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Ecological Momentary Assessment of Bulimia Nervosa: Does Dietary Restriction Predict Binge Eating?

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Abstract

The purpose of this study was to examine the relationship between caloric restriction (CR) and binge eating (BE) using ecological momentary assessment (EMA). Participants included 133 women with bulimia nervosa (BN) who completed an EMA protocol for 2 weeks. Logistic regression analyses tested whether CR increased the probability of BE episodes. The results revealed that the odds of BE increased on the day that restriction occurred as well as on the following day. In addition, both restriction and BE on one day predicted the likelihood of BE the subsequent day, but restriction for two days prior to the episode failed to add additional information for predicting BE. These findings support the cognitive-behavioral therapy (CBT) model of BN, suggesting that self-reported dietary restriction is predictive of subsequent BE episodes, and that reducing dietary restriction in treatment may lead to improvements in bulimic symptoms.

Keywords

ecological momentary assessment; bulimia nervosa; binge eating; caloric restriction

Patients with bulimia nervosa (BN) engage in episodes of binge eating (BE) as well as dietary restriction (Mathes, Brownley, Mo, & Bulik, 2009; Vögele, Hilbert, & Tuschen-Caffier, 2009). A number of factors, including stress, access to palatable food, negative emotions, and food restriction, have been shown to precipitate BE among those with BN (Anestis et al., 2010; Mathes et al., 2009; Stice, 2001). Caloric restriction (CR) and fasting have also been found to increase the risk of BE among laboratory animals and clinical populations (Mathes et al., 2009; Polivy, Zeitlin, Herman, & Beal, 1994; Stice, Davis, Miller, & Marti, 2008; Stice, Presnell, Groesz, & Shaw, 2005; Telch & Agras, 1996). Moreover, the related construct of dietary restraint, characterized by cognitive attempts to

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restrict the overall amount, frequency, or types of food consumed may also prompt BE (Fairburn, 2008; Hetherington, Stoner, Andersen, & Rolls, 2000).

Theoretically, CR may increase one's physiological susceptibility to engaging in BE episodes, but data supporting this causal relationship have been inconsistent. While there is considerable data supporting this association (e.g., Polivy, 1996; Polivy et al., 1994; Stice et al., 2008), other studies have failed to find a relationship. For example, a longitudinal study with moderately overweight adolescent girls who restricted their dietary intake and decreased their body mass showed a greater decrease in frequency of BE episodes (Stice, Martinez, Presnell, & Groesz, 2006). In addition, a study of overweight women who reported BE compared a dieting treatment group to a nondieting group and found that neither group lost weight but that those in the dieting group reported a decrease in their BE frequency in spite of reduced food intake (Goodrick, Poston, Kimball, Reeves, & Foreyt, 1998).

Physical hunger or metabolic need may not necessarily be predictive of BE among individuals with BN (Waters, Hill, & Waller, 2001). BE has been associated with increased hunger; however, excessive physiological hunger does not necessarily precipitate BE (Haedt-Matt & Keel, 2010). In summary, although reducing dietary restraint and dietary restriction is a clinical cornerstone of cognitive behavioral therapy (Fairburn, 2008) and several studies have observed a predictive relationship between dietary restriction or dietary restraint and BE, data from other investigations suggest that dietary restriction or restraint might actually decrease BE in some individuals.

In the current study, we employed a naturalistic data collection technique (ecological momentary assessment; EMA) among women with BN to obtain multiple daily assessments over a two-week period. A primary aim of this study was to examine the status of CR as a proximal antecedent for subsequent BE. Ecological momentary assessment (EMA) methods were used to examine the extent to which CR precipitates BE. EMA reduces measurement limitations of retrospective recall bias (Haedt-Matt & Keel, 2010), and has been shown previously to have utility for effectively measuring negative affect and affective lability as predictors of daily BE episodes among women with BN (Anestis et al., 2010; Haedt-Matt & Keel, 2010; Smyth et al., 2007; 2009). Because the inconsistent findings among investigations of CR and BE may be the result of methodological variability and measurement limitations, the use of EMA may be especially informative in understanding the extent to which dietary restriction precipitates BE episodes.

In examining CR as an antecedent to BE using EMA, the following research questions were addressed: (1) Is CR associated with BE during the same day? (2) Does CR predict the occurrence of BE on the subsequent day? (3) Do CR and BE each uniquely predict the occurrence of BE on the subsequent day? and (4) Do CR and BE predict BE two days after the initial occurrence? We hypothesized that a longitudinal analysis would show that CR was predictive of BE among participants with BN. In addition, we hypothesized that CR in combination with BE would predict BE on subsequent days.

