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A Fine-Grained Analysis of Eating Behavior in Women with Bulimia Nervosa

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Abstract

Objective—In the current study we were interested in developing a typology of eating in patients with bulimia nervosa based on the size of the eating episode, whether the episode was followed by self-induced vomiting, and the degree of loss of control self-reported by participants.

Method—Twenty-one adult women with bulimia nervosa, purging type, were evaluated using the Nutritional Data System for Research, the Eating Disorders Examination, and the Matrix.

Results—The most common type of episode resembled what might be termed “normal” eating which involved the consumption of less than 1000 kcal with no sense of loss of control and no vomiting. There was an increase in severity of self-assessed loss of control in objectively large eating episodes with vomiting. Self-reported hunger prior to eating episodes did not seem to be predictive of subsequent behavior. Most people were engaged in other behaviors while eating.

Discussion—The results of this study suggest a typology that included primarily four types of eating episodes. The results also suggest that when loss of control is assessed on a Likert-scale rather than as a dichotomous variable there is considerable variability in self-assessed degree of loss of control.

Keywords

bulimia nervosa; eating behavior; binge eating; vomiting; nutritional assessment

Introduction

Eating behavior in patients with bulimia nervosa (BN) has generally been described as evidencing a pattern of binge eating followed by self-induced vomiting and/or other compensatory behaviors[1]. In the DSM-IV the criteria require that binge eating and

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compensatory behaviors occur on average at least twice a week for three months; however, this criterion in DSM-5 will likely be changed to once a week[2, 3].

Our purpose in this study was to assess eating behavior in subjects with BN in greater detail. In particular, we were interested in examining the relative prevalence of subjective versus objective binge eating episodes and to further study the variable "loss of control", which is required for an episode to be assessed as a binge eating episode. Loss of control has commonly been associated with eating disorder psychopathology, and thus warrants further investigation[4]. Additionally, subjective and objective binge eating episodes have been shown to independently predict symptoms of eating disorders, including dieting practices and a reduced quality of life[5,6,7]. Our goal was to develop a typology wherein eating behavior could be classified as normal or abnormal with abnormal eating behaviors being characterized by: 1) objectively large eating binges (OBEs) versus subjective over-eating (SBEs); 2) whether or not the eating episode was followed by self-induced vomiting; and 3) loss of control measured on a Likert-scale rather than a dichotomous scale. On this third variable we wished to address our clinical impression that not all episodes are evaluated by patients in a dichotomous fashion (i.e. present or absent), which was the rationale for the Likert-scale assessment of loss of control.

Method

Participants

Subjects were Caucasian adult women recruited via referral or advertisements in the media who were asked to call in if they were interested in participating in a treatment trial for BN. This report concerns a subgroup (n = 21) of individuals who satisfied DSM-IV criteria for purging BN using self-induced vomiting, with the exception that the frequency criterion was decreased to once per week as per that proposed in DSM-5[3]. Subjects' mean age was 27 (range: 18-52 years; SD = 9.9), and subjects' mean body mass index (BMI) was 21.5 (range: 18.5-36.3; SD = 2.9). Approximately 24% of subjects were currently married, whereas 10% of subjects were divorced. In regard to education, 76% of subjects had received some form of post-high school training.

Subjects were required to be medically stable and not have met criteria for drug or alcohol abuse or dependence in the prior six months. Subjects previously treated with cognitive behavior therapy for BN were excluded. Subjects could be receiving pharmacotherapy for BN but must have been on a stable dosage for a minimum of six weeks. Subjects with a lifetime history of a psychosis were excluded, as were women who were pregnant or breast feeding. The protocol was approved by the local institutional review board.

