (Galvan, Hare, Voss, Glover, & Casey, 2007). Despite the important processes that occur throughout adolescence and emerging adulthood (i.e., development of self-identity and long-term health behavior patterns, increased independence, evolution of social influence and social support systems), research on modifiable weight-related factors and interventions in AYAs are limited (Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008).

Severe obesity is a rapidly growing pediatric subgroup of excess weight status that now affects 7% of adolescent females (Skinner & Skelton, 2014) and puts them at even greater

psychological risk (e.g., greater depression and anxiety; poorer quality of life) than youth who are overweight and obese (Phillips et al., 2012). Preliminary evidence suggests adolescents with severe obesity may have similar aberrant eating profiles to youth who are overweight and obese. The literature on eating behaviors in AYAs with severe obesity is limited, although initial evidence has begun to emerge regarding targeted eating behaviors (i.e., binge eating, a sense of loss of control; LOC) that may be relevant to weight loss surgery outcomes in AYAs with severe obesity. While these initial reports suggest that youth with severe obesity presenting for weight loss surgery may present similarly as children and adolescents who are overweight and obese in terms of prevalence rates (Zeller et al., 2015; Kim et al., 2008) and psychosocial correlates (Sysko, Zakarin, Devlin, Bush, & Walsh, 2011; Sysko et al., 2012), there have been few studies to our knowledge that comprehensively characterize the eating behaviors and patterns among AYAs with severe obesity.

In addition, pertinent factors such as psychotropic medication use will be important to take into account when considering this group's weight-related profile due to their heightened psychosocial risk and the appetite- and weight-altering effects of these medications (Sussman & Ginsberg, 1999; Davis et al., 2012). Furthermore, the majority of adolescents with severe obesity do not present for weight loss surgery (Wabitsch et al., 2013), yet will continue into adulthood with obesity or severe obesity (Freedman, Mei, Srinivasan, Berenson, & Dietz, 2007). Recent evidence indicates that similarly problematic eating behaviors (BED=15%; LOC=43%) are present in adults with severe obesity prior to undergoing bariatric surgery (Mitchell et al., 2014). Thus, earlier identification of these maladaptive eating behaviors and potential correlates such as dysregulation is essential for optimal intervention.

The current study utilizes data from a sample of AYA females with severe obesity to extend the literature by (1) comprehensively describing the eating behaviors and patterns of the current sample, and (2) determining the weight-related correlates of psychological dysregulation across domains of affective, behavioral, and cognitive dysregulation and stratified by age group (adolescents 15–17 and young adults 18–21 years of age) after controlling for relevant identified covariates. We propose that AYA females with severe obesity who have greater psychological dysregulation will have higher BMIs, greater body and weight dissatisfaction, more engagement in disordered and unhealthy eating behaviors, and less engagement in self-monitoring of weight-related behavior. These findings could have important clinical implications for an understudied group, as psychological dysregulation may be a novel target for intervention that could have a multidimensional impact on severe obesity in AYAs.

## **METHODS**

### **Participants**

Participants included a comparison group of AYA females (N=54) at a 24-month follow-up visit in a larger series of studies (TeenView/TeenView2) designed to document the psychosocial health trajectories of adolescents with severe obesity who have undergone weight loss surgery (WLS) as compared to those who did not, over the same course of time.

TeenView/TeenView2 are separately funded ancillary/supplemental studies to Teen-LABS, a prospective longitudinal observational cohort study executed across five academic medical centers in the U.S. documenting safety, efficacy, and QOL outcomes of adolescent WLS. The non-operative comparison group for the TeenView series was identified at baseline via research registries of eligible youth within non-surgical lifestyle change programs at Teen-LABS sites whose families were willing to be contacted for study enrollment should their child become a demographic match (i.e., gender, race, +/- 6 months in age) to a TeenView WLS participant. Study inclusionary criteria included body mass index (BMI)  $\geq 40$  kg/m<sup>2</sup>, age 13–18 years at baseline, one consenting caregiver, English-speaking, and not in special education classes. Eighty-six potential comparisons emerged as demographic matches, with 83 severely obese comparison adolescents (96.5% recruitment rate) agreeing to participate at baseline. Seventy comparisons continued participation in TeenView/TeenView2 at the 24 month assessment (84.3% retention), with the primary reasons for non-participation being participant refusal (n=7) or inability of the research staff to locate the participant (n=6). For the purposes of the current study, males (n=14) and individuals who did not complete the Dysregulation Inventory (n=2) were excluded, resulting in a final sample of 54 females.

### Study Procedures

Data were collected via laptop computer/web-based program and paper and pencil methods. Participants independently completed eating behavior and psychological measures, and were compensated for their time and contribution. Study protocols were approved by the Institutional Review Board at each institution.

### Measures

**Demographic Data**—Age, gender, race, educational status, and caregiver education were collected via self-report questionnaire.