Methods

Study participants

Participants included 133 females aged 18 and older recruited through eating disorder treatment centers, college campuses, and the general population of North Dakota. Institutional review board approval was received from the University of North Dakota and MeritCare (currently Sanford) Health System. Written informed consent was obtained from all participants. Their mean age was 25.3 (SD = 7.6), 64.7% were never married, 50.4%

were full-time students, and 97.0% were Caucasian. Participants received $100/week for completion of the study. In addition, they were given a $50 bonus for compliance rates of at least 85% or more on the EMA assessments.

Assessment

All participants met DSM-IV criteria for BN as diagnosed by a trained doctoral level psychologist using the Structured Clinical Interview for DSM-IV Axis I Disorders, Patient Edition-Eating Disorder Module (SCID-I/P; First, Spitzer, Gibbon, & Williams, 1995). The SCID-I/P was used to determine current (i.e., eating disorders) and lifetime (i.e., mood, anxiety, substance abuse/dependence) psychiatric diagnoses. The Eating Disorder module of the SCID- I/P was used to establish a current DSM-IV diagnosis of BN, from which study eligibility was determined.

EMA Measures

Wheeler and Reis (1991) describe the three types of self-report methods to record behaviors in EMA. The methods include *signal contingent*, in which participants receive semi-random signals during the day and are asked to self-report. *Event contingent* recording was employed when participants were asked to complete self-reports after a behavior of interest occurred (e.g., BE). *Interval contingent*, recording was used when participants are instructed to complete ratings at a predetermined time (Wheeler & Reis, 1991). In the present study, *interval contingent* was used when participants were asked to record various emotions and behaviors at the end of the day. At that time CR was assessed with the question: “Outside of the times when you have binged, how much did you restrict the amount of food you ate today?” followed by five choices: “No restriction; Mild restriction (attempt to generally cut back intake of food); Moderate restriction (1200–1600 calories) due to infrequent eating and/or low-cal food; Extreme restriction (<1200 calories) due to infrequent eating and/or low-cal food; Very extreme restriction – fasting or no eating except binge”.

EMA was used to establish the frequency and distribution of bulimic behaviors, including BE and restrictive eating. These procedures have been described in detail elsewhere (e.g., Crosby et al., 2009; Smyth et al., 2007). Briefly, participants were signaled on the palmtop computer six times during the day at semi-random times and instructed to record specific behaviors, such as BE. The semi-random time of the signal was determined randomly to be within +/− 20 minutes of each of six “anchor” times distributed evenly throughout the day: 8:30 a.m., 11:10 a.m., 1:50 p.m., 4:30 p.m., 7:10 p.m., and 9:50 p.m. In addition to recording BE when they were randomly signaled, participants were instructed to record BE episodes when they occurred (i.e., *event* contingent).

Reports of BE were gathered at the time that the binge episode occurred (i.e., *event contingent*) and at random signals (i.e., *signal contingent*) in which participants were asked to record if and when they had engaged in a BE episode since the last signal. After reviewing the practice data, participants were instructed to complete self-report assessments on the palmtop computers for two weeks.

Eligible participants were trained in how to use the palmtop computers and completed two practice days before beginning the two weeks of data collection. During training participants were provided with standard definitions of BE (“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 or the feeling of being compelled to eat”). Participants were also provided with examples of what constituted objectively large amounts of food. The BE assessments included eating episodes involving both subjectively and objectively large amounts of food.

Statistical Analysis

All analyses were conducted using Predictive Analytics SoftWare (PASW) for Windows Version 18.0 (SPSS Inc., Chicago, Illinois). Logistic regression was used to examine relationships between CR and BE.

Results

The dataset contained multiple observations nested within participants. It included 13,055 observations of momentary assessment for 1637 days from 133 patients. Also included were 1630 days that included end of day (interval contingent) recordings.

Four logistic regression models tested whether CR would increase the probability of BE episodes. Table 1 presents the parameter estimates (β), odds ratios (OR), and significance levels for the four logistic regression models. The first model examined the relation between the CR and BE probability on the same day. The OR of the first model was 1.182, meaning that the odds of BE increased by 1.182 for each one point increase in CR. The second model added temporal precedence and tested whether CR on a given day predicted BE on the subsequent day. The odds of BE increased by 1.296 for each one point increase in CR. The third model used both CR and BE on a given day to predict BE on the subsequent day. Results showed that both BE (adjusted OR = 2.004; $p < .001$) and CR (OR = 1.270; $p < .001$) on a given day were associated with an increased odds of BE on the subsequent day. Finally, the fourth model tested whether CR over two days added to model 3. While both BE and CR on a given day remained significant predictors of BE on the subsequent day, CR two days prior to BE did not add significantly to the model (OR = 1.106; p = .230).

Discussion

Our findings suggest that BE episodes are predicted by CR on the previous day. However, no additional information about the likelihood of BE is provided by the measurement of CR two days prior to the BE episode. Although the results of the current study do not address the specific mechanism by which CR is associated with subsequent BE, previous research suggests that biological factors of nutritional deprivation (Keys et al., 1950), cognitive variables of dietary restraint and subsequent disinhibition (Fairburn, 2008), or a combination of biological and psychological factors may contribute to this relationship.

