



Stress appraisal prospectively predicts binge eating through increases in negative affect

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Received: 4 July 2020 / Accepted: 23 November 2020 / Published online: 3 January 2021
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Abstract

Purpose Ecological momentary assessment (EMA) studies preliminarily support the transactional model of emotion regulation in eating disorders, such that heightened stress appraisal (i.e., the cognitive evaluation of an event's demands) results in increased negative affect (NA) and subsequent binge eating (BE). However, the temporal relationships between these variables and the magnitude of stress appraisal that is clinically significant require clarification. The current study aimed to extend previous research by (1) examining the temporal relationship between stress appraisal, changes in NA, and BE using three timepoints, (2) exploring what magnitude of momentary stress appraisal results in clinically significant increases in NA and BE, and (3) characterizing what stressors are associated with clinically significant stress appraisal.

Methods 37 adult females completed an EMA protocol assessing momentary stressors, stress appraisal, NA, and BE over 2 week duration. Multilevel mediation models were used to test the study aims.

Results Momentary increases in stress appraisal significantly predicted binge eating through increases in NA. Stress appraisal ratings of 0.50 SD higher relative to one's average stress appraisal began to significantly predict the likelihood of BE through increases in NA, and the likelihood of BE occurrence increased with every 0.25 increments in momentary stress appraisal. Work/school stressors and interpersonal stressors were the most commonly endorsed stressors of clinically significant stress appraisal.

Conclusion The current study supported the transactional model of emotion dysregulation in a binge eating sample and supports the use of momentary interventions at times of clinically significant stress appraisal to reduce BE risk.

Level of evidence Level II, controlled trial without randomization.

Keyword Ecological momentary assessment · Stress appraisal · Binge eating · Stressors · Negative affect

Introduction

Binge eating (BE), or recurrent episodes of eating large quantities of food accompanied by a sense of loss of control while eating, is a clinically significant phenomenon across a spectrum of eating disorders (EDs). Momentary increases in negative affect (NA) have been shown to precede BE episodes [1] and some studies have found that NA temporarily improves following a BE episode [2, 3] suggesting that BE may function as a maladaptive means of coping with NA

[4, 5]. Thus, understanding factors that increase momentary NA could inform the development of targeted interventions to prevent worsening of NA and the subsequent occurrence of BE.

One prominent model for understanding the factors that may promote momentary increases in NA in EDs is the transactional model of emotion dysregulation [6–8]. This model posits that emotions occur in response to cognitive evaluations of an event, and consequently determine behaviors. For example, when an individual experiences an event that places a demand on her to adjust or change in some manner (referred to as a stressor), she may judge the significance of the event and her resources to cope with it through a cognitive process known as stress appraisal [9]. If the individual evaluates that the demands of the stressor exceed her coping resources, she may be at an elevated risk for experiencing NA. Elevated NA is subsequently theorized

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to promote ED behaviors in an attempt to regulate NA [4, 5, 7].

Consistent with this model, a growing body of research has shown that stress is associated with both NA and BE [10, 11], though most of this research has been cross-sectional. Given that the potential associations between stress appraisal and NA may occur on a momentary level, ecological momentary assessment (EMA) is an ideal methodology to study their association with BE in naturalistic contexts using the real-time data [12]. To date, only two studies have utilized EMA to study the association between these constructs. The first study [8] found that momentary increases in stress appraisal (i.e., appraising an event as causing greater stress relative to one's average levels of stress) at Time1 promoted increases in NA from Time1 to Time2, and prospectively predicted BE at Time2. However, because NA and BE were measured concurrently, we cannot determine if increases in NA occurred as a result of appraising an event as stressful or if the increases in NA occurred as a consequence of a BE. The second study [3] compared mood and stress appraisal ratings on days when BE occurred versus days when no BE occurred, and found that the average intensity ratings of both stress appraisal and NA aggregated across all assessment points were significantly higher on days with a BE episode compared to days without BE. Additionally, on days with BE, both stress appraisal and NA intensity ratings increased during the hours preceding a BE episode and decreased in the hours following a BE episode. While these findings suggest a relationship between stress appraisal, NA, and BE, the overlap in assessment timepoints for both stress appraisal and NA reduces our ability to understand the temporal ordering of these constructs.