**Body Mass Index**—Heights and weights were measured by trained research staff using a standardized protocol for the majority of participants. Weight was obtained using a body composition analyzer (Tanita Scale Model TBF310). Height was measured using a wall-stabilized stadiometer. However, four comparisons participated remotely via a web-based program. In these cases, only self-report of height and weight were obtained. Body mass index was calculated using the kg/m<sup>2</sup> formula. To be consistent with Teen-LABS, severe obesity was defined as baseline BMI  $\geq 40$  kg/m<sup>2</sup>. CDC guidelines for determining weight status based on age/gender in children and adolescents were not used for this sample as BMI percentiles and z-scores do not provide descriptive data/variability at the extreme tails of the distribution and perform poorly in statistical analyses.

**Psychotropic Medication Use**—Psychotropic medication use within the past year was assessed via self-report using a single-item. Participants responded with a “yes” or “no” response to the item, “In the past 12 months, have you ever taken any medications for psychiatric or emotional problems?”

**Psychological Dysregulation**—The Dysregulation Inventory (DI; Mezzich, Tarter, Giancola, & Kirisci, 2001) is a self-report measure consisting of 92 items which assesses

problems with modulation of affect, behavior, and cognition and/or associated processes. Scoring for the DI produces a total score, as well as three subscales which were used in primary analyses in the current study: Affective Dysregulation (e.g., *Sometimes I get emotional over nothing; I just cannot calm down faster than most people*; Cronbach's alpha = .91), Behavioral Dysregulation (e.g., *I jump into situations before I think it through; I have difficulty keeping attention on tasks*; Cronbach's alpha = .91), and Cognitive Dysregulation (e.g., *I give up quickly if things do not go right; I have trouble changing the way I do things, even when I am doing them wrong*; Cronbach's alpha = .77). The DI scales have demonstrated good reliability, as well as concurrent and construct validity in female adolescents (Mezzich et al, 2001).

**Weight-Related Variables**—A self-report behavior form initially developed for the adult Longitudinal Assessment of Bariatric Surgery (LABS) study (Belle et al., 2007; Mitchell et al., 2014) was modified for use in the TeenView studies, which provided measures of various weight-related attitudes and behaviors for the current study. The study-specific questionnaire uses a combination of items drawn from pre-existing, validated instruments (*Questionnaire on Eating and Weight Patterns-Revised*; Yanovski, 1993; *Night Eating Questionnaire*; Allison, Stunkard, & Thier, 2004), as well as novel items developed by the LABS investigators to address other eating behaviors of potential relevance.

**Meal Patterns:** Frequency of eating was defined by the number of meals and snacks an individual self-reported consuming per day. Meal frequency was assessed using self-report of the number of days out of a 7-day week that an individual eats breakfast, lunch, and dinner. Similarly, eating out was assessed by the number of days in a week an individual self-reported eating out at fast food restaurants and other restaurants. All of these items asked about eating habits during a “usual or normal week” and included free response allowing individuals to generate the number of times/day or days/week.

**Weight Satisfaction:** Participants responded to a single item assessing the level of satisfaction with their current weight on a 5-point Likert scale (*1=Extremely Dissatisfied to 5=Extremely Satisfied*).

**Self-Monitoring of Weight-Related Behavior:** Participants were considered to self-monitor if they positively endorsed any of the following items for weight control in the past 6 months: *recorded your exercise daily; kept a graph of your weight; recorded what you eat daily*.

**Cigarette Smoking for Weight Control:** Participants indicated *yes* or *no* to determine whether they engaged in smoking cigarettes for weight control in the past 6 months.

**Problematic Eating Behaviors:** The following problematic eating behaviors were measured: unplanned eating, LOC eating, binge eating, eating in the absence of hunger (EAH), eating beyond satiety, evening hyperphagia, and night eating. Unplanned eating (past 6 months) was defined by any occasion(s) during which an individual ate continuously during the day or parts of the day without planning what and how much he/she would eat. Positive endorsement of unplanned eating was required for presence of LOC (i.e., feeling

like (s)he cannot control his/her eating). Participants who did not endorse unplanned eating were automatically coded for absence of LOC eating. Binge eating (past 3 months) was identified if an individual reported any episodes of binge eating in that time frame. EAH (past 3 months) was identified if an individual endorsed continuing to eat a meal despite a lack of hunger, at least once per week. Eating beyond satiety (past 3 months) was defined as continuing to eat a meal even though an individual felt full, at least once per week. Evening hyperphagia (past 3 months) was defined as a consumption of at least a quarter of an individual's daily food intake after suppertime. Night eating (past 3 months) was defined by both (a) getting up at least once in the middle of the night other than to use the bathroom at a minimum frequency of less than once a week, and (b) snacking in the middle of night reported at a frequency of *sometimes* or greater.

**Body Dissatisfaction**—The Body Shape Questionnaire (BSQ; Cooper, Taylor, Cooper, & Fairburn, 1987) is a 34-item measure that assesses self-perceptions of body shape and body dissatisfaction. The total score was used as a measure of body dissatisfaction with higher scores indicating greater body dissatisfaction (Cronbach's alpha = 0.98). The BSQ has demonstrated good reliability in addition to concurrent and discriminant validity.

