Published in final edited form as:

Eat Behav. 2020 January ; 36: 101343. doi:10.1016/j.eatbeh.2019.101343.

Emotional disorder symptoms, anhedonia, and negative urgency as predictors of hedonic hunger in adolescents

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Abstract

Affect and reward are associated with unhealthy eating and weight; however, less research has examined affective predictors of hedonic hunger (i.e., extreme reward responsivity, pleasure toward, and drive for food), particularly among adolescents. Whether symptoms indicative of emotional disturbance increase risk of adverse reward-based eating-related symptoms such as hedonic hunger, is unknown. Such evidence could explain why emotional problems increase risk of eating and weight problems, particularly among adolescents, when eating-related health problems often originate. This report examined baseline emotional disorder symptoms, negative urgency (i.e., tendency to act impulsively in response to negative affect), and anhedonia (i.e., loss of interest in activities and decreased pleasure) as prospective predictors of increases in hedonic hunger in adolescents; associations between changes in emotional disturbance problems and hedonic hunger were also examined. Ninth-grade students ($N=2,598$) from high schools completed paper-and-pencil surveys at baseline and a 1-year follow-up. In a multivariable model controlling for the covariance of emotional problems, higher negative urgency, general anxiety, and obsessive-compulsive symptoms, and lower anhedonia at baseline independently predicted increases in hedonic hunger one year later. Also, increases in negative urgency, general anxiety, and obsessive-compulsive symptoms and decreases in anhedonia independently predicted increases in hedonic hunger. Affect- and reward-related variables may be important contributors to risk of hedonic hunger in adolescence.

Hedonic hunger is a trait-based psychological factor characterized by extreme reward responsivity, pleasure toward, and drive for food typically in the absence of physiological hunger (Lowe et al., 2009). It has been shown to be associated with increased response in brain regions underlying neural and perceptual responses to cues of palatable foods (Burger, Sanders, & Gilbert, 2016) and various adverse health outcomes, including obesity and maladaptive eating behaviors (e.g., binge eating, unhealthy snacking, eating in the absence of hunger; Feig, Piers, Kral, & Lowe, 2018; Lowe et al., 2016; Schüz, Schüz, & Ferguson,

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2015; Stok et al., 2015). Thus, hedonic hunger may serve as a key psychological intermediate phenotype associated with eating and weight problems. While research on hedonic hunger may have important health-related implications, factors that contribute to the development of hedonic hunger are under-researched, particularly among adolescents.

Adolescence is a critical time for the development of obesity and maladaptive eating behaviors (Alberga, Sigal, Goldfield, Prud'Homme, & Kenny, 2012; Fergus & Zimmerman, 2005), and higher body weight in adolescence is predictive of elevated weight trajectory in adulthood (Reilly & Kelly, 2011; Wang, Chyen, Lee, & Lowry, 2008). In adolescence, drive for reward is high and impulse control is low due to ongoing brain changes and development (Casey, Jones, & Hare, 2008; Romer, 2010), suggesting that increases in hedonic hunger may be a potent risk factor for maladaptive eating and obesity during adolescence. More understanding of the determinants of hedonic hunger among adolescents may lead to improved treatments and preventions for eating and weight disorders during the critical time period of adolescence. Regarding the potential risk factors for developing adverse hedonic hunger, it seems plausible that because characteristics associated with emotional disturbance alter emotional reactions to reward-related and affective stimuli more generally, such factors could also alter responses to food stimuli.

Given the reward- and emotion-based nature of hedonic hunger, this research focuses on symptoms related to the experience of or reaction to emotional stimuli as risk factors for hedonic hunger. Individuals meeting clinical criteria for emotional disorders, including mood, anxiety, and obsessive-compulsive disorders, report more maladaptive eating behaviors compared to counterparts without psychiatric diagnoses (Hudson, Hiripi, Pope, & Kessler, 2007). Further, dimensional measures of negative affective symptoms including general negative affect, depression, and anxiety are associated with increased maladaptive eating behaviors (e.g., Mason & Lewis, 2014; Smith et al., 2018). In addition, negative urgency (i.e., tendency to act impulsively when experiencing negative emotions) has been implicated in relation to maladaptive eating behaviors, including binge eating (Fischer, Peterson, & McCarthy, 2013) and unhealthy snacking (Coumans et al., 2018), even after statistically controlling for general negative affect (Racine et al., 2013).

