



Subjective binge eating: a marker of disordered eating and broader psychological distress

Lisa M. Brownstone¹ · Anna M. Bardone-Cone²

Received: 29 July 2020 / Accepted: 13 October 2020 / Published online: 16 November 2020
© Springer Nature Switzerland AG 2020

Abstract

Purpose There is building, but limited evidence to suggest that subjective binge eating (SBE) is clinically concerning. The current study examined associated features of SBEs including disordered eating, body shame, negative affect, and interpersonal problems, as well as how SBE occurrence relates to other daily eating experiences.

Methods Participants were 400 individuals recruited via internet snowball or Amazon Mechanical Turk, including 132 with at least one SBE [with or without objective binge eating episodes (OBEs)] in the prior 3 months, 135 with at least one OBE (and no SBEs) in the prior 3 months, and 133 with no loss of control eating in the prior 3 months nor a likely lifetime history of anorexia nervosa. Participants responded to questionnaires assessing eating disorder behaviors (i.e., frequency of compensatory behaviors, dietary restriction), body shame, negative affect (depressive/anxiety symptoms), interpersonal difficulties, and perception of daily eating experiences.

Results Individuals with SBEs had higher numbers of vomiting, laxative misuse and hard exercise episodes, dietary restriction, body shame, depressive and anxiety symptoms, and negative perceptions of daily eating experiences as compared to those with only OBEs and no loss of control eating.

Conclusion These results suggest that SBEs (whether on their own or combined with OBEs) are more related to disordered eating symptoms, body image concerns, depressive/anxiety symptoms, and general eating distress than OBEs on their own, suggesting that clinicians may view SBEs as markers of concern across domains.

Level of evidence III, well-designed group-comparison regression analysis.

Keywords Subjective binge eating · Objective binge eating · Binge eating · Loss of control eating · Eating disorder

Introduction

A body of work has begun to examine how subjective binge eating (SBEs) and objective binge eating episodes (OBEs) may differ regarding eating pathology and broader psychological difficulties [1, 2]. OBEs are defined as core components of bulimia nervosa (BN) and binge eating disorder

(BED), and are characterized by loss of control and consumption of “objectively large” amounts of food [3]. SBEs, on the other hand, are not described as part of a clinical diagnosis, and involve loss of control and the consumption of subjectively (but not objectively) large amounts of food; there is also much less known about SBEs compared to OBEs. Given the need to further our understanding of SBEs, the current paper examines the relationship between presence of SBEs and disordered eating, as well as negative affect, interpersonal difficulties, and perceptions of daily eating experiences.

SBEs occur at fairly high rates. In a clinical sample of treatment-seeking individuals with binge eating/purging, one study found that 5% of their sample engaged in only SBEs, 10% engaged in only OBEs, and 85% engaged in both behaviors [4]. SBEs were also found to be more common than OBEs in an undergraduate female sample [5].

✉ Lisa M. Brownstone
lisa.brownstone@du.edu

Anna M. Bardone-Cone
bardonecone@unc.edu

¹ Department of Counseling Psychology, University of Denver, Morgridge College of Education, 1999 East Evans Avenue, Denver, CO 80210, USA

² Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill, CB#3270-Davie Hall, Chapel Hill, NC 27599, USA

Studies have begun to examine similarities and differences between SBEs and OBEs, finding few differences regarding eating disorder symptomatology, psychiatric comorbidity, and quality of life [1, 2, 6–10]. All of these studies, however, explored SBEs among nonclinical samples or samples recruited based upon OBE or bulimic symptoms, and, therefore, did not recruit based upon occurrence of SBEs. This is one of few studies recruiting based on loss of control without episode size requirements, which permits a unique focus on SBEs.

Previous studies with a wide range of clinical/nonclinical samples have found no differences between those with SBEs versus OBEs on broad disordered eating symptoms [2, 6, 11–13]. For example, Mond et al. [2], in a sample with bulimic-type eating disorders, and Jenkins et al. [12], in a nonclinical sample of undergraduate women, did not find differences in eating pathology between individuals regularly (at least weekly) experiencing only SBEs versus only OBEs. Similarly, Fitzsimmons-Craft et al. [11], among treatment-seeking adolescents with BN, also found no significant differences in eating disorder symptomatology between those with only SBEs versus only OBEs. Thus, individuals with SBE-only presentations appear to have similar levels of disordered eating as those with OBEs.

Some work has also examined eating disorder behaviors (e.g., purging) and body dissatisfaction as they relate to SBEs and OBEs. Brownstone et al. [1] found that SBEs, and not OBEs, accounted for unique variance in diuretic misuse and weight/shape concerns, while Fitzsimmons-Craft et al. [11] found that SBEs, not OBEs, accounted for unique variance in dietary restraint. Dias Santana et al. [14] also found that adolescents with self-reported diabetes mellitus versus those without diabetes mellitus reported higher frequencies of SBEs, but not OBEs, and discussed how higher SBE occurrence may relate to the dietary restrictions required of those with diabetes mellitus as part of managing illness. SBEs, thus, may be more related to dietary restraint, body dissatisfaction, and diuretic misuse than OBEs.