### Data Analysis Plan

The present study utilized SPSS version 22 (IBM, 2013) and MPlus Version 7.2 (Muthen & Muthen, 1998–2012). First, independent samples t-tests, correlations, and chi-square tests were conducted in SPSS to determine whether psychotropic medication use, race/ethnicity, and age were related to eating behaviors or dysregulation for covariate identification. To address our primary aim, Pearson and point-biserial correlations stratified by age group (adolescents 15–17 years and young adults 18–21 years of age) were conducted in MPlus to determine whether dysregulation scales were associated with BMI, body dissatisfaction, eating behaviors, meal patterns, self-monitoring of weight-related behavior, and weight satisfaction. For the correlations, study design (i.e., nesting of participants within data collection site) was accounted for by a specialized variable command in MPlus to avoid possible Type-I errors.

## RESULTS

### Sample Descriptive Data

Demographic data for the sample are displayed in Table 1. At the time of follow-up, participants were between the ages of 15–21 years old. The majority of participants were Caucasian and enrolled in school (i.e., junior or senior high, post-secondary). Median caregiver education was 1–2 years of college (no degree yet). Most participants were severely obese (i.e., BMI ≥ 40) at the 24-month follow-up, although 4 participants had a BMI between 38–39 and 1 participant had a BMI of 31. In addition, one-third of the sample self-reported medication use for psychiatric or emotional problems in the past 12 months.

Descriptive data (i.e., mean, standard deviation, and range values) for the Dysregulation Inventory are shown in Table 2. The frequencies, means and standard deviations, and ranges for meal patterns, weight satisfaction, and body dissatisfaction are also presented in Table 2.

Participants ate between four and five times per day on average including meals and snacks, although no data were available regarding timing of snacks/meals. Breakfast was eaten an average of 3–4 times per week, while lunch and dinner were consumed an average of 5–6 times per week. The sample reported eating out an average of 4–5 times per week, with 3–4 times at fast food restaurants and 1–2 times at other restaurants each week. Body dissatisfaction scores ranged broadly with the mean score falling in the non-clinical range (Cooper et al., 1987). Almost half of the sample (44.44%) endorsed “extremely dissatisfied” with their current weight.

Rates of problematic eating varied across behaviors. Unplanned eating throughout the day was reported by over one-quarter of the sample (29.63%). One in five participants self-reported experiencing a loss of control over eating (22.22%), and one in ten endorsed binge eating (11.11%). Over one-third of the sample (37.04%) reported EAH, while fewer endorsed eating beyond satiety (22.22%). Almost two-thirds of the sample (61.11%) self-reported evening hyperphagia, although night eating was less commonly reported (12.96%). Approximately one-quarter of the sample (25.93%) indicated that they engaged in some form of daily self-monitoring (i.e., weight, eating, or exercise monitoring). Cigarette smoking for weight control was uncommon (3.70%) and thereby was not included in correlation analyses.

### Weight-Related Correlates of Dysregulation

**Covariate Testing**—T-tests and correlations revealed that neither age nor race (Caucasian vs. African-American/Biracial) were related to dysregulation. However, age was associated with four weight-related behaviors [night eating ( $r=.49, p=.01$ ), EAH ( $r=.35, p=.01$ ), eating out – general ( $r=.41, p=.002$ ), and eating out at fast food restaurants ( $r=.38, p=.005$ )]; thus, correlation analyses were stratified by age. T-tests and chi-square tests were conducted to determine whether there were differences between weight-related variables or dysregulation in those who endorsed medication use for psychiatric/emotional problems over the past year and those who did not. No such differences were identified using an alpha level of .05. As such, medication use was not included as a covariate in primary analyses.

**Correlations: Dysregulation and Weight-Related Variables**—Table 3 provides correlation coefficients stratified by age group for the associations between weight-related variables and dysregulation subscales. Self-monitoring of weight-related behavior was the only variable that was not associated with any of the dysregulation scales for either age group. However, when examining age groups specifically, no significant associations emerged between any of the dysregulation scales and frequency of eating, binge eating, evening hyperphagia, or body dissatisfaction for adolescents. Only associations between night eating and dysregulation for the young adult group are provided as adolescent night eating was limited. For the young adult group, weight satisfaction and eating out at non-fast food restaurants were the only variables not significantly associated with any the dysregulation scales.

**Affective Dysregulation:** Affective dysregulation was positively correlated with eating out at fast food restaurants and eating beyond satiety for both adolescents and young adults.

Weight satisfaction was the only other variable associated with affective dysregulation for the adolescent group, with less weight satisfaction related to greater affective dysregulation. Several eating behaviors were positively associated with affective dysregulation for the young adult group with medium to large effects, which included eating out (general), unplanned eating, LOC eating, binge eating, EAH, and night eating. Furthermore, there was a large positive correlation between body dissatisfaction and affective dysregulation for young adults. In addition to the variables discussed prior that did not share a relationship with any of the dysregulation subscales, affective dysregulation was not significantly associated with BMI, frequency of eating, eating out (non-fast food), or evening hyperphagia for either age group.

**Behavioral Dysregulation:** Behavioral dysregulation was positively associated with unplanned eating, EAH, and eating beyond satiety for both age groups, with medium to large effects. The majority of weight-related variables were positively associated with behavioral dysregulation for young adults, including BMI, frequency of eating, eating out (general and fast food), binge eating, evening hyperphagia, night eating, and body dissatisfaction; however, no significant associations between these variables and behavioral dysregulation emerged in adolescents. Furthermore, eating out (non-fast food), LOC, and weight satisfaction were not significantly associated with behavioral dysregulation in adolescents or young adults.