Measurement

Subjects underwent screening using a variety of assessments and filled out several questionnaires as part of the treatment study. Assessments included the Eating Disorder Examination (EDE)[8], and a variety of other assessments, not of direct relevance to this report. Relative to the current report, trained assessors collected details of participants' eating behavior using the Nutritional Data System for Research (NDS-R)[9]. This computer-

based system involves calling participants in the evening on three successive days, including one weekend day, and recording detailed information about their food intake during that day. Subjects were aware on which days they would be called. The system allows for careful assessment of kilocalorie, macronutrient and micronutrient intake. In conjunction with this, subjects were also interviewed about the details of each eating episode in which they ingested 25 kilocalories or more using an interview developed for this purpose termed the Matrix (V.1.2). On the Matrix, a series of questions were asked about each eating episode, including the series of questions summarized in Table 1. Previous research has shown that food consumption of 1000 kilocalories or more is more nourishment that most people would consume during a typical eating episode[10,11,12,13]. In line with these past findings, the present study identified eating episodes of less than 1000 kilocalories as SBEs, and eating episodes 1000 kilocalories or greater as OBEs.

Statistical Analyses

Data from the NDS-R and the Matrix were combined to permit an examination of the foods and amounts ingested relative to the detailed data regarding the characteristics of each episode obtained using the Matrix. Data from the EDE were also incorporated into the analysis. Variables included: 1.) the amount of kilocalories consumed; 2.) whether the person vomited after eating (yes or no); and 3.) whether the person had a sense of loss of control while eating (score of 1-4 on a 0 to 4 point scale). Eight types of eating episodes were developed based on these variables. This resulted in the typology shown in Table 2.

The goal of this study was to examine key factors within a typology of eating behavior with the ability to classify normal and abnormal eating episodes. Statistical analyses were conducted to determine the role of key characteristics (i.e., kilocalories consumed, self-induced vomiting after eating, loss of control while eating) of such eating patterns. A random effects linear model was used to evaluate differences across eating episode types. The primary outcome variables included the Matrix data points, as shown in Table 1. Models included a random effect for participant, and fixed effects for type of eating episode. Bonferroni-corrected pairwise contrasts were utilized for examining the pairwise comparisons between eating episode types. A comparison of categorical and non-categorical factor assessments was also undertaken. SPSS for Windows Version 19.0 was used in order to conduct the analyses (SPSS, Chicago, IL).

Results

Development of Eating Episode Types

The most common type of episode, Type 1, resembled what might be termed “normal” eating, (which involved consumption of less than 1,000 kcal, and no sense of loss of control [LOC] or vomiting). OBEs were defined by the ingestion of > 1,000 kcal with a sense of LOC with (type 8) or without (type 6) vomiting. SBEs were defined by the ingestion of < 1,000 kcal with a sense of LOC with (type 4) or without (type 2) vomiting. Type 6 occurred rarely. Other subtypes (eating an amount of food < 1,000 kcal but vomiting despite no sense of LOC; eating > 1,000 kcal without vomiting and without a sense of LOC; and eating > 1,000 kcal and vomiting but without a sense of LOC) also were rare.

As was mentioned, degree of LOC was recorded on a Likert-scale, ranging from 0 = not at all to 4 = extremely. A positive score of 1-4 was considered indicative of some degree of loss of control. Data were also examined using 2 as the cutoff (not shown), but did not appear to yield meaningfully different results. Data regarding the self-rated severity of loss of control are summarized in Table 3.

As can be seen there was an increasing severity of self-assessed loss of control from 1-4 in OBEs with or without vomiting; however, the pattern was somewhat different for SBEs, with the highest degree of loss control being associated with SBEs with vomiting, but the lowest degrees of loss of control associated with SBEs without vomiting.

Assessment of Kilocalories and Loss of Control

Kilocalorie means, medians and ranges per ingestive episode as assessed using the NDSR are shown in Table 4. As can be seen there was a marked increase in the kilocalories ingested per eating episode from Type 1, to SBEs without vomiting (type 2), to SBEs with vomiting (type 4), to OBEs without vomiting (type 6), to OBEs with vomiting (type 8). There was a significant positive correlation between degree of rated LOC and kilocalories ingested across all episodes ($r = .57$; $p < .001$), as well as episodes of < 1,000 kilocalories ($r = .44$; $p < .001$). The correlation between episodes of > 1,000 kilocalories approached statistical significance ($r = .26$; $p < .06$).