Research has also examined how SBEs versus OBEs are related to anxiety/depressive symptoms. Goossens et al. [6], comparing adolescents with only SBEs versus only OBEs, found no significant differences regarding depression symptoms, while Latner et al. [15] found that frequencies of OBEs, and not SBEs, accounted for unique variance in depressive/anxiety symptomatology among community women. In contrast, two other studies found that SBEs are more related to depressive/anxiety symptoms than OBEs [1, 11]. Additionally, a recent study found that among adolescents, positive affectivity interacted with self-regulation difficulties to account for variance in SBEs; whereas, negative affectivity interacted with self-regulation difficulties to account for variance in OBEs [16]. Thus, evidence is mixed

regarding whether SBEs versus OBEs are more indicative of negative affect.

Two less explored areas of research regarding SBEs and OBEs are interpersonal difficulties and perceptions of daily eating. One study found that SBEs, not OBEs, accounted for unique variance in social avoidance and insecure attachment [1]. To the authors' knowledge, no prior literature has explored differences in how individuals with SBEs versus OBEs versus no loss of control eating interpret daily eating. Does a person with SBEs interpret all eating experiences as “bad” in nature or “too much”? Understanding how individuals with SBEs experience eating on a daily basis would extend the existing phenomenological understanding of SBEs.

The current study examined disordered eating symptoms, body shame, negative affect, and interpersonal problems among individuals with SBEs (with or without OBEs) as compared to individuals with only OBEs and individuals without loss of control eating in the prior 3 months (nor a likely lifetime AN history). Groups were also compared on perceptions of daily eating experiences. We hypothesized that those with SBEs as compared to those with only OBEs and no loss of control eating would have elevated disordered eating and body shame, and equivalent, if not higher, depression/anxiety symptoms and interpersonal difficulties. We also hypothesized that those with SBEs would be the most likely to experience all eating as out of control given that SBEs occur, by definition, during episodes that are not large in size and, therefore, may occur in a wider range of daily contexts.

Methods

Participants

Participants included 132 individuals with at least one SBE during the prior 3 months (“SBE-included”) with or without OBEs,¹ 135 individuals with at least one OBE (and no SBEs) during the prior 3 months (“OBE-only”), and 133 individuals with neither a history of loss of control eating in the prior 3 months nor a likely lifetime AN history (non-loss of control eating; “non-LOC”). Inclusion criteria for this study included being over 18 years of age and having sufficient English reading ability to complete an online survey. We recruited both individuals with loss of control eating and

¹ Notably, only 42 participants of the total 132 participants in the SBE-included group reported only SBEs. Due to discrepant group sizes and our interest in SBEs as markers (regardless of other episode types), we did not analyze this group on its own.

those with no loss of control eating using two main recruitment approaches, described below.

We recruited individuals who reported loss of control eating primarily by means of snowball sampling with initial outreach to groups associated with eating disorders [e.g., e-mails to listservs and organizations (e.g., Project Heal, University of North Carolina Center of Excellence for Eating Disorders) and announcements posted to various social media pages through Facebook (e.g., Eating Disorder Hope)] [17]. The e-mail/announcement was aimed at recruiting individuals who had experienced loss of control eating in the prior 3 months (with the goal of finding those with SBEs and/or OBEs), and included an online survey link. The announcement also asked recipients to repost/forward study information.

We recruited non-LOC individuals through Amazon Mturk, a recruitment method used in social science with similar reliability on demographic and personality measures when compared to lab-based (mostly undergraduate) samples [18]. Shapiro et al. [19] found that prevalence of depression, anxiety, and trauma exposure among Mturk participants matched or exceeded the general population, indicating that Mturk is useful for examining subclinical and clinical difficulties. The Mturk recruitment announcement stated that the study was “about eating” without specifying loss of control eating. Mturk participants completed an identical survey as snowball-recruited participants, and reported on loss of control eating experiences if applicable. A subset of participants recruited through Mturk reported loss of control eating, and were included in the SBE-included or OBE-only group.

Of 217 participants who reported no loss of control eating in the prior 3 months nor a likely lifetime history of AN from the Mturk recruitment, 84 were randomly excluded to match SBE-included and OBE-only groups, resulting in 133 non-LOC participants for analyses. Random exclusions were made within gender to maintain a similar gender ratio as loss of control eating groups. Excluded versus included non-LOC individuals did not significantly differ on core study variables or demographics.

Procedure

All participants completed the online survey in locations of their choosing (e.g., home). Before completing the online survey, participants read a online consent form that outlined information about study participation; they indicated electronic consent to proceed with the survey on this page before answering survey questions. Surveys were anonymized via Qualtrics, such that identifiers (e.g., IP address, location) were not included. After demographic and likely history of AN questions, participants were asked about presence/absence of loss of control eating in the past 3 months and

whether the amount eaten was perceived by themselves and others as large. The survey then proceeded through questions regarding SBEs and/or OBEs, as applicable, and broader psychological functioning. As a control item to check that participants were paying attention, we asked participants to “choose the number 4 below” from multiple choice options: 1, 2, 3, 4, and 5. All participants responded correctly to this item, providing confidence that they were attending carefully. To minimize participant burden, subsets of items from established measures were used with included items selected based upon high item-total correlations and thematic content. See “Appendix” for selected items from these measures.