**Cognitive Dysregulation:** Significant positive correlations of large magnitude were identified between cognitive dysregulation and BMI and LOC for adolescents and young adults. Similarly, positive associations of medium to large strength for both age groups emerged between cognitive dysregulation and eating out (general and fast food). Eating out at non-fast food restaurants was associated with cognitive dysregulation for adolescents but not young adults. Unplanned eating, binge eating, EAH, eating beyond satiety, evening hyperphagia, and night eating were all positively associated with cognitive dysregulation in young adults but not adolescents. Cognitive dysregulation was also significantly related to body dissatisfaction (i.e., greater cognitive dysregulation with more body dissatisfaction) in young adults, although the association was bordering significance in adolescents. There were no significant associations identified between cognitive dysregulation and frequency of eating or weight satisfaction for either age group.

## DISCUSSION

The findings of the current study comprehensively document the meal patterns, problematic eating behaviors, and body and weight dissatisfaction endorsed by AYA females with severe obesity and, further, demonstrate an association between many of these weight-related variables with psychological dysregulation. Breakfast was the least consistently consumed meal eaten an average of 3–4 times per week, while lunch and dinner were consumed more regularly at an average of 5–6 times per week. However, AYAs reported eating out an average of 4–5 times per week and consuming most of those meals at fast food restaurants (vs. other non-fast food restaurants). These findings from the current sample of AYA females with severe obesity are particularly problematic given that skipping breakfast and fast food consumption have previously been linked to increased weight gain in the transition



from adolescence to adulthood (Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing, 2006).

Overall, rates of problematic eating behaviors in the current study were comparable or higher than those of adolescents who are overweight and obese (Tanofsky-Kraff et al., 2004; Goldschmidt, Aspen, Sinton, Tanofsky-Kraff, & Wilfley, 2008). The most common problematic eating behavior endorsed was evening hyperphagia, followed by EAH and unplanned eating throughout the day. LOC eating and eating beyond satiety were reported by about 1 in 5 females, while binge eating and night eating were less common (i.e., endorsed by about 1 in 10 females). Cigarette smoking for weight control was uncommon in this sample, which was interesting as evidence suggests higher risk of substance use, specifically cigarette smoking, in adolescents with severe obesity (Ratcliff, Jenkins, Reiter-Purtill, Noll, & Zeller, 2011). A quarter of the sample reported daily self-monitoring of some weight-related behavior (i.e., weight, eating, or exercise monitoring). Although there was wide variability in body dissatisfaction scores with the mean score of the sample in the non-clinical range (Cooper et al., 1987), almost half of the sample endorsed extreme dissatisfaction with their weight.

In addition to a broad endorsement of problematic meal patterns and eating behaviors by the sample, these weight-related variables were associated with different aspects of psychological dysregulation (i.e., affective, behavioral, and cognitive dysregulation). In general, the mean levels of psychological dysregulation of the current sample were difficult to interpret due to the limitations of norm-based data for AYAs currently available in the literature. In comparison to a sample of 10–12 year-old children, the current sample's mean scores resemble the offspring of men considered to be "psychiatrically normal", while the mean scores of offspring of men with substance use disorders were significantly higher than those of the current sample (Mezzich et al., 2001). Associations between dysregulation and weight-related variables were examined separately for adolescents and young adults, which provided important insights into how dysregulation may be associated with eating attitudes and patterns through later development. The associations between dysregulation and weight-related behaviors were more apparent in young adults, although the patterns that emerged appear to be consistent with previous disordered eating literature. Previous studies on the development of eating behaviors have identified precursors to disordered eating that occur more commonly in children and adolescents (e.g., EAH; LOC), compared to eating attitudes and behaviors seen in subclinical or diagnostic disordered eating more commonly occurring in young adults (binge eating, night eating, etc.) (Hilbert & Brauhardt, 2014; Stice, Marti, & Rohde, 2013). Expanding on that research, the current findings show a similar pattern of eating behaviors in association with dysregulation, such that dysregulation was associated with EAH, eating beyond satiety, unplanned eating, and LOC in adolescents, and those same behaviors in addition to body dissatisfaction, binge eating, evening hyperphagia, and night eating in young adults. Given that dysregulation levels did not differ significantly by age, these patterns support the notion that dysregulation in adolescence and adulthood may manifest differently over time in regard to weight-related eating attitudes and behaviors, perhaps as a result of individual (e.g., brain maturation, temperament) or environmental (caregiver relationship qualities) factors not measured in this study (Galvan et al., 2007). Furthermore, these differences could potentially reflect the greater degree of freedom that

young adults typically have than teenagers to shape their food environment and consumption patterns. Simultaneously, this point highlights the potential for the late teenage years, often a period of novelty and increased independence, to comprise a prime developmental window for setting up aberrant and unhealthy eating behaviors then likely to be sustained through young adulthood.