Beyond negative affect, the lack of positive affect is also associated with eating behavior. Similar to how negative urgency represents a maladaptive (hyperactive) response, anhedonia — inability to experience pleasure from activities that are typically found to be enjoyable— represents a maladaptive (hypoactive) response that is related to binge eating, uncontrolled eating, and emotional eating in adults (Keränen, Rasinaho, Hakko, Savolainen, & Lindeman, 2010) and obesity in adolescents (Cho et al., 2018). No studies were found examining relationships between anhedonia and eating in adolescents.

Whether the three aforementioned variables are associated with hedonic hunger in adolescence concurrently or longitudinally are unknown. While emotional disorder symptoms, anhedonia, and negative urgency are conceptually and psychometrically distinct constructs, they are correlated and are each manifestations of maladaptive emotional experience (Leventhal et al., 2015). Further, while anhedonia is a component of depression and typically included in measures of depression, measures of depression assess a range of

symptoms (e.g., sleep quality, appetite, anhedonia, mood, cognition) and may not adequately capture any one symptom (Fried & Nesse, 2015). In addition, Nakonezny, Carmody, Morris, Kurian, and Trivedi (2010) found that measuring anhedonia separately can capture one's total hedonic capacity or reward responsivity, which is a related but separate construct from depression. Therefore, there may be predictive utility to assessing anhedonia as a separate construct. Thus, it is unclear whether the three construct domains (i.e., emotional symptoms, anhedonia, and negative urgency) exhibit empirically unique associations with hedonic hunger, which is important for isolating sources of risk.

In the current study, emotional disorder symptoms (i.e., depression, general anxiety, social anxiety, and obsessive compulsive symptoms), anhedonia, and negative urgency were examined simultaneously as predictors of increases in hedonic hunger over a 1-year period of adolescence in a cohort of high school students. It was hypothesized that higher levels of emotional disturbance characteristics at baseline would be associated with increased hedonic hunger one year later. Given the possibility that accelerations in maladaptive affect may amplify increasing hedonic hunger and previous evidence linking changes in anhedonia and emotional disorder symptoms over time with obesity and other eating behaviors (e.g., Cho et al., 2017; Keränen et al., 2010), both baseline levels and change scores from baseline to one-year later were examined as predictors of increases in hedonic hunger.

Method

Participants and Procedures

Study participants were drawn from a cohort survey focused on studying mental and physical health and health behaviors of adolescents. Participants were students from 10 Los Angeles area high schools and were recruited using a convenience sampling approach, which has been described in greater detail elsewhere (Leventhal et al., 2015). Ninth-grade students ($N=3396$) who were not enrolled in special education were recruited at the 10 schools in 2013. In order to enroll in the study, students provided assent and their parents provided consent. Data collection involved assessments at baseline (fall 9th grade, 2013; N surveyed=3383, 99.6%) and a 12-month follow-up (fall 10th grade, 2014; N surveyed=3,282 (96.6%). Paper-and-pencil surveys were administered onsite in students' classrooms; students not in class during data collection completed abbreviated surveys by telephone, Internet, or mail; some measures used in this report were omitted from the abbreviated survey. The analytic sample included 2,598 students with data available at the baseline and 12-month follow-up on study measures ($n=2,464$; 95%). The study protocol was approved by an university Institutional Review Board.

Measures

Demographics.—Adolescents self-reported gender, age, race, height, weight, and parental education.

Hedonic hunger.—The 11-item Children's Power of Food Scale (C-PFS; Lowe et al., 2009) was used to assess hedonic hunger. Respondents rated items on a Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Sample items included, "I feel like food

controls me instead of me controlling my food choices” and “Just before I taste a favorite food, I get very excited”. The C-PFS has demonstrated adequate psychometric properties among children (Laurent, 2015). Cronbach’s alphas in the current study were .95 at baseline and follow-up.