Taken together, the two previous EMA studies provide preliminary support for the transactional model of emotion dysregulation. However, the timepoints used in prior studies do not allow us to fully understand the temporal relationship between stressors, stress appraisal, NA, and BE. Additionally, no study to has evaluated what magnitude of stress appraisal is needed to increase the risk for NA and BE, which could have clinical implications. For example, better understanding the magnitude of stress that reliably predicts an increase in risk for a BE episode could inform the optimal time of delivering momentary interventions.

Thus, the current study sought to extend the previous research on the relationship between stressors, stress appraisal, NA, and BE in a sample of women with transdiagnostic BE. First, to better understand the temporal nature between these constructs, we utilized three distinct timepoints to examine the temporal association between stressors, stress appraisal, NA and BE (stressor and stress appraisal at Time1, changes in NA between Time1 and Time2, and BE at Time3). We hypothesized that the relationship between momentary stress appraisal at Time1 and

risk of BE at Time3 will be mediated by increases in negative affect between Time1 and Time2. As exploratory aims, we sought to (1) identify the clinically significant magnitude of stress appraisal defined as the magnitude of increase in momentary stress appraisal that is associated with an increase in NA and heightened risk for BE, and (2) characterize stressors associated with clinically significant stress appraisal.

Methods

Procedures

The current sample was drawn from two EMA studies. Participants were recruited from the community through the distribution of flyers and posting in online forums as well as referrals from ED treatment clinics. Participants completed a phone screen to determine initial study eligibility. Eligible participants provided informed consent and completed a diagnostic interview using Eating Disorder Examination Interview 17.0. And provided informed consent for participation, and both studies were approved by the Drexel University Institutional Review Board.

Study 1 ($N=16$) examined the feasibility and acceptability of a smartphone application designed to deliver ecological momentary interventions to augment in-person Integrative-Cognitive Affective Therapy (ICAT) for treatment-seeking women experiencing clinically significant BE (defined as eating an amount of food that you consider excessive or an amount of food that other people would consider excessive, with an associated loss of control over eating episodes). Inclusion criteria included (1) between the ages of 18 and 65, and (2) endorsing at least one BE episode per week on average, and one compensatory behavior per week on average (including purging behaviors, driven exercise, and/or other extreme weight control behaviors) over the previous three months [13]. Exclusion criteria included (1) inability to read/speak English; (2) acute suicidality; (3) severe psychopathology (e.g., psychosis, mania), cognitive impairment or intellectual disability determined by a phone screen; (4) currently pregnant or breastfeeding; and (5) $BMI < 18.0 \text{ kg/m}^2$. The delivery of app-based interventions was contingent upon completion of EMA surveys. For the current study, we used EMA data from the first two weeks of the study during which no interventions were delivered based on EMAs. Four participants were excluded due to poor EMA compliance. Hence, a final sample size of 12 participants was obtained. Study 2 ($N=27$) was an EMA study in which women with clinically significant BE were invited to participate in an EMA study designed to assess real-time predictors and consequences of elevated body dissatisfaction [14]. Inclusion criteria included (1) between the ages of 18

and 65, and (2) reporting of at least one BE episode per week on average over the past three months). Exclusion criteria were (1) inability to read/speak English; (2) acute suicidality; (3) severe psychopathology (e.g., psychosis, mania), cognitive impairment or intellectual disability determined by a phone screen; (4) currently pregnant or breastfeeding; and (5) BMI < 18.0 kg/m². Of the eligible participants, two patients dropped out prior to study initiation and therefore were not included in the current study.