BMI was strongly associated with cognitive dysregulation across all ages, in addition to behavioral dysregulation in young adults, which is consistent with past research that has linked impulsivity, cognitive inflexibility, and other aspects of executive dysfunction to BMI and obesity (Lokken et al., 2009; Delgado-Rico, Río-Valle, González-Jiménez, Campoy, & Verdejo-García, 2012). Eating out at fast food restaurants was broadly associated with dysregulation in both adolescents and young adults, as well as unplanned eating (especially for young adults), while frequency of eating was not typically associated with dysregulation. This could suggest that unplanned or unhealthy food choices, rather than an increase in the number of eating episodes, may be a result of dysregulated emotion, behavior, and/or thinking. LOC shared a specific association with cognitive dysregulation across ages as well as affective dysregulation in young adults, which is consistent with past research linking self-regulatory processes in adults and affective control in youth to LOC (Manasse, Juarascio, Forman, Berner, Butryn, & Ruocco, 2014; Goossens et al., 2009).

Behavioral dysregulation emerged as the dominant domain related to aberrant eating (e.g., unplanned eating, EAH, eating beyond satiety) in adolescents, while the majority of aberrant eating behaviors were related to all three domains of dysregulation in young adults. This may be explained by the functions underpinning each domain or dysregulation, such that impulsivity and inattention in eating may contribute to EAH, eating beyond satiety, and unplanned eating, while other eating behaviors such as binge eating and evening hyperphagia may also be driven by behavioral dysregulation or, alternatively, mood dysregulation (e.g., eating to regulate or cope with intense emotion) or cognitive dysregulation (e.g., difficulties problem-solving or appropriately planning meals may lead to eating the majority of calories at the end of the day). Body dissatisfaction was significantly related to all aspects of dysregulation in young adults but not adolescents, although the strength of the associations were similar between the groups which may be indicative of a statistical power issue. The current findings between body dissatisfaction and dysregulation provide insight into the processes that may underlie the emotional, behavioral, and cognitive problems that have previously been linked to body dissatisfaction (Haedt-Matt, Zalta, Forbush, & Keel, 2012; Wade & Tiggemann, 2013). Our findings are consistent with those of Graziano and colleagues (2013) who identified a longitudinal association between self-regulation difficulties early in life and the development of body image and eating concerns in preadolescent years. We speculate that behavioral dysregulation in particular may have strong associations with body image and other eating behaviors due to the breakdown of attentional and inhibitory processes previously associated with body dissatisfaction and eating behaviors (Curtin, Pagoto, & Mick, 2013; Gowey, Stromberg, Lim, & Janicke, 2015), such that body dissatisfaction may be developed or perpetuated as a result of difficulty inhibiting unpleasant repetitive thoughts about one's body or perhaps biased attention to these unpleasant thoughts and feelings.

The findings of the current study should be considered in the context of several limitations. Due to small sample size, statistical power was limited. Subsequently, very low frequency variables and group comparisons involving small groups and unequal variances could not be validly analyzed. Low frequency weight-related variables violated normality assumptions for statistical analysis; as such, results should be interpreted with caution. In addition, the assessment methodology of eating behaviors was based on self-report rather than interview, and measure of time/history varied across behaviors (i.e., past 3–6 months). Generalizability of findings are limited due to the nature of the sample (i.e., severely obese AYA females). Furthermore, a small portion (10%) of participants were no longer considered severely obese per conservative BMI criteria at the 24 month assessment point.

Current data suggests that the comprehensive weight-related profile (i.e., meal patterns, problematic eating behavior engagement, body and weight dissatisfaction) of severe obesity in AYAs is, in some aspects, both similar to and more problematic than that of AYAs who are overweight and obese. Severe obesity in adolescence persists into adulthood without intervention (Freedman et al., 2007), and the problematic meal patterns and eating behaviors identified in the current study have been associated with greater longitudinal weight gain, particularly in the transition from adolescence to adulthood (Niemeier et al., 2006; Neumark-Sztainer, Wall, Story, & Standish, 2012; Tanofsky-Kraff et al., 2006). Furthermore, one or more domain(s) of psychological dysregulation were associated with eating out (specifically at fast food restaurants), the majority of problematic eating behaviors assessed, and body dissatisfaction. Taken together, these data suggest that AYA females with severe obesity exhibit problematic weight-related behaviors that are likely to contribute to further excessive weight gain during their transition to adulthood in the absence of intervention.

While further exploration is needed to determine the specific role of psychological dysregulation in the development and/or maintenance of problematic weight-related attitudes and behaviors and obesity, preliminary findings suggest that dysregulation may be a novel target for intervention that could have a multidimensional impact on functioning (e.g., eating and weight outcomes, psychosocial health). The current results suggest that interventions addressing dysregulation should perhaps be implemented during emerging adolescence when long-term health behavior patterns are being established (Nelson et al, 2008) and emerging adulthood when opportunities for lifestyle changes may present with life transitions. More work is needed in identifying the risk and protective factors related to dysregulation throughout these developmental stages in individuals with severe obesity that may facilitate/impede the development of problematic eating patterns. Early identification of problematic weight-related attitudes and behaviors through screening or brief assessment measures at primary care or specialty clinic visits will be important, in addition to targeting both obesity and problematic eating attitudes and behaviors in interventions utilizing a combination of evidenced-based conventional approaches for weight management and problematic eating (i.e., family-based behavioral and cognitive-behavioral treatment) and novel techniques to address relevant comorbid factors such as dysregulation (e.g., executive functioning skill building).