Participants recruited through snowball method were given an opportunity to participate in a drawing offering four chances toward a \$25 gift card to Amazon.com, while Mturk participants were compensated \$0.40 for survey completion. Mturk specifications were set such that repeat participants were not included. This study was approved by University of North Carolina at Chapel Hill’s Institutional Review Board.

Measures

Demographics and likely history of AN

Participants were asked about gender, race, ethnic identity, and age, as well as questions to approximate lifetime history of AN (i.e., whether others had ever been concerned about their past low weight, low weight/height at that time, and whether they tried to lose or keep off weight at that time). These questions were not diagnostic, but rather allowed for our team to get a sense of whether or not a person may have had a history of AN per DSM-5 criteria.

Identification of SBEs and OBEs

Participants were asked if they had experienced loss of control eating in the prior 3 months, and those who indicated “yes” were asked additional questions to differentiate SBEs from OBEs. Participants were asked about SBEs as follows: “Was there at least one episode in the past 3 months when both of the following two criteria were met: (1) You experienced loss of control. AND (2) You perceived the amount you ate as too large but others would *not* have agreed that it was too much food?” OBEs were assessed as follows: “In the past 3 months when you felt out of control while eating, was there a time when you ate what others would perceive as a large amount of food?” Participants then provided examples of their most recent SBE and/or OBE, such that size of the episodes could be confirmed. The sizes of example episodes were coded based upon Eating Disorder Examination (EDE) size criteria [20] by two independent raters: the first author and a post-baccalaureate research assistant with 1.5 years of eating disorder assessment experience. Percent

agreement between the two coders for SBE and OBE examples were 80.92% and 79.10%, respectively. For discrepant codes, the first author examined the discrepancy, and determined which codes were most representative. For difficult to categorize amounts, consultation with a colleague specializing in eating disorders yielded final consensus.

Disordered eating symptoms and body shame

The Eating Disorder Examination-Questionnaire (EDE-Q) is a 36-item self-report survey adapted from the EDE interview, which assesses psychological symptoms of eating disorders [20, 21]. Construct validity has been demonstrated by high correlations between the EDE-Q and interview version of the EDE subscales ranging from 0.78 to 0.85 [21]. To assess eating disorder behaviors, we used items from the EDE-Q that assess number of episodes over the prior 28 days of vomiting, laxative misuse, diuretic misuse, and hard exercise. We also asked the number of days in the past 28 days that participants had deliberately engaged in dietary restriction (a dietary restraint item from the EDE-Q).

To assess body shame, we used two items from the Body Shame subscale of the Objectified Body Consciousness Scale (OBCS-BS) [22]. The Body Shame subscale captures feelings of shame related to one's body not conforming to cultural expectations. The OBCS-BS has been found to have adequate internal consistency with an alpha of 0.75 in prior work [22]. Construct validity has also been demonstrated with an expected negative correlation between body shame and body esteem [22]. In the current study, the correlation between the items from the OBCS was 0.68 ($p < 0.001$).

Negative affect

We selected six items from the depression and anxiety scales of the Depression Anxiety Stress Scales (DASS) [23], a 21-item self-report measure, including three 7-item self-report scales: anxiety, depression, and stress, each scale with adequate internal consistency (Cronbach's alpha > 0.88) and validity when compared to other measures of depression and anxiety, such as the Hospital Anxiety and Depression Scale and Beck Depression Inventory [23, 24]. In the current study, coefficient alphas for the items chosen from the depression and anxiety scales were 0.88 and 0.79, respectively.

Interpersonal difficulties

We selected five items across the UCLA Loneliness Scale (UCLA-LS—three items) [25] and the Multidimensional Scale of Perceived Social Support (MSPSS—two items) [26].

The UCLA-LS is a 20-item self-report survey that assesses feelings of loneliness using a 4-point scale

(1 = *never*, 4 = *always*) [27]. The UCLA-LS has been found to have high internal consistency with alphas of 0.89–0.94 in prior work, and high test–retest reliability over a 1-year time period [25]. Construct validity has been demonstrated by high concordance between UCLA-LS and self-perceived inadequacy of [25]. In the current study, the coefficient alpha for the three items from UCLA-LS was 0.87.

The MSPSS is a 12-item measure of perceived adequacy of social support with a 7-point scale (1 = *very strongly disagree*, 7 = *very strongly agree*) and focuses on three subscales: family, friends, and significant other [26]. The MSPSS has been found to have good internal reliability with alphas between 0.84 and 0.93 [28, 29]. Validity from each subscale has also been demonstrated by concordance with other indicators of perceived support in the given domain (e.g., adolescents reporting closer relationships with family perceiving greater family social support than those not reporting close relationships with family) [29]. In the current study, the correlation between items from the MSPSS (one from Family subscale, one from Friends subscale) was 0.39 ($p < 0.001$).

Perceptions of daily eating experiences

There was no precedent from which to base measurement of daily eating experience perception. Thus, we used a novel, computer-based approach to ascertain how participants would perceive imagined eating scenarios regarding loss of control, amount, and healthfulness.