A mixed-model analysis was also conducted to examine the within-subjects association between kilocalories and loss of control over eating (est. = .0012; SE = .0001; $p < .001$; pseudo-$R^2 = .27$). That is, kilocalories and loss of control were positively associated, suggesting that for an increase of 1,000 kilocalories the loss of control rating is expected to increase by a value of 1.2.

A generalized estimating equations (GEE) model was performed using momentary loss of control ratings (0 = Not at all; 4 = Extremely) and kilocalories consumed to predict the occurrence/nonoccurrence of vomiting. Greater loss of control (est. = .673; SE = .151; $p < .001$) and greater kilocalories consumed (est. = .002; SE = .0004; $p < .001$) were both associated with a greater likelihood of vomiting.

Assessments of Eating Episode Type

Data on characteristics of each type of episode in relation to the Matrix are shown in Table 5. Each variable was rated from 0 = never to 4 = extremely, except for the last variable which examined whether the subject was alone or with someone else. Because participants did not endorse chewing and spitting or rumination of food after eating these variables were not included within the analyses.

Hunger prior to eating—Eating episode type was related to hunger prior to eating ($F_{4, 377.57} = 5.59$, $p < .001$; pseudo-$R^2 = .05$). Subjective binge eating episodes without vomiting included significantly more hunger prior to eating than subjective binge eating episodes with vomiting and normal eating episodes, $p < 001$. Further assessment of hunger prior to eating included non-categorical analyses of kilocalories consumed, loss of control, and vomiting (pseudo-$R^2 = .03$). Loss of control was positively associated with hunger prior

to eating (est. = .135; SE = .052; $p < .01$). Hunger prior to eating was negatively associated with vomiting (est. -.723; SE = .212; $p < .001$). Due to the similar findings for variance accounted for by the models, as categorical or non-categorical measurements, it appears as though both options provide a comparable assessment of hunger prior to eating.

Feeling compelled to start eating—Eating episode type was significantly related to feeling compelled to start eating ($F_{4, 383.07} = 73.04$, $p < .001$; pseudo-$R^2 = .41$). Subjects who reported normal eating episodes (Type 1) experienced less compulsion to start eating than the other episode types, $p < .001$. Subjective binge eating episodes without vomiting (Type 2) were associated with less compulsion to start eating than subjective binge eating episodes with vomiting (Type 4) and objective binge eating episodes with vomiting (Type 8), $p < .001$. Further non-categorical analyses using kilocalories consumed, loss of control, and vomiting were also conducted (pseudo-$R^2 = .49$). Loss of control was positively associated with compulsion to start eating (est. = .578; SE = .045; $p < .001$). The comparison of the variance accounted for by the two types of models shows that the categorical measurement is a slightly better assessment of compulsion to start eating.

Feeling compelled to continue eating—Eating episode type was significantly related to feeling compelled to continue eating ($F_{4, 380.91} = 107.30$, $p < .001$; pseudo-$R^2 = .52$). Normal eating episodes (Type 1) were characterized by less compulsion to continue eating than the other eating episode types, $p < .001$. Subjective binge eating episodes without vomiting (Type 2) showed less compulsion to continue eating than subjective binge eating episodes with vomiting (Type 4) and objective binge eating episodes (Type 8), $p < .001$. Objective binge eating episodes without vomiting (Type 6) were associated with less compulsion to continue eating than objective binge eating episodes with vomiting (Type 8), $p < .04$. Compulsion to continue eating was non-categorically assessed by analyzing kilocalories consumed, loss of control, and vomiting. Loss of control was positively related to compulsion to continue eating (est. = .67; SE = .042; $p < .001$; pseudo-$R^2 = .56$). Given the similar degree of variance accounted for by each of the models, it appears as though either method of analysis (i.e., categorical or non-categorical) may sufficiently measure characteristics of eating episodes in relation to compulsion to continue eating.