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## REFERENCES

- Allison, KC.; Stunkard, AJ.; Thier, SL. Overcoming Night Eating Syndrome: A Step-by-Step Guide to Breaking the Cycle. Oakland, CA: New Harbinger; 2004.
- Belle SH, Berk PD, Courcoulas AP, Flum DR, Miles CW, Mitchell JE. Longitudinal Assessment of Bariatric Surgery Consortium Writing Group. Safety and efficacy of bariatric surgery: Longitudinal Assessment of Bariatric Surgery. *Surgery for Obesity and Related Diseases*. 2007; 3(2):116–126. [PubMed: 17386392]
- Bjork JM, Smith AR, Danube CL, Hommer DW. Developmental differences in posterior mesofrontal cortex recruitment by risky rewards. *Journal of Neuroscience*. 2007; 27:4839–4849. [PubMed: 17475792]
- Cooper PJ, Taylor MJ, Cooper Z, Fairburn CG. The development and validation of the Body Shape Questionnaire. *Eating Disorders*. 1987; 6:485–494.
- Curtin C, Pagoto S, Mick E. The association between ADHD and eating disorders/pathology in adolescents: A systematic review. *Open Journal of Epidemiology*. 2013; 3:193–202.
- Davis C, Fattore L, Kaplan AS, Carter JC, Levitan RD, Kennedy JL. The suppression of appetite and food consumption by methylphenidate: The moderating effects of gender and weight status in healthy adults. *International Journal of Neuropsychopharmacology*. 2012; 15(2):181–187. [PubMed: 21733284]
- Delgado-Rico E, Río-Valle JS, González-Jiménez E, Campoy C, Verdejo-García A. BMI Predicts Emotion-Driven Impulsivity and Cognitive Inflexibility in Adolescents With Excess Weight. *Obesity*. 2012; 20(8):1604–1610. [PubMed: 22421897]
- Faith MS, Hittner JB. Infant temperament and eating style predict change in standardized weight status and obesity risk at 6 years of age. *International Journal of Obesity*. 2010; 34(10):1515–1523. [PubMed: 20805827]
- Freedman DS, Mei Z, Srinivasan SR, Berenson GS, Dietz WH. Cardiovascular risk factors and excess adiposity among overweight children and adolescents: the Bogalusa Heart Study. *The Journal of Pediatrics*. 2007; 150(1):12–17. [PubMed: 17188605]
- Galvan A, Hare T, Voss H, Glover G, Casey BJ. Risk-taking and the adolescent brain: Who is at risk? *Dev Sci*. 2007; 10:F8–F14. [PubMed: 17286837]
- Goldschmidt AB, Aspen VP, Sinton MM, Tanofsky-Kraff M, Wilfley DE. Disordered eating attitudes and behaviors in overweight youth. *Obesity*. 2008; 16(2):257–264. [PubMed: 18239631]
- Goossens L, Braet C, Van Vlierberghe L, Mels S. Loss of control over eating in overweight youngsters: the role of anxiety, depression and emotional eating. *European Eating Disorders Review*. 2009; 17(1):68–78. [PubMed: 18729132]