We showed participants images of five food items: banana, bowl of salad, pizza slice, bagel, and muffin. Participants were asked the following: “Imagine that you have not eaten in 2 h and that the last item of food you ate was a small snack (e.g., 1 cup of pretzels or carrots). Now imagine that you just ate the item of food pictured”. Participants then indicated on a Likert scale from 0 to 6 the extent to which they would have (1) felt “out of control”, (2) perceived the item as “too much food”, and (3) considered the item as “bad” or “unhealthy”. Items were grouped into “carbohydrate” (i.e., pizza, bagel, muffin) and “fruit/vegetable” (i.e., banana, bowl of salad) categories. Mean responses for questions within category were considered in analyses.

Data analytic plan

We compared SBE-included, OBE-only, and non-LOC groups using multivariate analyses of variance (MANOVA) for each of the following conceptual groupings of dependent variables: compensatory behaviors, negative affect, interpersonal difficulties, and perception of daily eating experiences, with analyses of variance (ANOVA) following significant multivariate findings.

Table 1 Demographic descriptive statistics and group differences

	SBE-included	OBE-only	Non-LOC	Significance
Age (mean, SD)	24.13 (8.38) ^a	27.63 (10.35) ^b	38.57 (13.88) ^c	$F(2,397)=61.12, p<0.001$
Gender				Pearson chi-square = 14.59, $p=0.006$
Woman (% , <i>n</i>)	95.46% (<i>n</i> = 126) ^a	84.44% (<i>n</i> = 114) ^b	90.23% (<i>n</i> = 120) ^{a,b}	
Man (% , <i>n</i>)	2.27% (<i>n</i> = 3) ^a	14.07% (<i>n</i> = 19) ^b	9.77% (<i>n</i> = 13) ^b	
Other (% , <i>n</i>)	2.27% (<i>n</i> = 3) ^a	1.48% (<i>n</i> = 2) ^a	0.00% (<i>n</i> = 0) ^a	
Likely History of AN	17.42% (<i>n</i> = 23) ^a	8.15% (<i>n</i> = 11) ^b	N/A	Pearson chi-square = 6.92, $p=0.031$
Race and ethnicity				
Caucasian/white (% , <i>n</i>)	86.36% (<i>n</i> = 114)	85.93% (<i>n</i> = 116)	81.95% (<i>n</i> = 109)	Pearson chi-square = 1.21, $p=0.545$
Not Hispanic/Latino (% , <i>n</i>)	89.39% (<i>n</i> = 118)	91.85% (<i>n</i> = 124)	96.24% (<i>n</i> = 128)	Pearson chi-square = 4.60, $p=0.100$

Differing superscripts indicate groups significantly different from one another. For age, we used analysis of variance (ANOVA), followed by a post-hoc Tukey test to determine which groups were significantly different from one another. For all other variables, we used omnibus chi-square tests, followed by *z* square cell comparison tests with Bonferroni correction when omnibus chi-square tests were significant, as suggested by Goodman (1969)

SBE subjective binge eating, *OBE* objective binge eating, *SBE-included* includes those with SBEs with or without OBEs in the prior 3 months (*n* = 132), *OBE-only* includes those with only OBEs in the prior 3 months (*n* = 135), *Non-LOC* individuals without self-reported loss of control eating in the prior 3 months, nor likely lifetime history of anorexia nervosa (*n* = 133)

Dietary restriction and body shame were investigated using ANOVAs with significant ANOVAs followed by Tukey post-hoc tests.

Analyses were run with and without number of episodes (total SBEs and OBEs over the past 3 months) as a covariate, since number of episodes may correlate with overall severity of eating difficulties, and, further, may differ depending upon whether a person reports multiple types of loss of control eating. The pattern of findings was identical with and without the covariate; thus, for parsimony, we reported findings without the covariate.

Results

Demographic information

Demographic information for each group and tests of group differences are presented in Table 1. No significant group differences were found for race/ethnicity. Significant group differences were found regarding age with the non-LOC group significantly older ($M = 38.57$ years) than both the OBE-only ($M = 27.63$ years) and SBE-included groups ($M = 24.13$ years). Based on *z* score cell comparison, the SBE-included group had significantly more participants who identified as being a woman (95.46%; $n = 126$) than the OBE-only group (84.44%; $n = 114$), but not the non-LOC group (90.23%; $n = 120$). Additionally, the SBE-included group had significantly more participants with a likely AN history (17.42%; $n = 23$) than the OBE-only group (8.15%; $n = 11$).

Disordered eating symptoms and body shame

There was a significant group difference in number of episodes of compensatory behaviors over the prior 28 days, $F(8,654) = 9.64$, Wilks' Lambda = 0.80, $p < 0.001$ (see Table 2). The SBE-included group had higher numbers of vomiting, laxative misuse, and hard exercise episodes over the prior 28 days than both OBE-only and non-LOC groups. The OBE-only and non-LOC groups did not significantly differ on compensatory behaviors.

Groups were also significantly different on dietary restriction ($F(2,330) = 37.18$, $p < 0.001$) and body shame ($F(2,334) = 89.39$, $p < 0.001$) with the SBE-included group higher on dietary restriction and body shame than the OBE-only group, which was higher than the non-LOC group (see Table 2).