Feeling upset after eating—Eating episode type was related to feeling upset after eating ($F_{4, 382.55}$) = 121.49, $p < .001$; pseudo-$R^2 = .54$). Normal eating episodes (Type 1) and subjective binge eating episodes without vomiting (i.e., type 2) were significantly different from each other and resulted in less upset feelings than all other types (Types 6 and 8) of eating episodes, $p < .001$. Kilocalories consumed, vomiting, and loss of control while eating were also assessed non-categorically in relation to feeling upset after eating (pseudo-$R^2 = .56$). Vomiting (est. = .779; SE = .178; $p < .001$) and loss of control were positively associated with feeling upset after eating (est. .562; SE = .044; $p < .001$). Given the variance accounted for by each model, it appears that both methods of analysis (i.e., categorical and non-categorical) are comparable in their abilities to assess eating episodes in relation to feeling upset after eating.

Feeling full after eating—Eating episode type was related to feeling full after eating ($F_{4, 378.58}$) = 39.03, $p < .001$; pseudo-R^2 = .29). Although normal eating episodes (Type 1) and subjective binge eating episodes without vomiting (Type 2) did not differ from each other, both showed a significantly lower degree of feeling full after eating than subjective binge eating episodes with vomiting (Type 4), objective binge eating episodes without vomiting (Type 6), and objective binge eating episodes with vomiting (Type 8), $p < .001$. Subjective binge eating episodes with vomiting (Type 4) showed less fullness than objective binge eating episodes with vomiting (Type 8, $p < .03$. Kilocalories consumed, vomiting, and loss of control while eating were further assessed as non-categoricalvariables in relation to feeling full after eating (pseudo-R^2 = .31). Kilocalories consumed (est. = .0004; SE = .0001; $p < .001$), vomiting (est. = .508; SE = 183; $p < .006$), and loss of control (est. = .151; SE = .045; $p < .001$) were positively associated with feeling full after eating. Due to the similar percentages of variance accounted for by the models, both methods of analysis (i.e., categorical and non-categorical) appear to provide similar assessments of eating episodes in relation to feeling full after eating.

Data on activities engaged in while eating are shown in Table 6. The majority of subjects were usually engaged in some other behavior during all types of episodes. The high percentage in the “other” category is of interest, but can’t be characterized further.

Discussion

The purpose of this study was to attempt to examine eating behavior in a group of women with purging type BN in more detail. The typology created was based on three variables: 1.) the amount of food ingested (< 1,000 kcal vs. > 1,000 kcal), 2.) whether or not the episode was followed by vomiting and, 3.) whether or not the episode was characterized by a sense of LOC. This resulted in a typology including 8 subtypes. Using this system the most common type of eating behavior was ingestion of an amount of food <1,000 kcal without a sense of LOC and without an episode of vomiting, suggesting that most eating episodes in patients with BN could be considered by these criteria as “normal”. In employing this nomenclature the most common type of problematic eating episode would be SBEs without vomiting followed by OBEs with vomiting, followed by SBEs with vomiting. These types of eating episodes accounted for the vast majority of eating episodes. Ninety-five percent of subjects reported SBEs and 67% reported OBEs during this 3-day period suggesting that this 3-day period did not necessarily capture days wherein OBEs with vomiting occurred and would have satisfied criteria for BN.

The Matrix system utilized also allowed for an examination of self-rated degree of LOC. The results here were interesting. Subjects tended to rate an increasing sense of LOC for SBEs with vomiting and OBEs with or without vomiting. An opposite pattern was observed for SBEs not followed by vomiting. The cut point used in the primary analysis, which was LOC of 1-4, was arbitrary, and different cut points would yield different results. The examination of using 2 as the cut point did not result in any apparent great differences.

In examining the results relative to the EDE data the subjects were on average experiencing an OBE about once a day and were scored as having SBEs at a significantly lower

frequency. These data are somewhat at odds with those collected using the NDS-R and the Matrix, which found a substantially greater frequency of SBEs. This suggests that SBEs may be scored differently when evaluated retrospectively using the EDE versus data obtained from the same day using the NDS-R. This result is similar to those found in previous studies that have examined the reliability of the EDE[14,15], and suggests that subjects in the present study were less likely to recall SBEs than OBEs. The conflicting impressions of the data across measures raise interesting questions about the validity of self-reported ratings of SBEs in general.