- Gowey MA, Stromberg S, Lim CS, Janicke DM. The Moderating Role of Body Dissatisfaction in the Relationship between ADHD Symptoms and Disordered Eating in Pediatric Overweight and Obesity. *Children's Health Care*. (just-accepted). 2015
- Graziano PA, Kelleher R, Calkins SD, Keane SP, Brien MO. Predicting weight outcomes in preadolescence: the role of toddlers' self-regulation skills and the temperament dimension of pleasure. *International Journal of Obesity*. 2013; 37(7):937–942. [PubMed: 23044856]
- Haedt-Matt AA, Zalta AK, Forbush KT, Keel PK. Experimental evidence that changes in mood cause changes in body dissatisfaction among undergraduate women. *Body image*. 2012; 9(2):216–220. [PubMed: 22210105]
- Hilbert A, Brauhardt A. Childhood loss of control eating over five-year follow-up. *International Journal of Eating Disorders*. 2014; 47(7):758–761. [PubMed: 24899359]
- Hoek HW, Van Hoeken D. Review of the prevalence and incidence of eating disorders. *International Journal of Eating Disorders*. 2003; 34(4):383–396. [PubMed: 14566926]
- IBM Corp. Released. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp; 2013.
- Kim RJ, Langer JM, Baker AW, Filter DE, Williams NN, Sarwer DB. Psychosocial status in adolescents undergoing bariatric surgery. *Obesity Surgery*. 2008; 18(1):27–33. [PubMed: 18085345]
- Lokken KL, Boeka AG, Austin HM, Gunstad J, Harmon CM. Evidence of executive dysfunction in extremely obese adolescents: A pilot study. *Surgery for Obesity and Related Diseases*. 2009; 5(5): 547–552. [PubMed: 19766958]
- Luna B, Garver KE, Urban TA, Lazar NA, Sweeney JA. Maturation of cognitive processes from late childhood to adulthood. *Child Dev*. 2004; 75:1357–1372. [PubMed: 15369519]
- Manasse SM, Juarascio AS, Forman EM, Berner LA, Butryn ML, Ruocco AC. Executive Functioning in Overweight Individuals with and without Loss-of-Control Eating. *European Eating Disorders Review*. 2014; 22(5):373–377. [PubMed: 24962637]
- Mezzich AC, Tarter RE, Giancola PR, Kirisci L. The dysregulation inventory: A new scale to assess the risk for substance use disorder. *Journal of Child & Adolescent Substance Abuse*. 2001; 10(4): 35–43.
- Mitchell JE, King WC, Courcoulas A, Dakin G, Elder K, Engel S, Wolfe B. Eating behavior and eating disorders in adults before bariatric surgery. *International Journal of Eating Disorders*. 2014; 48(2):215–222. [PubMed: 24719222]
- Muthen, LK.; Muthen, BO. *Mplus User's Guide*. Seventh. Los Angeles, CA: Muthen & Muthen; 1998–2012.
- Nederkoorn C, Jansen E, Mulken S, Jansen A. Impulsivity predicts treatment outcome in obese children. *Behaviour Research and Therapy*. 2007; 45(5):1071–1075. [PubMed: 16828053]
- Nelson MC, Story M, Larson NI, Neumark-Sztainer D, Lytle LA. Emerging adulthood and college-aged youth: An overlooked age for weight-related behavior. *Obesity*. 2008; 16:2205–2211. [PubMed: 18719665]
- Niemeier HM, Raynor HA, Lloyd-Richardson EE, Rogers ML, Wing RR. Fast food consumption and breakfast skipping: predictors of weight gain from adolescence to adulthood in a nationally representative sample. *Journal of Adolescent Health*. 2006; 39(6):842–849. [PubMed: 17116514]
- Neumark-Sztainer D, Hannan PJ. Weight-related behaviors among adolescent girls and boys: Results from a national survey. *Archives of Pediatrics & Adolescent Medicine*. 2000; 154(6):569–577. [PubMed: 10850503]
- Neumark-Sztainer D, Wall M, Story M, Standish AR. Dieting and unhealthy weight control behaviors during adolescence: associations with 10-year changes in body mass index. *Journal of Adolescent Health*. 2012; 50(1):80–86. [PubMed: 22188838]
- Phillips BA, Gaudette S, McCracken A, Razaq S, Sutton K, Speed L, Ward W. Psychosocial functioning in children and adolescents with extreme obesity. *Journal of Clinical Psychology in Medical Settings*. 2012; 19(3):277–284. [PubMed: 22437944]
- 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(4):389–401. [PubMed: 15558645]

- Ratcliff M, Jenkins TM, Reiter-Purtill J, Noll JG, Zeller MH. Risk-taking behaviors of adolescents with extreme obesity: Normative or not? *Pediatrics*. 2011; 127:827–834. [PubMed: 21518723]
- Riggs NR, Huh J, Chou CP, Spruijt-Metz D, Pentz MA. Executive function and latent classes of childhood obesity risk. *Journal of Behavioral Medicine*. 2012; 35(6):642–650. [PubMed: 22218938]
- Skinner AC, Skelton JA. Prevalence and trends in obesity and severe obesity among children in the United States, 1999–2012. *JAMA pediatrics*. 2014; 168(6):561–566. [PubMed: 24710576]
- Spinella M, Lyke J. Executive personality traits and eating behavior. *International Journal of Neuroscience*. 2004; 114(1):83–93. [PubMed: 14660070]
- Stice E, Marti CN, Rohde P. Prevalence, incidence, impairment, and course of the proposed DSM-5 eating disorder diagnoses in an 8-year prospective community study of young women. *Journal of Abnormal Psychology*. 2013; 122(2):445. [PubMed: 23148784]
- Sussman N, Ginsberg D. Effects of psychotropic drugs on weight. *Psychiatric Annals*. 1999; 29(10):580.
- Sysko R, Devlin MJ, Hildebrandt TB, Brewer SK, Zitsman JL, Walsh BT. Psychological outcomes and predictors of initial weight loss outcomes among severely obese adolescents receiving laparoscopic adjustable gastric banding. *Journal of Clinical Psychiatry*. 2012; 73(10):1351–137. [PubMed: 23140654]
- Sysko R, Zakarin EB, Devlin MJ, Bush J, Walsh BT. A latent class analysis of psychiatric symptoms among 125 adolescents in a bariatric surgery program. *International Journal of Pediatric Obesity*. 2011; 6(3–4):289–297. [PubMed: 21299450]
- Tanofsky-Kraff M, Cohen ML, Yanovski SZ, Cox C, Theim KR, Keil M, Yanovski JA. A prospective study of psychological predictors of body fat gain among children at high risk for adult obesity. *Pediatrics*. 2006; 117(4):1203–1209. [PubMed: 16585316]
- Tanofsky-Kraff M, Yanovski SZ, Wilfley DE, Marmarosh C, Morgan CM, Yanovski JA. Eating-disordered behaviors, body fat, and psychopathology in overweight and normal-weight children. *Journal of Consulting and Clinical Psychology*. 2004; 72(1):53. [PubMed: 14756614]
- Wabitsch M, Moss A, Reinehr T, Wiegand S, Kiess W, Scherag A, Hebebrand J. Medical and psychosocial implications of adolescent extreme obesity- acceptance and effects of structured care, short: Youth with Extreme Obesity Study (YES). *BMC Public Health*. 2013; 13(1):789. [PubMed: 23987123]
- Wade TD, Tiggemann M. The role of perfectionism in body dissatisfaction. *Journal of eating disorders*. 2013; 1(2):1–6. [PubMed: 24764524]
- Wildes JE, Marcus MD, Kalarchian MA, Levine MD, Houck PR, Cheng Y. Self-reported binge eating in severe pediatric obesity: Impact on weight change in a randomized controlled trial of family-based treatment. *International Journal of Obesity*. 2010; 34(7):1143–1148. [PubMed: 20157322]
- Yanovski SZ. The questionnaire on eating and weight patterns-revised. *Obesity Research*. 1993; 1:306–24. [PubMed: 16350580]
- Zeller MH, Inge TH, Modi AC, Jenkins TM, Michalsky MP, Helmrath M, Buncher R. Severe Obesity and Comorbid Condition Impact on the Weight-Related Quality of Life of the Adolescent Patient. *The Journal of Pediatrics*. 2015; 166(3):651–659. [PubMed: 25556022]