Negative affect

There was a significant group difference in negative affect, $F(6,662) = 12.42$, Wilks' Lambda = 0.81, $p < 0.001$. The SBE-included group reported higher anxiety and depression symptoms than the OBE-only group, which in turn reported higher depression and anxiety than the non-LOC group (see Table 2).

Interpersonal difficulties

There was a significant group difference in interpersonal difficulties, $F(4,664) = 22.28$, Wilks' Lambda = 0.78, $p < 0.001$. The SBE-included and OBE-only groups did not differ from each other on loneliness or perceived social support, but

Table 2 Group comparisons using MANOVA and ANOVA among SBE-included, OBE-only, and non-LOC eating groups

	SBE-included	OBE-only	Non-LOC	Significance
Eating disorder symptoms				
Dietary restriction	4.86 ^a	3.88 ^b	2.50 ^c	$F(2,330) = 37.18, p < 0.001$
Compensatory behavior frequency				$F(8,654) = 9.64, Wilks' \Lambda = 0.80, p < 0.001, partial \eta^2 = 0.11$
Vomiting	5.92 ^a	0.47 ^b	0.00 ^b	$F(2,330) = 14.81, p < 0.001$
Laxative use	1.57 ^a	0.26 ^b	0.01 ^b	$F(2,330) = 17.21, p < 0.001$
Diuretic use	1.36 ^a	0.48 ^{a,b}	0.01 ^b	$F(2,330) = 5.01, p = 0.007$
Hard exercise	7.10 ^a	2.05 ^b	1.44 ^b	$F(2,330) = 25.07, p < 0.001$
Body shame	4.08 ^a	3.71 ^b	2.43 ^c	$F(2,334) = 89.39, p < 0.001$
Negative affect				
Anxiety	2.11 ^a	1.69 ^b	1.34 ^c	$F(2,333) = 27.56, p < 0.001$
Depression	2.32 ^a	2.02 ^b	1.48 ^c	$F(2,333) = 26.63, p < 0.001$
Interpersonal difficulties				
Loneliness	3.08 ^a	3.01 ^a	2.20 ^b	$F(2,334) = 47.57, p < 0.001$
Perceived Social Support	4.18 ^a	4.28 ^a	5.21 ^b	$F(2,333) = 20.82, p < 0.001$
Perception of daily eating experiences				
Carbohydrate images				
$F(6,656) = 29.59, Wilks' \Lambda = 0.62, p < 0.001, partial \eta^2 = 0.21$				
“Out of control”	4.77 ^a	3.43 ^b	1.90 ^c	$F(2,330) = 80.66, p < 0.001$
“Too much food”	5.07 ^a	3.44 ^b	2.22 ^c	$F(2,330) = 74.99, p < 0.001$
“Bad/unhealthy”	5.82 ^a	5.06 ^b	3.58 ^c	$F(2,330) = 57.41, p < 0.001$
Fruit/vegetable images				
$F(6,656) = 16.08, Wilks' \Lambda = 0.76, p < 0.001, partial \eta^2 = 0.13$				
“Out of control”	2.32 ^a	1.37 ^b	1.23 ^b	$F(2,330) = 32.39, p < 0.001$
“Too much food”	2.80 ^a	1.50 ^b	1.37 ^b	$F(2,330) = 45.47, p < 0.001$
“Bad/unhealthy”	1.84 ^a	1.27 ^b	1.30 ^b	$F(2,330) = 12.40, p < 0.001$

Results from multivariate tests are indicated in bold. Compensatory behavior frequencies were reported as number of episodes in the past 28 days. Superscripts specify which groups were statistically significantly different from one another based upon post-hoc Tukey tests. Possible values of the constructs are as follows: dietary restriction: 0–6, body shame: 0–5, anxiety/depression symptoms: 0–3, loneliness: 0–3, perceived social support: 0–6, perception of daily eating experiences: 0–6

SBE subjective binge eating, *OBE* objective binge eating, *SBE-included* includes those with SBEs with or without OBEs in the prior 3 months ($n = 132$), *OBE-only* includes those with only OBEs in the prior 3 months ($n = 135$), *Non-LOC* individuals without self-reported loss of control eating in the prior 3 months, nor likely lifetime history of anorexia nervosa ($n = 133$)

both groups reported higher loneliness and less perceived social support than the non-LOC group (see Table 2).

Perception of daily eating experiences

There was a significant group difference in perceptions of imagined carbohydrate eating experiences, $F(6,656) = 29.59$, Wilks' $\Lambda = 0.62$, $p < 0.001$. The SBE-included group reported higher likelihood of interpreting eating carbohydrates as “out of control”, “too much food”, and “bad/unhealthy” than the OBE-only group, which in turn reported a higher likelihood of these negative perceptions than the non-LOC group.

There was also a significant group difference in perceptions of imagined fruit/vegetable eating experiences, $F(6,656) = 16.08$, Wilks' $\Lambda = 0.76$, $p < 0.001$. The SBE-included group reported a higher likelihood of interpreting the experience of eating fruits/vegetables negatively than the OBE-only and non-LOC groups, but the OBE-only

group did not significantly differ from the non-LOC group (see Table 2).