For both studies, EMA data were collected using both signal contingent surveys and event contingent surveys over a 2 week duration. Signal-contingent surveys were completed at three semi-random points throughout the day. Both studies used the same EMA items to assess stressors, stress appraisal, NA and BE. Participants received training on the EMA protocol, which included completing an EMA survey in-person and receiving definitions of BE. Preliminary data analyses comparing means and variance for all EMA variables between the two studies demonstrated minimal differences between studies. As such, data were collapsed across the two studies for all analyses. Hence, a final sample size of 25 participants was obtained.

Participants

Consistent with other EMA studies with individuals with ED, the current sample combined participants of various ED diagnoses to include a transdiagnostic BE sample [15, 16]. Our final sample included 37 adult females ($M_{\text{age}} = 35.34 \pm 11.56$ years, range = 19–64 years, $M_{\text{BMI}} = 30.31 \pm 7.61$ kg/m², range = 20.40–58.20 kg/m²; 66.05% Caucasian) with clinically significant BE.

Measures

Diagnostic interview. The Eating Disorder Examination Interview 17.0 [17] was administered to assess disordered eating behaviors [18]. The EDE is a semi-structured interview assessing engagement in disordered eating behaviors and cognitions over the previous three months.

Stressors and stress appraisal. At each prompt, participants selected from a list of items any stressful events [i.e., interpersonal stressors, financial stressors, work/school stressors, and other stressors (e.g. daily life hassles)] that had occurred since the last survey, and for each event that occurred, indicated how stressful they evaluated the event in the present moment (i.e., stress appraisal) from 1 (“not at all”) to 5 (“very much”). This specific question to assess stressful events and stress appraisal was adopted from previous literature [3, 8].

Negative affect (NA). NA was measured using 11 items that were adapted from the Positive and Negative Affect Schedule (PANAS; $\alpha = 0.92$; [19]). Participants reported

momentary NA on a 5-point Likert scale from 1 (not at all) to 5 (extremely) for each item. Items were averaged at each time point to form momentary NA ($\alpha = 0.79\text{--}0.81$). To avoid the confound of stress appraisal ratings on NA ratings we conducted within-person correlation between them. Within-person stress appraisal was only moderately correlated with NA ($r = 0.38$), establishing that NA and stress appraisal are two distinct constructs.

Binge eating (BE). At each prompt, participants selected from a list of disordered eating behavior (i.e., binge eating, self-induced vomiting, use of laxative/diuretics, compulsive exercise) that had occurred since the last survey. As is typical in other EMA studies, BE was defined as, ‘consuming an amount of food that you consider excessive, or an amount of food that other people would consider excessive, with an associated loss of control [20]. The BE assessments included eating episodes involving both subjectively and objectively large amounts of food, as recent literature indicates that the sense of loss of control over eating, rather than the amount of food, is the defining feature of binge eating [21].

Statistical analyses

All analyses were conducted using IBM SPSS 25.00 and Beta 2 MLMed Macro for SPSS [22, 23]. To examine whether stress appraisal at Time1 (i.e., predictor) predicted BE at Time3 (i.e., outcome) via changes in NA from Time1 to Time2 (i.e., mediator), following the approach used in previous studies [8, 24], we estimated 1-1-1 multilevel mediation model with fixed slopes which means the independent variable, mediating variable, and dependent variable were all used as Level 1 within-person variables. The independent variable was momentary stress appraisal at Time1, the mediating variable was NA at Time2, and BE at Time3 were the dependent variables. Prior binge episodes and NA at Time1 were the covariates. Although the length of time between two consecutive time points varied, the average interval separating the two was 2 h and 40 min. We first tested the direct effect of the independent variable (i.e., momentary stress appraisal) on BE. Then, we examined the model with the mediator (i.e., NA) added. In the mediation models, Time1 levels of NA, BE, purging episodes were included as covariates of Time2 NA (the mediator), and Time2 levels BE and purging episodes was included as a covariate of Time3 BE. This allowed us to assess whether increases in NA precede BE. The between-subjects effects of stress appraisal and NA were included as predictors of BE as well. Additionally, since the data were collapsed across studies, we ran all analyses controlling for nesting at the study level.