Emotional disorder symptoms.—The Revised Children’s Anxiety and Depression Scale-Version 2 (RCADS-2; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000) was used to assess a variety of emotional disorder symptoms. The current study used the Social Phobia (e.g., “I feel afraid that I will make a fool of myself in front of people”), Major Depression (e.g., “I feel worthless”), Generalized Anxiety (e.g., “I worry about what is going to happen”), and Obsessive-Compulsive (e.g., “I cannot seem to get bad or silly thoughts out of my head”) subscales. Items were rated on a 4-point scale ranging from 0 (*never*) to 3 (*always*), and higher scores indicate greater symptom levels. The RCADS has been shown to have good reliability and validity (Chorpita, Moffitt, & Gray, 2005). Cronbach’s alphas for baseline and follow-up were: Social Phobia=.92 and .93; Major Depression=.91 and .94; Generalized Anxiety=.90 and .91; and Obsessive-Compulsive=.82 and .86.

Anhedonia.—The Snaith–Hamilton Pleasure Scale (SHAPS; Snaith, 1993) measured anhedonia. Participants respond to items on a 4-item scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). A sample item was, “I would get pleasure from helping others”). Consistent with Leventhal et al. (2015), items were averaged and scored such that higher scores indicated greater levels of anhedonia. The SHAPS demonstrates good psychometric properties (Snaith et al., 1995). Cronbach’s alphas in the current study were .90 and .94 at baseline and follow-up, respectively.

Negative urgency.—The UPPS Impulsive Behavior Scale – Negative Urgency Subscale (UPPS-NU; Whiteside & Lynam, 2001) measured negative urgency. Participants responded to 12 items on a scale ranging from 1 (*agree strongly*) to 4 (*disagree strongly*) with higher scores indicating greater negative urgency. A sample item was, “It is hard for me to resist acting on my feelings.” The UPPS demonstrates adequate psychometric properties (Smith et al., 2007). Cronbach’s alphas in the current study were .89 at baseline and follow-up.

Statistical Analyses

Analyses were conducted in SPSS version 24 (IBM; Armonk, NY). Descriptive statistics and bivariate correlations were calculated among study variables. A two-level multilevel model (i.e., adolescents nested within schools) was used to conduct analyses. Multilevel modeling accounts for non-independence of observations in the data (individuals nested within schools; Schwartz & Stone, 1998). A three-level model of adolescents nested within classes nested within schools was considered, but the intraclass coefficient correlation (ICC) for class was low (ICC=.008). Therefore, the two-level model was retained. Multiple imputation (Schafer, 1999) was used to impute data for missing demographic covariates. Recent research has suggested using only complete cases for variables in the main analyses (i.e., not imputing primary independent and dependent variables; Hughes, Heron, Sterne, & Tilling, 2019). Thus, only covariates were imputed, and complete case analysis was used for

other variables. The dependent variable in the model was hedonic hunger at one-year follow-up. Analyses controlled for hedonic hunger at baseline and demographic variables including gender, age, race, BMI percentile, and highest parental education. A multivariable model was calculated that included all independent variables. The model examined baseline emotional disorder symptoms (i.e., depression, general anxiety, social anxiety, and obsessive-compulsive symptoms), anhedonia, and negative urgency and change scores from baseline to follow-up of each emotional disorder symptom, anhedonia, and negative urgency as predictors of hedonic hunger at follow-up.

Results

At baseline, the mean age of the sample was 14.08 ($SD=0.42$), and 46.6% of adolescents were male and 53.4% were female. The mean CDC BMI percentile was 59.67 ($SD=29.25$) with 13.9% of adolescents with overweight and 4.9% with obesity. The racial/ethnic breakdown of the sample was 48.3% Hispanic, 16.4% White, 16.8% Asian, 6.8% Multiracial, 5.0% Black or African-American, 4.2% Native Hawaiian or Pacific Islander, 1.6% Other, and 1.0% American Indian or Alaskan Native. For highest parental education, 13.7% had less than eighth grade, 3.4% had some high school, 7.8% had high school, 14.5% had some college, 16.9% had a college degree, 27.3% had an advance degree, and 16.3% were unknown. In analyses comparing completers versus non-completers, completers had higher baseline social anxiety ($p=.03$) and parental education ($p=.04$), lower baseline anhedonia ($p=.004$), and were younger ($p<.001$).