**Table 1**

Descriptive data for sample including anthropometric, demographic, and medication variables (N = 54)

	Mean $\pm$ SD (%)	Range
<b>Age</b>	18.29 $\pm$ 1.31	15.25–21.00
<b>Race</b>		
Caucasian	59.26%	-
African-American	38.89%	-
Biracial	1.85%	-
<b>Currently attending school</b>	74.1%	-
<b>Caregiver education</b>		
< High school	1.75%	-
Some high school	14.04%	-
Graduated high school or GED	22.81%	-
1+ years post-secondary	61.40%	-
<b>BMI</b>	48.71 $\pm$ 6.95	30.80–68.23
<b>Psychotropic Medication Use</b>	33.33%	-

**Table 2**

Descriptive data for psychological and weight-related variables (N = 54)

Variable	Mean $\pm$ SD	Range
<b>Psychological Dysregulation</b>		
Affective Dysregulation	24.66 $\pm$ 12.87	0–63.00
Behavioral Dysregulation	24.89 $\pm$ 12.50	3.00–59.00
Cognitive Dysregulation	29.76 $\pm$ 8.42	10.00–47.00
<b>Meal Patterns (Past 7 Days)</b>		
Frequency of Eating (Times/Day)	4.42 $\pm$ 2.16	1.00–11.00
Eat Breakfast (Times/Week)	3.85 $\pm$ 2.14	0–7.00
Eat Lunch (Times/Week)	5.77 $\pm$ 1.55	1.00–7.00
Eat Dinner (Times/Week)	5.96 $\pm$ 1.88	1.00–7.00
Eating Out - General (Total Meals/Week)	4.87 $\pm$ 4.10	0–18.00
Eating Out - Fast Food (Meals/Week)	3.19 $\pm$ 3.01	0–12.00
Eating Out - Other Restaurants (Meals/Week)	1.71 $\pm$ 1.99	0–8.00
<b>Weight Satisfaction</b>	1.96 $\pm$ 1.06	1.00–4.00
<b>Body Dissatisfaction</b>	95.35 $\pm$ 41.94	37.00–189.00



**Table 3**  
Stratified correlations by age between dysregulation and weight-related variables

Weight-Related Variable	Affective Dysregulation		Behavioral Dysregulation		Cognitive Dysregulation	
	15-17 <sup>a</sup>	18-21 <sup>b</sup>	15-17 <sup>a</sup>	18-21 <sup>b</sup>	15-17 <sup>a</sup>	18-21 <sup>b</sup>
	BMI	.29	.23	.21	.41*	.70**
Frequency of Eating	.28	.17	.23	.36**	.15	.28
Eat Out: General	.18	.44**	-.06	.54***	.47***	.28*
Eat Out: Fast Food	.32**	.46**	-.01	.60***	.39*	.39***
Eat Out: Non Fast Food	-.17	.23 <sup>^</sup>	-.10	.22	.27*	.00
Unplanned Eating	.28	.33**	.40***	.45***	.14	.36**
Loss of Control	.26	.57***	.09	.36	.54**	.49**
Binge Eating	.06	.39**	.47	.38***	.10	.26**
EAH	.22	.23*	.45*	.30***	.11	.23***
Eating beyond Satiety	.55**	.41**	.54***	.40***	.15	.41***
Evening Hyperphagia	-.32	.42	-.27	.42**	-.19	.49***
Night Eating	-	.32*	-	.57***	-	.28*
Self-Monitoring	-.09	-.04	-.06	-.08	.18	-.05
Weight Satisfaction	-.36***	-.30	.14	-.13	.04	-.03
Body Dissatisfaction	.42	.60***	.41	.40**	.48 <sup>^</sup>	.39***

<sup>^</sup> p=.05-.06

\* p<.05

\*\* p<.01

\*\*\* p<.001

<sup>a</sup> Adolescent subgroup (n=22; 15-17 year-olds)

<sup>b</sup> Young adult subgroup (n=32; 18-21 year-olds)

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BMI=Body Mass Index; EAH=Eating in the Absence of Hunger

Note: Missing coefficients represent analyses that did not have enough variability to produce a meaningful statistical estimate