To identify the magnitude of stress appraisal that increases the risk for a BE, we identified surveys representing average stress appraisal levels. Next, we selected all surveys representing momentary increase in stress appraisal

(i.e., instances when an individual’s stress appraisal rating was higher relative to one’s average stress appraisal rating). We then calculated within-subject S.D. and created four categories of stress appraisal by adding 0.25 S.D., 0.50 S.D., 0.75 S.D. and 1 S.D. to participant’s stress appraisal rating. The five categories represented five different magnitudes of stress appraisal. Next, we ran 5 separate mediation models using the same 1-1-1 multilevel mediation model approach described above to test different magnitudes of stress appraisal as independent variables at Time1; each of these models was run for BE at Time3 mediated by NA at Time2 within the same day.

Results

EMA descriptives

Mean compliance with prompted EMA surveys was 86.4% [Study 1: 81.6% (SD = 17.2) and Study 2: 91.2% (SD = 9.2)]. The final sample included 2659 surveys. A total of 1095 BE episodes (41.2% of all surveys) were

endorsed. Average stress appraisal was 2.70 (S.D. = 1.64) over the course of two weeks.

Mediation model

Consistent with our hypothesis, momentary increases in stress appraisal at Time1 significantly predicted BE at Time3 mediated by increases in NA from Time1 to Time3 (indirect pathway: $p = 0.05$, OR = 1.15, see Table 1).

Clinically significant stress appraisal

Results from mediation models are shown in Table 1. Stress appraisal ratings of 0.50 SD higher relative to one’s average at Time1 began to significantly predict the likelihood of BE at Time3 through increases in NA from Time1 to Time2 ($p = 0.04$, OR = 1.17). Further, results showed that the likelihood of BE occurrence increased with every 0.25 increments in momentary stress appraisal (see Fig. 1).

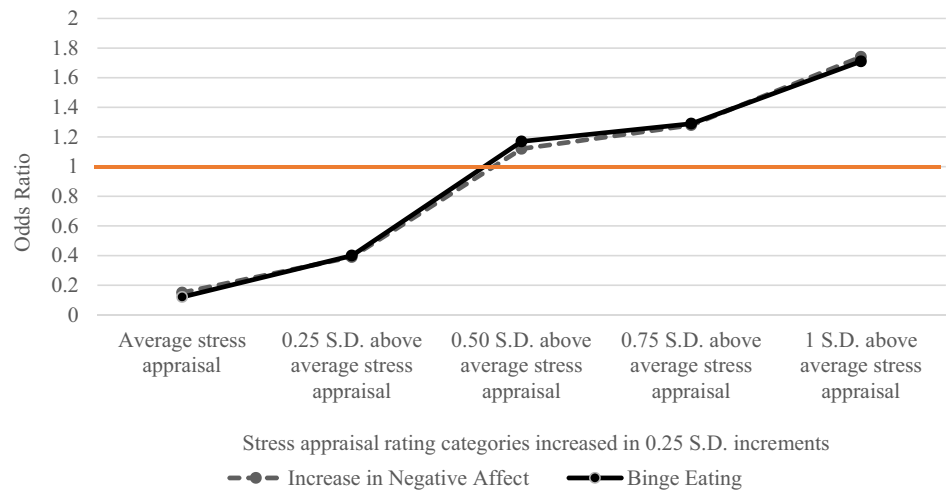
Table 1 Within-subjects mediation of different magnitudes of stress appraisal modeled separately