Descriptive statistics of study variables are presented in Table 1. On average, adolescents had relatively low levels of hedonic hunger, emotional disorder symptoms, negative urgency, and anhedonia; however, there was substantive inter-individual variability in these characteristics. Hedonic hunger, general anxiety, social anxiety, and obsessive-compulsive symptoms, on average, decreased from baseline to follow-up; and anhedonia, depressive symptoms, and negative urgency, on average, increased (see Table 1). Although, effect sizes for across wave changes were very small to small. Bivariate correlations between variables are displayed in Table 2. In general, the patterns of correlations were similar at baseline and follow-up and were low to moderate in magnitude, suggesting that the emotional disturbance characteristics were associated with one another but tapping distinct constructs. In addition, correlations showed that hedonic hunger was positively related to all emotional disturbance characteristics except unrelated to anhedonia.

Table 3 displays results of the multilevel model of baseline and changes in emotional disorder symptoms, anhedonia, and negative urgency from baseline to one year later predicting hedonic hunger. Higher baseline negative urgency, general anxiety, and obsessive-compulsive symptoms, and lower anhedonia at baseline each independently predicted increases in hedonic hunger one year later. Regarding change variables, increases in negative urgency, general anxiety, and obsessive-compulsive symptoms, and decreases in anhedonia independently predicted increased hedonic hunger. The pseudo R^2 for the model with only covariates and baseline hedonic hunger was .30, and the pseudo R^2 for the full model tested in Table 3 was .35. Thus, the addition of baseline and change predictors explained a small amount of variance in the hedonic hunger at follow-up.

Discussion

This paper provides new evidence implicating emotional disorder symptoms as risk factors for hedonic hunger—a key psychological intermediate phenotype implicated in eating disorders, maladaptive eating, and obesity (Feig et al., 2018; Lowe et al., 2016; Schüz et al., 2015; Stok et al., 2015)—during a vital developmental period of mid-adolescence (Alberga et al., 2012). Given the results from the current study that baseline negative urgency and changes in negative urgency predicted increased hedonic hunger, hedonic hunger may be an important pathway in the association of negative urgency and maladaptive eating behaviors. More research is needed to understand how the association between negative urgency and increases in hedonic hunger is related to actual eating behaviors. In addition, given consistent relationships between negative urgency and hedonic hunger, it is possible that negative urgency could function as a mediator linking mental health symptoms and hedonic hunger. Consistent with this assertion, previous cross-sectional research has found that negative urgency mediated the link between negative affect and maladaptive eating, although longitudinal analyses are needed (e.g., Lavender, Green, Anestis, Tull, & Gratz, 2015; Lee & Chang, 2017).

In addition, baseline general anxiety and obsessive-compulsive symptoms and changes in these symptoms predicted increased hedonic hunger. This shows that general anxiety and obsessive-compulsive symptoms both predict and track along with hedonic hunger. Numerous studies have shown associations between anxiety and maladaptive eating behaviors in adolescents (e.g., Balantekin, Birch, & Savage, 2017; Jung et al., 2017), but this is the first study to find a specific relation between contemporaneous changes in anxiety-related phenomena and hedonic hunger. It is possible that food is used as a coping mechanism for negative emotions (Haedt-Matt & Keel, 2011), which could over time lead to over-responsiveness to food.

Consistent with our results, Jung et al. (2017) also found that anxiety was more salient compared to depressive symptoms in predicting eating outcome in adolescents. Anxiety is strongly related to appearance and body image concerns, which are strongly tied to eating pathology (Mason et al., 2018). Regarding obsessive-compulsive symptoms, research suggests that similar to other addictive behaviors, individuals can experience obsessive thoughts about eating and compulsive behaviors toward the consumption of food (Niemic, Boswell, & Hormes, 2016). The concurrent tracking of obsessive-compulsive symptoms and hedonic hunger over time may reflect this pattern of obsession and compulsion directed toward food and its association with over-responsiveness to food.