As might be expected, and as would be dictated to some extent by the nature of the classification, SBE or OBE episodes that were followed by vomiting, be they objective or subjective, were of larger kilocalorie content than were SBEs or OBEs not followed by vomiting. There was also a positive correlation between the degree to which LOC was rated and the amount ingested during the eating episode. Additionally, the majority of eating episodes with vomiting included higher loss of control ratings (3 or 4; Type 4: 81.5%, Type 8: 85.3%); and thus suggest that vomiting may be an important factor for the interpretation of eating episodes. This raises the interesting question as to whether or not LOC is evaluated differently retrospectively if people have engaged in vomiting behavior, the possibility being that if they know an ingestive episode was followed by vomiting and/or involved the ingestion of a large amount of calories they are more likely to endorse having had a higher degree of LOC.

In general hunger ratings prior to eating did not vary appreciably across the types. Relative to feeling driven or compelled to begin eating or to continue eating, the highest values were obtained for OBEs that were followed by vomiting and the second highest for SBEs followed by vomiting, but these did not differ significantly from OBEs without vomiting on feeling driven or compelled to start eating. Hunger prior to eating episodes did not seem, at least as rated retrospectively, to be strongly predictive of subsequent behavior, while feeling driven or compelled to start eating or to continue eating was higher for episodes followed by vomiting. Feeling upset after eating resulted in the highest scores for both OBEs and SBEs followed by vomiting but these were not different from OBEs not followed by vomiting. Again whether this was experiential or rated this way in retrospect because of the vomiting is unclear. The data suggest that the greater the degree of fullness the greater the likelihood of vomiting, although again it is difficult to know when this was ascertained by the subject since this was retrospectively determined. The questions as to how much subjects were paying attention to their eating did not seem to vary across the types of eating episodes. The amount of fullness, however, seemed to be maximal in those with OBEs followed by vomiting (although not significantly different from OBEs without vomiting).

Of particular interest was the percentage of times the subjects reported they were with someone else when eating, which ranged from a low of 23% during OBEs followed by vomiting to a high of 58% in SBEs not followed by vomiting. This is an unexpected finding and suggests that not uncommonly eating episodes that evolve into SBEs or OBEs begin in a social context and probably end when the individual isolates herself or himself to vomit, if such a behavior follows the eating episode. Most people were engaged in other behaviors while eating, whether the eating involved Type 1 eating, OBEs or SBEs. A high percentage

in the “other” category suggests that this question could be better phrased in subsequent research in this area.

All variable relationships were examined using both categorical and non-categorical assessment measures. Across all analyses it appears as though both methods provide comparable findings for interpreting the impact of kilocalories consumed, loss of control, and vomiting in relation to various aspects of subjective and objective binge eating episodes.

There are a number of limitations to this study that must be considered. First, the sample size is small. Second, these were all patients who satisfied criteria for purging BN with vomiting who were interested in a treatment study, and therefore were treatment seekers, who may not be representative of those with BN in general. Third, subjects are aware of which days they will be called for assessments, which may have influenced their eating behavior. Also, although the assessments NDS-R and Matrix were proximal to the actual behavior in which subjects engaged, none-the-less the data were retrospective assessing the prior 24 hours. Given the lack of reliable methods for the measurement of eating behaviors, future research should consider the strengths of current measurement options.

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Table 1

Matrix Data Points for Each Eating Episode [*]

• Duration of eating episode
• Location of eating episode
• How hungry were you prior to eating episode? (0-4[*])
• Did you feel out of control during eating episode? (0-4[*])
• Did you feel driven or compelled to start eating? (0-4[*])
• How upset did you feel after eating? (0-4[*])
• How much were you paying attention to your eating? (0-4[*])
• How full did you feel after eating? (0-4[*])
• Did you chew and spit food after eating?
• Did you ruminate food after eating?
• Were you engaged in other activities while eating? (such as TV, computer use, reading)
• Alone vs. with another person/people while you were eating

0 = Not at all; 4 = Extremely

[*]Items from the Matrix (V.1.2) for the examination of eating episodes.