Independent variable	a Pathway	b Pathway	c Pathway (direct effect)	c’ Pathway (indirect effect)	95% Confidence intervals (CI)
Magnitudes of stress appraisal ratings	Stress appraisal at T1 → increase in NA from T1 to T2	Increase in NA from T1 to T2 → BE at T3	Stress appraisal at T1 → BE at T3	Stress appraisal at T1 → Increase in NA from T1 to T2 → BE at T3	
Within-person average stress appraisal at T1	0.83 S.E=0.04 OR=0.15	0.81 S.E=.01 OR=0.18	0.73 S.E=0.24 OR=0.13	0.99 S.E=0.22 OR=0.12	0.29–3.00
Magnitudes of stress appraisal ratings higher than within-person average at T1	Stress appraisal at T1 → increase in NA from T1 to T2	Increase in NA from T1 to T2 → BE at T3	Stress appraisal at T1 → BE at T3	Stress appraisal at T1 → Increase in NA from T1 to T2 → BE at T3	Stress appraisal at T1 → increase in NA from T1 to T2
Any higher ratings	1.39* S.E=0.34 OR=1.35	2.01** S.E=1.01 OR=1.28	1.13* S.E=0.54 OR=1.47	1.89* S.E=0.04 OR=1.15	0.96–2.19
0.25 SD higher ratings (3.11 out of 5)	0.86 S.E=0.14 OR=0.39	0.99* S.E=0.67 OR=0.37	0.79* S.E=1.04 OR=0.42	1.54 S.E=0.22 OR=0.40	0.06–1.78
0.50 SD higher ratings (3.52 out of 5)	1.00* S.E=1.19 OR=1.12	1.16* S.E=1.07 OR=1.11	0.83* S.E=1.04 OR=1.18	1.85** S.E=1.77 OR=1.17	0.80–3.00
0.75 SD higher ratings (3.93 out of 5)	1.04* S.E=0.99 OR=1.28	2.01* S.E=0.07 OR=1.24	1.13* S.E=1.00 OR=1.26	2.02** S.E=1.84 OR=1.29	0.81–4.02
1.00 SD higher ratings (4.34 out of 5)	1.79* S.E=1.11 OR=1.74	2.01** S.E=1.35 OR=1.78	1.43* S.E=0.99 OR=1.38	2.52** S.E=2.01 OR=1.71	1.00–3.00

* $p < .05$

** $p < .01$

Fig. 1 Figure showing odds of momentary increases in negative affect and binge eating in relation to 0.25 SD incremental increases in stress appraisal ratings. Redline indicates the level at which the odds of increases in negative affect and binge eating would be constant regardless of a trigger level



Characterizing stressors

Presence of a stressor was reported on 97.70% of all EMA surveys. Table 2 shows the stressors associated with different magnitudes of stress appraisal. During moments when average stress appraisal was reported and risk for BE was minimal, participants endorsed work/school stressors on 37.80%, interpersonal stressors on 22.70%, other stressors on 21.80%, and financial stressors on 11.70% of the surveys. However, when momentary stress appraisal was 1 S.D. above one’s average and risk for BE was highest, participants endorsed work/school stressors on 45%, interpersonal stressors on 31%, other stressors on 27%, and financial stressors on 7% of the surveys.

Discussion

The purpose of the present study was to examine the association between stress appraisal, NA and BE proposed by the transactional model of emotional dysregulation [6] in a sample with transdiagnostic BE using a naturalistic design. We also sought to identify the magnitude of stress appraisal that is needed to prospectively promote risk for increases

in NA and BE. Consistent with our hypothesis, the relationship between stress appraisal at Time1 and increased likelihood of BE at Time 3 was mediated by increases in NA from Time1 to Time2. Although previous research has supported the hypothesized association between stress appraisal and disordered eating behaviors mediated by NA [7, 8], this is the first study that clearly establishes the temporal precedence of stress appraisal in increasing NA and precipitating BE. These results also validate the transactional model of emotional dysregulation in the context of BE such that individuals cognitive evaluation of an event as stressful impacted their emotions and subsequent behavior (i.e., BE). By extending the transactional model of emotion dysregulation to binge eating, the study provides insight into relevant cognitive and affective momentary predictors of BE as well as the temporal association between these factors. Our results add to the extant literature by suggesting that stress appraisal may be an unexplored contributor to BE and may also play important role in regulating NA.