Findings for anhedonia were opposite to what was hypothesized, as previous studies have reported positive associations between anhedonia and maladaptive eating behaviors (Keränen et al., 2010). Previous work has only been done in adults samples, thus, it is possible that associations between anhedonia and eating require more complex developmental explanations. In general, adolescents with low levels of anhedonia (i.e., loss of pleasure) may also not derive pleasure from food. Given associations between anhedonia and increased maladaptive eating behaviors, it is possible that individuals with anhedonia try to use food to increase their levels of pleasure (Davis & Fox, 2008). However, the current

results show that this may not translate to increased trait hedonic hunger over one year. A methodological explanation for these findings might be content overlap of the two measures. The measure of anhedonia in this study (i.e., the SHAPS) asks about anticipated pleasure from various sensory experiences, including food, and the hedonic hunger measures (i.e., C-PFS) asks about pleasure from food. Thus, it is possible that hedonic hunger may be a manifestation of a high sensitivity to reward that spans multiple types of rewarding experiences and is assessed in anhedonia scales, such as the SHAPS, and present among those with low anhedonia and high hedonic capacity.

Overall, preventing over-responsiveness to food may be useful in reducing negative eating and weight outcomes over time. Our study showed that high negative urgency and lower anhedonia might serve as indicators of future increases in over-responsiveness to the food environment in early adolescence. Adolescents are exposed to a food environment that is dominated by ultra-processed foods (e.g., chocolate, pizza) that have high levels of refined carbohydrates and fat (Steele et al., 2016). These ultra-processed foods are more effective at engaging reward-related neural systems and are more likely to be consumed in response to negative emotions than more minimally processed foods (e.g., apples, carrots; Boggiano et al., 2015; DiFeliceantonio et al., 2018). Thus, the modern food environment may contribute to the association between negative urgency and hedonic hunger. More research is needed to determine what preventive strategies may be useful in curbing this risk in these individuals as well as how the association between low anhedonia and hedonic hunger can be buffered.

Strengths of this study include the longitudinal examination of predictors of hedonic hunger in a diverse sample of adolescents. The primary limitation of this study was that constructs of interest were only assessed with self-report measures. While measures had excellent psychometric properties, they are subject to retrospective recall biases and measurement error. Future research may benefit from utilizing biological measures (e.g., neuroimaging) as well as clinical interviews. For example, neuroimaging can help elucidate common brain regions that underlie associations between emotion and reward and increases in hedonic hunger, which may identify biological bases for hedonic hunger. Another limitation is that there were several small differences between completers and non-completers, and this could potentially bias findings. Finally, because this is the first study to look at change in hedonic hunger in adolescence, it is unclear the extent to which a one year follow-up over the course of the first year of high school represents a critical time point for change in hedonic hunger to occur. However, previous research has shown steady increases in disordered eating throughout adolescence (e.g., Slane, Klump, McGue, & Iacono, 2014), which marks adolescence in general as a period of rapid change in eating-related problems. Nevertheless, It will be important for future research to chart the trajectory of hedonic hunger across adolescence to better understand critical assessment and intervention points for hedonic hunger.

Future studies should clarify the association between anhedonia, hedonic hunger, and eating- and weight-related outcomes to better understand the nature of these associations. Executive functioning and reward sensitivity are both associated with emotional disorder symptoms and eating (Smith, Mason, Johnson, Lavender, & Wonderlich, 2018; Snyder, Miyake, & Hankin, 2015; Vandeweghe, Verbeke, Vervoort, Moens, & Braet, 2017; Zald & Treadway,

2017) and are rapidly developing and changing across adolescence (Blakemore & Choudhury, 2006; Galván, 2013). As such, executive functioning and reward sensitivity may be important developmental variables that could explain how emotional symptoms lead to changes in hedonic hunger. In regard to developmental changes related to the age of adolescents in our sample, adolescents tend to peak in reward-seeking behaviors at around 15 and impulse control tends to increase linearly with age throughout adolescence (Colver & Longwell, 2013). Therefore, the age of our sample appears to represent an important time when reward and executive functioning deficits may be present. In sum, while effects were generally small, this study showed that emotional disturbance and over-responsiveness to reward may play a role in increases in hedonic hunger.

Acknowledgments

This research was supported by grants R01-DA033296 and P50-CA180905 from the National Institutes of Health.

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Highlights

- Little research has examined affective predictors of hedonic hunger in adolescents.
- Negative urgency, anxiety, and OCD symptoms predicted increases in hedonic hunger.
- Lower anhedonia predicted increases in hedonic hunger.
- These variables tracked together across the one-year period.
- Affect and reward processes contribute to hedonic hunger risk in adolescence.

Table 1.