Discussion

The SBE-included group endorsed significantly higher rates of disordered eating symptomatology (i.e., dietary restriction and number of vomiting, laxative misuse and hard exercise episodes in the past 28 days) and greater body shame than OBE-only and non-LOC individuals. The findings related to dietary restriction and body shame replicate prior research and align with the higher likelihood of history of lifetime AN among the SBE-included group in this sample [1, 11]. It could be that SBEs, at least among some individuals, are a holdover symptom from previous AN, with SBEs more likely marking dietary restriction and body shame. Notably, the OBE-only group did not significantly differ from the non-LOC group on compensatory behaviors. These findings

suggest that the presence of SBEs among the general population may be more indicative of disordered eating than OBEs, particularly using online recruitment.

Regarding negative affect, the SBE-included group reported significantly higher anxiety and depression symptoms than both OBE-only and non-LOC groups. These findings align with previous evidence that SBEs may indicate worse negative affect than OBEs on their own [1, 11].

SBE-included and OBE-only groups did not significantly differ in their report of interpersonal difficulties (i.e., loneliness and perceived social support), but both groups reported higher levels of difficulties in these areas than the non-LOC group. This, in contrast to Brownstone et al. [1], suggests that SBEs may not indicate greater interpersonal difficulties than OBEs. Rather, either form of loss of control eating may co-occur with loneliness and lack of perceived social support.

Regarding perceptions of daily eating experiences, the SBE-included group was more likely to perceive both carbohydrate and fruit/vegetable consumption experiences negatively as compared to OBE-only and non-LOC groups. The OBE-only group was more likely to perceive carbohydrate consumption experiences, but not fruit/vegetable consumption, negatively compared to the non-LOC group. Thus, individuals with SBEs may have a more global tendency to experience eating as out of control and negative regardless of food type, which may result in a wider range of aversive eating contexts and potentially more chronic stress related to eating.

All group differences between SBE-included and OBE-only groups remained after controlling for total number of SBE/OBE episodes. Therefore, we can more confidently conclude that there is something about SBEs, even when combined with OBEs, that results in associations with variables under consideration, and that associations are not merely markers of higher numbers of loss of control episodes and, therefore, higher symptom severity. That said, future research should examine SBE-only versus OBE-only versus SBE and OBE presentations to further understand these different behaviors.

The present study was the first to investigate SBEs using online recruitment and data collection. We used language commonly used in the EDE interview to operationalize SBEs for our participants. Additionally, we asked for example episodes to confirm size. Given the lack of retesting in the current study, we were not able to determine test–retest reliability of SBE assessment. We did find, however, that using our approach, many participants were able to provide an example episode that corresponded to the size definition when applicable. Thus, we were able to identify individuals meeting SBE criteria using a novel online assessment tool that could be applied in future research. A limitation was that to limit participant burden,

we used subsets of items from psychometrically validated instruments. Another limitation relates to online recruitment and online data collection. Online recruitment may result in selection bias of only participants with access to technology and comfort with online research, and, additionally, online data collection may be associated with less engagement and attention than methodologies involving personal interaction. As an attempt to assess attention, we included a control item to check that participants were paying attention and their responses to the control item suggested they were as described above.

Future research should continue to assess SBEs separately, and expand on negative affect findings by exploring how momentary affective experience of SBEs may differ from OBEs. Additionally, further research on how to target SBEs in treatment will be important as we build our understanding of this little-known subtype of binge eating, which have been found to be particularly difficult to treat [30].

The current findings have diagnostic, assessment, and therapeutic implications. Given that SBEs likely mark disordered eating and negative affect, our diagnostic system should incorporate this information by including SBEs as possible loss of control eating that can accompany compensatory behaviors for a diagnosis of BN or another defined diagnosis besides Other Specified Feeding and Eating Disorder to allow for maximal insurance coverage and treatment refinement. Furthermore, the size distinction between SBEs and OBEs should not be dismissed in treatment or future research, because SBEs are likely distinct from OBEs with regard to associated psychological difficulties. It is clear that SBEs should be considered with the same, if not higher, level of clinical concern as OBEs, and should be assessed separately from OBEs. Clinicians may benefit from asking detailed questions about size of loss of control eating episodes, as size may provide relevant clinical information. SBEs may be markers of more severe disordered eating symptomatology, particularly compensatory behaviors and dietary restriction, and clinicians should be aware of this possibility when working with clients who struggle with SBEs.

What is already known on this subject?

Research shows that SBEs are common among the general population and eating disorder samples [4, 5]. There is also building evidence that SBEs are clinically concerning in terms of their associations with other disordered eating symptoms, negative affect, and broader psychological distress [1, 2, 6–10]. Furthermore, existing research shows that SBEs may have unique phenomenology and associated features compared to OBEs [1, 6, 11, 14–16].

What does this study add?