Our exploratory analysis also identified the magnitude of stress appraisal needed to confer risk for an increased likelihood of BE. We found that risk begins to significantly increase as early as 0.50 S.D. higher than one’s average stress appraisal, and that risk continues to increase as stress

Table 2 Stressors associated with different magnitudes of stress appraisal

	Types of stressors			
	Work/school	Interpersonal	Others	Financial
Magnitudes of stress appraisal ratings				
Within-person average stress appraisal	784 (37.80%)	471 (22.70%)	243 (11.70%)	452 (21.80%)
Magnitudes of stress appraisal ratings higher than within-person average at T1				
0.25 SD higher ratings (3.11 out of 5)	268 (52%)	141 (28%)	163 (32%)	75 (15%)
0.50 SD higher ratings (3.52 out of 5)	151 (43%)	108 (31%)	96 (28%)	31 (9%)
0.75 SD higher ratings (3.93 out of 5)	126 (42%)	92 (31%)	87 (29%)	31 (10%)
1.00 SD higher ratings (4.34 out of 5)	111 (45%)	77 (31%)	67 (27%)	18 (7%)

appraisal continues to rise above one's own average. Given that some amount of stress was reported at 97% of all surveys, these results have high clinical value by establishing that one's stress appraisal is most relevant to subsequent risk for engagement in BE. Our results suggest that while stressors may be ubiquitous in every-day life, these stressors only increase NA and likelihood of BE when stress appraisal is elevated above one's own average such that with every one unit increase in 0.50 S.D. above one's average stress appraisal level, BE was 1.17 times more likely. This study shows that work /school and interpersonal stressors were the most common events that were evaluated highly stressful. These findings are consistent with previous research demonstrating that individuals with EDs rate interpersonal and work/school stressors as most subjectively stressful, and also align with the interpersonal model of EDs, which presumes that adverse interpersonal events produce mood reactivity and perpetuate BE [25–27]. By characterizing and establishing a threshold for clinically significant stress appraisal, our findings indicate that the appraisal of specific stressors, particular work/school stressors or interpersonal stressors, as greater than an individual's usual level of stress is a relevant momentary risk factor for BE warranting further exploration.

While replication and extension of the present findings are warranted, our findings are particularly relevant for informing existing clinical interventions. First, our findings implicate the importance of addressing stress appraisal in treatment of BE. Although the current gold standard treatment for BE seeks to reduce residual binges by teaching individuals to problem solve and forestall events that might worsen NA [28], our results indicate that individuals may benefit from therapeutic interventions such as learning appraisal-focused coping skills (e.g., modifying the way they evaluate an event). Second, our findings may inform the design of momentary interventions (such as ecological momentary interventions [29] and just-in-time, adaptive interventions [30]) that deliver ecologically valid interventions in real-time. A key goal when designing a momentary intervention is to identify precise moments when delivery of the intervention will benefit the patient and avoid delivering an intervention during moments which incorrectly represent the moment of need. If our results are replicated, they suggest that when developing an EMI system to reduce the risk for BE, stress appraisal may be an important target. Specifically, moments when stress appraisal is 0.50 S.D above one's average could be the precise moments to deliver therapeutic interventions such as cognitive reappraisal or emotion regulation skills to reduce the risk for affectively driven BE.