Table 2

Typology of Eating Episode *

Vomiting/LOC				
	No/No	**No/Yes**	**Yes/No**	**Yes/Yes**
< 1,000 kcal	Type 1	Type 2	Type 3	Type 4
	186 (45.4%)	119 (29.0%)	13 (3.2%)	38 (9.3%)
≥1,000 kcal	Type 5	Type 6	Type 7	Type 8
	4 (1.0%)	8 (2.0%)	1 (0.0%)	41 (10.0%)

Percentages indicate the frequencies for each eating episode type.

* Eating typologies as determined by kilocalories consumed, loss of control, and vomiting.

Table 3

Self-reported Degree of LOC by Episode Type (1-4) *

Episodes	Type	LOC				
SBEs		0	1	2	3	4
Without vomiting	2	0.0	43.7%	37.8%	15.1%	3.4%
With vomiting	4	0.0	13.2%	5.3%	34.2%	47.3%
OBEs						
Without vomiting	6	0.0	12.5%	12.5%	50.0%	25.0%
With vomiting	8	0.0	4.9%	9.8%	26.8%	58.5%

* Percentages indicate the frequencies of eating episodes for each level of LOC by episode type.

Table 4

Kcal per Eating Episode for the 5 Common Types*

Type	X	Median	Range
1 Normal	260.4	214.7	27.5 – 847.4
2 SBE- V	334.0	283.9	38.1 – 977.8
4 SBE + V	665.7	586.2	70.1 – 999.9
6 OBE- V	1339.6	1239.9	1094.2 – 1852.4
8 OBE + V	2049.8	1711.3	1018.3 – 4232.1

*Values depict measures of central tendency and dispersion for each episode type

Table 5

Characteristics of Types of Episodes*

	"Normal" (1) M(SE)	SBE-V (2) M(SE)	SBE + V (4) M(SE)	OBE-V (6) M(SE)	OBE + V (8) M(SE)	*p*
"How hungry did you feel prior to this eating episode?"	1.93 (.19)	2.44 (.20)	1.69 (.25)	2.47 (.40)	2.13 (.24)	<.001
"Did you feel driven or compelled to start eating?"	1.03 (.12)	2.12 (.13)	3.08 (.19)	2.77 (.35)	3.49 (.18)	<.001
"Did you feel driven or compelled to continue eating?"	.75 (.14)	2.14 (.15)	3.10 (.20)	2.69 (.34)	3.39 (.19)	<.001
"How upset did you feel afterward about this eating episode?"	.56 (.13)	1.68 (.14)	3.33 (.19)	3.04 (.33)	3.35 (.18)	<.001
"How much were you paying attention to your eating?"	1.76 (.14)	2.05 (.15)	2.01 (.21)	1.91 (.38)	1.97 (.20)	.17
"How full did you feel after this eating episode?"	1.72 (.16)	1.98 (.17)	2.91 (.21)	3.25 (.35)	3.54 (.20)	<.001
"Was anyone else present when you were eating?"	47%	58%	39%	57%	23%	-

*Values depict the Matrix (V.1.2) data points by episode type. Percentages indicate the frequencies for episodes in which participants noted eating within the presence of others.

Table 6

What Behaviors Engaged in While Eating*

	Normal (1)	SBE-V (2)	SBE + V (4)	OBE-V (6)	OBE + V (8)
Nothing else	49 (26%)	15 (13%)	10 (26%)	0 (0%)	10 (24%)
TV, computer, reading	39 (32%)	37 (31%)	12 (32%)	4 (50%)	18 (44%)
Talking, visiting	43 (23%)	32 (27%)	11 (29%)	2 (25%)	8 (20%)
Other	55 (30%)	35 (29%)	5 (13%)	2 (25%)	5 (12%)

*Values indicate the frequency of behaviors across eating episode types.