Findings from the current study contribute to the growing literature suggesting that self-reported dietary restriction predicts BE. Although this study found a predictive relationship between dietary restriction and BE, the extent to which reduction of actual food intake (dietary restriction) compared to attempted reduction of food intake (dietary restraint) is unclear given that this study only measured actual food consumption which was assessed using self-report. The concept of dietary restraint was not addressed in this study. Dietary restriction and restraint may impact BE among individuals with BN, but inconsistencies are evident across studies. Thus, additional research is needed to determine the predictive role of both dietary restraint and restriction (as well as their combination) on BE among those with BN.

Another important implication of the present findings is their potential relevance to the treatment of BN. These findings provide empirical support for the CBT model of BN (Fairburn et al., 1993) as well as the more recent transdiagnostic model of EDs (Fairburn, 2009). Specifically, this investigation indicates that self-reported restriction of food intake is predictive of BE episodes on the same and subsequent day.

There are several clinical implications that emerge from the data. In providing support for the CBT model of BN, this study suggests that reducing attempted CR in individuals with BN may be an effective strategy to reduce BE in this population. In addition, these findings support the premise that one mechanism of CBT's efficacy may be the direct targeting of CR. In general, these results support the use of structured meal plans and nutritional rehabilitation to reduce CR in patients with BN, regardless of the overall treatment employed.

Persons with BN may use CR as a means for temporary weight loss and attainment of ideal goals. The findings from the current study may lead to knowledge for guiding future treatments, including designing interventions that reduce starvation effects by teaching patients how to avoid delayed eating (e.g., planning ahead, dealing with difficult situations, remaining flexible). Treatment interventions need to address this issue and develop individualized CBT plans that improve the likelihood of individuals thoughtfully processing and retaining information about the impact of CR, which may stimulate long-term behavioral changes.

This study has several limitations that should receive consideration. There is an inherent selection bias because this was based on an adult sample of women with BN. Therefore these findings may not generalize to adolescents or males with BN or to heterogeneous ED populations. Another limitation of the current study was that it was unclear whether or not participants completely fasted (i.e., did not consume any food during a given day), if they fasted with the exception of BE, if they restricted their food intake but did not fast, or if they attempted to restrict their food intake but were unsuccessful. The severity of dietary restriction is an important consideration because fasting has been shown to be a stronger risk factor than dieting for predicting BN pathology (Stice et al., 2008). In addition, the measurement of CR in this study was based on participant self-report and therefore may not have correlated with actual food intake or CR (Stice et al., 2004). Future studies should consider using measures other than, or in addition to, self-reported restriction (e.g., interview-based dietary recall methods).

In spite of these limitations, the current study provides important information about the potential contributing factor of self-reported dietary restriction to BN symptoms. One notable strength of this study is the use of EMA since data were gathered in the participants' naturalistic environment in close approximations of real time, which is intended to reduce retrospective recall bias. Future research is needed to replicate these findings and expand them to broader ED populations as well as using more detailed assessment measures of CR and BE. In addition, investigations are needed to understand the mechanisms by which addressing CR in the context of CBT and other types of ED treatment can maximally impact BE, potentially through the use of EMA in the context of treatment.

Abbreviations

BE	binge eating
BN	bulimia nervosa
CBT	cognitive behavioral therapy
CR	caloric restriction
EMA	ecological momentary assessment
SCID	Structured Clinical Interview for DSM-IV Axis I Disorders

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- CR and BE may both serve as significant antecedents of BE among patients with BN.
- Regression models indicate CR predicts BE for current day and subsequent day.
- CR for two days prior to BE failed to add additional information for predicting BE.
- BE episodes may depend on the length of time a person restricts caloric intake.

Table 1

Parameter estimates from the logistic regression models predicting binge eating by caloric intake restriction

Model	IV	DV	Number of Observations	β	Odds Ratio	95% CI	p
1. Restriction current day	R_{di}	BE_{di}	1637	.167	1.182	1.026, 1.359	.020
2. Restriction one day before	R_{di-1}	BE_{di}	1358	.259	1.296	1.126, 1.489	<.001
3. Restriction one day before	R_{di-1}	BE_{di}	1358	.239	1.270	1.129, 1.428	<.001
Binge eating one day before	BE_{di-1}	BE_{di}		.695	2.004	1.636, 2.455	<.001
4. Restriction one day before	R_{di-1}	BE_{di}	1236	.174	1.190	1.028, 1.377	.019
Restriction two days before	R_{di-2}	BE_{di}		.101	1.106	0.938, 1.303	.230
Binge eating one day before	BE_{di-1}	BE_{di}		.682	1.978	1.613, 2.425	<.001

Note: IV = Independent variable, DV = Dependent variable, R = Restriction (5 levels), BE = Binge eating (2 levels)

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