This study had several limitations. First, our sample was relatively small, included only women and were mostly Caucasian which limits our ability to generalize these findings. Second, we were unable to assess for other

ED behaviors (e.g., purging, exercise) because of the low occurrence rate of these behaviors in our sample. Third, although our model predicted a significant proportion of variance in risk for BE, there remains a substantial portion of unexplained variance, suggesting that stress appraisal and NA may operate in concert with other factors. Fourth, although existing evidence suggests that participant reactivity to EMA methodology is limited [31], it is possible that repeated assessments may have impacted participants' appraisals of events, mood, and behavior patterns. Fifth, although we adopted the EMA question to assess stress appraisal from previous studies [3, 8], the question required participants to pick the type of the stressor to which they attribute their stress. This approach may have forced participants to attribute current stress to a recent event since the previous survey. However, there may be situations where current stress levels are not triggered by an immediately preceding event, but rather from previous events or rumination on general life stressors. Future research may benefit by asking participants if they are aware of any event since the previous survey that caused their current stress level and, if participant endorsed occurrence of an event, they may be asked to report the type of event. Sixth, the current study did not assess the clinical presentation of binge planning or how planning binges in advance may lead to increased negative affect. Binge planning may increase negative affect as the individual may anticipate subsequent guilt after the binge episode. Future research should explore the role of binge planning in the relationship between stress appraisal, negative affect, and binge eating. Lastly, we did not assess for different types of interpersonal events that might differentially be associated with high-stress appraisal (e.g., conflict with a partner might produce different levels of stress compared to an argument with a friend). Future research should consider assessing the relationships among different types of interpersonal stressors, increases in NA and BE as well as other types of ED behaviors.

The current study supported the transactional model of emotion dysregulation in a BE sample and suggests that stress appraisal may an important target in treatment for BE.

What is already known on this subject?

Previous EMA studies have found that heightened stress appraisal results in increased NA and subsequent BE. However, the temporal relationship between these variables and the magnitude of stress appraisal that is clinically significant requires clarification, as it is unknown if increased NA from stress appraisal is predictive of BE and what magnitude of stress appraisal predicts subsequent BE.

What your study adds?

The current study adds to the field of literature on stress appraisal and BE by highlighting heightened stress appraisal as a momentary risk factor for BE and highlighting the magnitude of stress appraisal that is clinically significant. Our findings implicate the importance of addressing stress appraisal in treatment of BE and the utility of delivering momentary interventions to benefit the patient when they are at the highest risk of BE.

Funding This work was supported by NEDA Feeding Hope Grant awarded to Adrienne Juarascio and by WELL Center Seed Fund Award to Paakhi Srivastava.

Compliance with ethical standards

Conflict of interest No authors have any conflicts of interest to disclose.

Ethics approval Both parent studies which collected data for the current study were approved by the Drexel University Institutional Review Board.

Human and animal rights All procedures performed were in accordance with the ethical standards of the institutional review board of Drexel University and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

Consent to participate and for publication Participants provided informed consent at the baseline assessment for data collection and publication of de-identified data.