All of this existing research has been conducted in nonclinical samples or samples recruited based upon engagement in OBEs or bulimic behaviors. This is the first study to recruit specifically based upon SBE occurrence, and to look at relations between SBE occurrence and individuals' perceptions of eating more broadly. Our findings show that, even controlling for total number of loss of control eating episodes, SBEs seem to mark increased severity of disordered eating symptoms (i.e., body shame, restrictive eating and bulimic behavior symptoms), negative affect, and more globalized tendency to view all eating, regardless of food type, as out of control and negative.

Funding The current research was funded by the John Dashiell Dissertation Start Up award through University of North Carolina at Chapel Hill Department of Psychology and Neuroscience.

Availability of data and material Study data is available upon request.

Compliance with ethical standards

Conflict of interest The authors have no conflicts of interest or competing interests to disclose.

Ethical approval This study was approved by University of North Carolina at Chapel Hill's Institutional Review Board.

Informed consent Informed consent was obtained from all the individual participants included in the study.

Appendix

Selected items used in online survey

UCLA Loneliness Scale Version 3: Participants indicate frequency of experiencing this from “Often”, “Sometimes”, “Rarely”, “Never” [25]. Items included were: “There is no one I can turn to (item 7)”, “No one really knows me well (item 15)”, “I feel isolated from others (item 16)”.

Depression Anxiety Stress Scales (DASS-21): Participants indicate the extent to which the statement “applies to them” on a scale from 0 to 4: “Did not apply to me” (0) to “Applied to me very much or most of the time” (3) [23]. Items included were: “I couldn't seem to experience any positive feeling at all (item 3)”, “I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion) (item 4)”, “I felt that I had nothing to look forward to (item 10)”, “I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat) (item

19)”, “I felt scared without any good reason (item 20)”, “I felt that life was meaningless (item 21)”.

Multidimensional Scale of Perceived Social Support (MSPSS): Participants indicate on a scale from 1 to 7 the extent to which they agree with the statement (“1” if you Very Strongly Disagree Circle to “7” if you Very Strongly Agree) [26]. Items included were: “I get the emotional help and support I need from my family (item 4)”, “I can talk about my problems with my friends (item 12)”.

Objectified Body Consciousness Scale-Body Shame subscale (OBCS-BS): Participants indicate the extent to which they agree with the statement (“1” if they “Strongly Disagree” to “5” if they “Strongly Agree”) [22]. Items included were: “When I can't control my weight, I feel like something must be wrong with me (item 9)”, “I feel like I must be a bad person when I don't look as good as I could (item 11)”.

References

1. Brownstone LM, Bardone-Cone AM, Fitzsimmons-Craft EE et al (2013) Subjective and objective binge eating in relation to eating disorder symptomatology, negative affect, and personality dimensions. *Int J Eat Disord* 46(1):66–76. <https://doi.org/10.1002/eat.22066>
2. Mond JM, Latner JD, Hay PH, Owen C, Rodgers B (2010) Objective and subjective bulimic episodes in the classification of bulimic-type eating disorders: another nail in the coffin of a problematic distinction. *Behav Res Ther* 48(7):661–669. <https://doi.org/10.1016/j.brat.2010.03.020>
3. American Psychiatric Association (2013) Diagnostic and statistical manual of mental disorders, 5th edn. American Psychiatric Association, Philadelphia. <https://doi.org/10.1176/appi.books.9780890425596>
4. Kerzhnerman I, Lowe MR (2002) Correlates of subjective and objective binge eating in binge-purge syndromes. *Int J Eat Disord* 31(2):220–228. <https://doi.org/10.1002/eat.10026>
5. Luce KH, Crowther JH, Pole M (2008) Eating Disorder Examination Questionnaire (EDE-Q): norms for undergraduate women. *Int J Eat Disord* 41(3):273–276. <https://doi.org/10.1002/eat.20504>
6. Goossens L, Soenens B, Braet C (2009) Prevalence and characteristics of binge eating in an adolescent community sample. *J Clin Child Adolesc Psychol* 38:342–353. <https://doi.org/10.1080/15374410902851697>
7. Li N, Mitchison D, Touyz S, Hay P (2019) Cross-sectional comparison of health-related quality of life and other features in people with and without objective and subjective binge eating using a general population sample. *BMJ Open*. <https://doi.org/10.1136/bmjopen-2018-024227> ((Published 2019 Feb 20))
8. Mulders-Jones B, Mitchison D, Girosi F, Hay P (2017) Socioeconomic correlates of eating disorder symptoms in an Australian population-based sample. *PLoS ONE*. <https://doi.org/10.1371/journal.pone.0170603>
9. Palavras MA, Hay PJ, Lujic S, Claudino AM (2015) Comparing symptomatic and functional outcomes over 5 years in two non-clinical cohorts characterized by binge eating with and without objectively large episodes. *Int J Eat Disord* 48(8):1158–1165. <https://doi.org/10.1002/eat.22466>
10. Palavras MA, Morgan CM, Borges FM, Claudino AM, Hay PJ (2013) An investigation of objective and subjective types of binge