Descriptive statistics of study variables

	Baseline	Follow-Up			
	<i>M (SD)</i>	<i>M (SD)</i>	<i>T</i>	<i>p</i>	<i>d</i>
CPFS hedonic hunger	2.40 (0.96)	2.26 (1.01)	7.68	<.001	.15
RCADS-2 depression	0.78 (0.70)	0.83 (0.28)	-3.46	.001	.09
RCADS-2 general anxiety	1.36 (0.78)	1.29 (0.82)	4.74	<.001	.09
RCADS-2 social anxiety	1.35 (0.81)	1.23 (0.84)	7.57	<.001	.06
RCADS-2 obsessive-compulsive	0.74 (0.64)	0.66 (0.66)	6.14	<.001	.12
UPPS negative urgency	1.78 (0.60)	1.97 (0.70)	-15.60	<.001	.30
SHAPS anhedonia	1.68 (0.49)	1.73 (0.60)	-4.17	<.001	.09

Note. CPFS = Children's Power of Food Scale; RCADS-2 = Revised Children's Anxiety and Depression Scale-Version 2; SHAPS = Snaith-Hamilton Pleasure Scale

Table 2.

Pearson Correlations and of Study Variables at Baseline and Follow-Up

	1	2	3	4	5	6	7	8	9	10	11
1. CPFS hedonic hunger	-	.28	.31	.30	.31	.35	-.07	-.10	-.03	.04	-.09
2. RCADS-2 depression	.28	-	.61	.55	.56	.47	.22	-.22	-.01	-.03	.05
3. RCADS-2 general anxiety	.31	.63	-	.63	.52	.42	.06	-.20	-.03	.00	.04
4. RCADS-2 social anxiety	.29	.58	.65	-	.52	.37	-.06	-.28	-.03	.06	-.02
5. RCADS-2 obsessive-compulsive	.32	.56	.54	.51	-	.42	.04	-.08	.003	-.02	.03
6. UPPS negative urgency	.33	.47	.41	.39	.39	-	.14	-.07	.01	.01	.04
7. SHAPS anhedonia	-.05	.29	.14	.04	.12	.18	-	.08	.03	-.17	.12
8. Gender	-.12	-.21	-.25	-.28	-.08	-.18	.004	-	.08	-.02	.04
9. Age	-.03	.01	.04	-.02	-.003	-.01	.04	-.08	-	-.03	.06
10. Parental education	.03	.001	.01	.05	.01	.02	.07	-.04	-.01	-	-.08
11. BMI-z	-.07	.06	.05	-.02	.03	.02	.10	-.05	.07	.01	-

Note. CPFS = Children's Power of Food Scale; RCADS-2 = Revised Children's Anxiety and Depression Scale-Version 2; SHAPS = Snaith-Hamilton Pleasure Scale; Correlations for variables at baseline are above the diagonal, and correlations for variables at follow-up are below the diagonal. Correlations above $\pm .05$ are significant

Table 3.

Parameter Estimates from General Estimating Equations of Changes in Affective Symptoms, Anhedonia, and Negative Urgency from Baseline to Follow-Up Predicting Hedonic Hunger at One Year Follow-Up

Parameter	Unstandardized <i>B</i>	<i>SE</i>	<i>P</i>
Baseline Scores			
RCADS-2 depression	−0.02	0.04	.665
RCADS-2 general anxiety	0.10	0.04	.008
RCADS-2 social anxiety	0.11	0.04	.724
RCADS-2 obsessive-compulsive	0.09	0.04	.048
UPPS negative urgency	0.20	0.04	<.001
SHAPS anhedonia	−0.18	0.04	<.001
Change Scores			
RCADS-2 depression	−0.01	0.04	.720
RCADS-2 general anxiety	0.13	0.03	<.001
RCADS-2 social anxiety	0.04	0.03	.199
RCADS-2 obsessive-compulsive	0.23	0.04	<.001
UPPS negative urgency	0.19	0.03	<.001
SHAPS anhedonia	−0.11	0.03	.001

Note RCADS-2 = Revised Children's Anxiety and Depression Scale-Version 2; SHAPS = Snaith–Hamilton Pleasure Scale. Univariable and multivariable models controlled for baseline hedonic hunger, gender, age, race, BMI, and parental education; = change.