References

- Haedt-Matt AA, Keel PK (2011) Revisiting the affect regulation model of binge eating: a meta-analysis of studies using ecological momentary assessment. *Psychol Bull* 137(4):660
- Berg KC et al (2017) Negative affect and binge eating: reconciling differences between two analytic approaches in ecological momentary assessment research. *Int J Eat Disord* 50(10):1222–1230
- Smyth JM et al (2007) Daily and momentary mood and stress are associated with binge eating and vomiting in bulimia nervosa patients in the natural environment. *J Consult Clin Psychol* 75(4):629
- Heatherton TF, Baumeister RF (1991) Binge eating as escape from self-awareness. *Psychol Bull* 110(1):86
- Pearson CM, Wonderlich SA, Smith GT (2015) A risk and maintenance model for bulimia nervosa: from impulsive action to compulsive behavior. *Psychol Rev* 122(3):516
- Fruzzetti AE, Worrall JM (2010) Accurate expression and validating responses: a transactional model for understanding individual and relationship distress. *Support Process Intim Relat* 11:121–150
- Haynos AF, Fruzzetti AE (2011) Anorexia nervosa as a disorder of emotion dysregulation: evidence and treatment implications. *Clin Psychol Sci Pract* 18(3):183–202
- Goldschmidt AB et al (2014) Ecological momentary assessment of stressful events and negative affect in bulimia nervosa. *J Consult Clin Psychol* 82(1):30
- Lazarus RS (1996) *Psychological stress and the coping process*. McGraw-Hill.
- Hilbert A et al (2011) Psychophysiological responses to idiosyncratic stress in bulimia nervosa and binge eating disorder. *Physiol Behav* 104(5):770–777
- Freeman LMY, Gil KM (2004) Daily stress, coping, and dietary restraint in binge eating. *Int J Eat Disord* 36(2):204–212
- Stone AA, Shiffman S (1994) Ecological momentary assessment (EMA) in behavioral medicine. *Ann Behav Med* 16(3):199–202
- Juarascio AS et al Feasibility and acceptability of a smartphone application to augment In-Person Integrative-Cognitive affective therapy for binge eating. *Int J Eat Disord* (under review)
- Srivastava P et al Intra-individual variability in body dissatisfaction among individuals with binge eating (in preparation)
- Mason TB et al (2019) Examination of momentary maintenance factors and eating disorder behaviors and cognitions using ecological momentary assessment. *Eating Disorders*. <https://doi.org/10.1080/10640266.2019.1613847>
- Smith KE et al (2020) Examining intra-individual variability in food-related inhibitory control and negative affect as predictors of binge eating using ecological momentary assessment. *J Psychiatr Res* 120:137–143
- Fairburn CG, Cooper Z, O'Connor M (1993) The eating disorder examination. *Int J Eat Disord* 6:1–8
- Association American Psychiatric, DSM-5 Task Force, (2013) *Diagnostic and statistical manual of mental disorders, DSM-5™*. 5th edn. VA, American Psychiatric Publishing Inc, Arlington ISBN 978-0-89042-554-1
- Watson D, Clark LA, Tellegen A (1988) Development and validation of brief measures of positive and negative affect: the PANAS scales. *J Pers Soc Psychol* 54(6):1063
- Berner LA et al (2017) Temporal associations between affective instability and dysregulated eating behavior in bulimia nervosa. *J Psychiatr Res* 92:183–190
- Fitzsimmons-Craft EE 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
- Hayes AF, Rockwood NJ (2020) Conditional process analysis: Concepts, computation, and advances in the modeling of the contingencies of mechanisms. *Am Behav Sci* 64(1):19–54
- Rockwood NJ (2017) *Advancing the formulation and testing of multilevel mediation and moderated mediation models*. The Ohio State University.
- Mason TB et al (2018) Examining a momentary mediation model of appearance-related stress, anxiety, and eating disorder behaviors in adult anorexia nervosa. *Eat Weight Disord-Stud Anorex, Bulim Obes* 23(5):637–644
- Arcelus J et al (2013) The role of interpersonal functioning in the maintenance of eating psychopathology: a systematic review and testable model. *Clin Psychol Rev* 33(1):156–167
- Murphy R et al (2012) Interpersonal psychotherapy for eating disorders. *Clin Psychol Psychother* 19(2):150–158
- Ansell EB, Grilo CM, White MA (2012) Examining the interpersonal model of binge eating and loss of control over eating in women. *Int J Eat Disord* 45(1):43–50
- Fairburn CG (2008) *Cognitive Behavior Therapy and Eating Disorders*. Guilford Press.

29. Heron K, Smyth J (2010) Ecological momentary interventions: Incorporating mobile technology into psychosocial and health behaviour treatments. *Br J Health Psychol* 15(1):1–39
30. Juarascio AS et al (2018) Just-in-time adaptive interventions: a novel approach for enhancing skill utilization and acquisition in cognitive behavioral therapy for eating disorders. *Int J Eat Disord* 51(8):826–830
31. Stein KF, Corte CM (2003) Ecologic momentary assessment of eating-disordered behaviors. *Int J Eat Disord* 34(3):349–360

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