- eating episodes in a clinical sample of people with co-morbid obesity. *J Eat Disord* 1:26. <https://doi.org/10.1186/2050-2974-1-26>
11. Fitzsimmons-Craft EE, Ciao AC, Accurso EC et al (2014) Subjective and objective binge eating in relation to eating disorder symptomatology, depressive symptoms, and self-esteem among treatment-seeking adolescents with bulimia nervosa. *Eur Eat Disord Rev* 22(4):230–236. <https://doi.org/10.1002/erv.2297>
 12. Jenkins PE, Conley CS, Rienecke Hoste R, Meyer C, Blissett JM (2012) Perception of control during episodes of eating: relationships with quality of life and eating psychopathology. *Int J Eat Disord* 45(1):115–119. <https://doi.org/10.1002/eat.20913>
 13. Shomaker LB, Tanofsky-Kraff M, Elliott C et al (2010) Salience of loss of control for pediatric binge episodes: does size really matter? *Int J Eat Disord* 43(8):707–716. <https://doi.org/10.1002/eat.20767>
 14. Dias Santana D, Mitchison D, Gonzalez-Chica D et al (2019) Associations between self-reported diabetes mellitus, disordered eating behaviours, weight/shape overvaluation, and health-related quality of life. *J Eat Disord* 7:35. <https://doi.org/10.1186/s40337-019-0266-y>
 15. Latner JD, Hildebrandt T, Rosewall JK, Chisholm AM, Hayashi K (2007) Loss of control over eating reflects eating disturbances and general psychopathology. *Behav Res Ther* 45(9):2203–2211. <https://doi.org/10.1016/j.brat.2006.12.002>
 16. Van Malderen E, Goossens L, Verbeken S, Boelens E, Kemps E (2019) The interplay between self-regulation and affectivity in binge eating among adolescents. *Eur Child Adolesc Psychiatry* 28(11):1447–1460. <https://doi.org/10.1007/s00787-019-01306-8>
 17. Goodman LA (1961) Snowball sampling. *Ann Math Stat* 32:148–170
 18. Buhrmester M, Kwang T, Gosling SD (2011) Amazon's mechanical turk: a new source of inexpensive, yet high-quality, data? *Perspect Psychol Sci* 6(1):3–5. <https://doi.org/10.1177/1745691610393980>
 19. Shapiro DN, Chandler J, Mueller PA (2013) Using mechanical turk to study clinical populations. *Clin Psychol Sci*. <https://doi.org/10.1177/1087054715597471>
 20. Fairburn CG, Cooper Z (1993) The eating disorder examination. In: Fairburn CG, Wilson GT (eds) *Binge eating: nature, assessment and treatment*. Guilford Press, New York, pp 317–360. <https://doi.org/10.1002/erv.2400030211>
 21. Fairburn CG, Beglin SJ (1994) Assessment of eating disorders: interview or self-report questionnaire? *Int J Eat Disord* 16(4):363–370. [https://doi.org/10.1002/1098-108X\(19942\)16:4%3c363::AID-EAT2260160405%3e3.0.CO;2-%23](https://doi.org/10.1002/1098-108X(19942)16:4%3c363::AID-EAT2260160405%3e3.0.CO;2-%23)
 22. McKinley NM, Hyde JS (1996) The objectified body consciousness scale: development and validation. *Psychol Women Q* 20:181–215. <https://doi.org/10.1111/j.1471-6402.1996.tb00467.x>
 23. Lovibond PF, Lovibond SH (1995) The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behav Res Ther* 33(3):335–343. [https://doi.org/10.1016/0005-7967\(94\)00075-u](https://doi.org/10.1016/0005-7967(94)00075-u)
 24. Henry JD, Crawford JR (2005) The short-form version of the Depression Anxiety Stress Scales (DASS-21): construct validity and normative data in a large non-clinical sample. *Br J Clin Psychol* 44(Pt 2):227–239. <https://doi.org/10.1348/014466505X29657>
 25. Russell DW (1996) UCLA Loneliness Scale (Version 3): reliability, validity, and factor structure. *J Pers Assess* 66(1):20–40. https://doi.org/10.1207/s15327752jpa6601_2
 26. Zimet GD, Dahlem NW, Zimet SG, Farley GK (1988) The multidimensional scale of perceived social support. *J Pers Assess* 52:30–41. https://doi.org/10.1207/s15327752jpa5201_2
 27. Russell D, Peplau LA, Ferguson ML (1978) Developing a measure of loneliness. *J Pers Assess* 42(3):290–294. https://doi.org/10.1207/s15327752jpa4203_11
 28. Cauty-Mitchell J, Zimet GD (2000) Psychometric properties of the Multidimensional Scale of Perceived Social Support in urban adolescents. *Am J Community Psychol* 28(3):391–400. <https://doi.org/10.1023/A:1005109522457>
 29. Zimet GD, Powell SS, Farley GK, Werkman S, Berkoff KA (1990) Psychometric characteristics of the Multidimensional Scale of Perceived Social Support. *J Pers Assess* 55(3–4):610–617. <https://doi.org/10.1080/00223891.1990.9674095>
 30. Goldschmidt AB, Accurso EC, Crosby RD et al (2016) Association between objective and subjective binge eating and psychopathology during a psychological treatment trial for bulimic symptoms. *Appetite* 107:471–477. <https://doi.org/10.1016/j.appet.2016.08.104>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.