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ORIGINAL CONTRIBUTION

A comparison of the accuracy of self-reported intake with measured intake of a laboratory overeating episode in overweight and obese women with and without binge eating disorder

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Abstract
Purpose Research has demonstrated significant underreporting of food intake in obese individuals with and without binge eating disorder (BED). An improved understanding of the accuracy of self-reported food intake is central to diagnosis of eating disorders and monitoring response to treatment. The purpose was to: (1) confirm those with BED consume significantly more kilocalories (kcal) than overweight/obese controls when instructed to overeat in the laboratory and (2) compare dietary recall data with measured intake.
Methods Fifteen women fulfilling BED criteria and 17 controls participated in an overeating episode and completed a 24-h dietary recall.
Results BED participants consumed significantly more kilocalories according to both methodologies. The BED group self-reported 90% of the measured intake compared to 98% for the control group. Mean differences between the methods indicated that on average both groups underreported intake; however, the mean difference between methods was significantly greater in the BED group.
Conclusions Findings confirm that those with BED consume significantly more than controls during a laboratory binge and controls tended to be more accurate in recalling their intake 24 h later.

Keywords Binge eating disorder · Obesity · Food intake · Meal patterning · Dietary recall · Underreporting

Introduction

Binge eating disorder (BED) is currently classified in the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) [1], as a provisional diagnosis requiring further study to support its utility as an eating disorder's diagnosis. Two central criteria describe binge eating in the DSM-IV: (1) "Eating in a discrete period of time an amount of food that is definitely larger than most individuals would eat during a similar period of time and under similar circumstances" and (2) "a sense of lack of control" [1]. In both clinical and research settings, the food intake data necessary to determine whether an individual fulfills the first criteria above are collected utilizing self-report techniques. Throughout medicine, there are concerns regarding the accuracy of self-reported data. Research has demonstrated significant underreporting of food intake in obese individuals with [2, 3] and without BED [4–6]. For those with BED, precise measurements of energy intake are

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associated with additional challenges since eating episodes are often secretive and associated with feelings of embarrassment and guilt over how much one is eating [7–9]. These characteristics of binge eating may influence accuracy of reporting.

Few studies have specifically examined the accuracy of self-reported food intake data in BED. Reports utilizing the doubly labeled water (DLW) method to measure total daily energy expenditure (TDEE) suggest that obese individuals report approximately 60% of their actual energy intake [4, 5]. DLW studies provide a highly accurate estimate of TDEE (within 4–5%) in free-living individuals [10]. In a given individual, TDEE will equal energy intake if there is no change in body weight during the data collection period. Our group measured TDEE by the doubly labeled water method with concurrent food log data collection [3]. By comparing self-reported food intake collected by food record to measured TDEE, we found that women with BED report 70% of daily intake while obese controls report 73%. When comparing daily food intake assessed by dietary recall interview to measured TDEE, those with BED reported 80% of their intake while obese controls reported 68%. There was no statistical difference between BED and obese controls in proportion of reported intake in either methodology. To the best of our knowledge, this is the only study that has utilized DLW to explore accuracy of self-reported food intake in women with BED. Yanovski's group examined the accuracy of self-reported data by comparing average daily food intake assessed by food records to estimated daily energy expenditure calculated by the Harris–Benedict equation (HBE) [2]. The BED group reported energy intake equivalent to 94% of their predicted energy requirements compared to 60% in the non-BED obese group. The differences between these studies are notable and could be attributed to a discrepancy between measured TDEE and estimated energy expenditure calculated by the HBE or variability in accuracy of reported food intake. Given this, an examination of accuracy of self-reported food intake in women with and without BED is warranted.

Despite the challenges associated with precise, objective measurement of eating behaviors, laboratory studies have been utilized to study food intake in obese women with and without BED. Our group and others have measured food intake in the laboratory through the administration of a test meal to simulate a binge eating episode. Test meal composition has varied by laboratory and included liquid meals [11, 12], single-item meals [13–16], and multiple-item arrays of food [14, 17–20]. Despite differing laboratory methodologies, results have consistently demonstrated that individuals with BED have greater total energy intake than non-BED weight-matched controls when instructed to overeat. However, marked variability in meal size has been observed when those with BED are instructed to overeat in the laboratory, with total food intake ranging from 1,515 [14] to 2,963 kilocalories (kcal) [2]. This variability has been attributed to unique laboratory protocols and food intake that is proportional to body size during an overeating episode. Guss and colleagues observed a significant positive correlation between meal size during a laboratory binge eating episode and body mass index (BMI) [18]. To the best of our knowledge, this finding has not been replicated in the literature.

In the current study, we sought to replicate findings by our group and others that participants with BED will consume more kilocalories than their non-BED counterparts when instructed to overeat in the laboratory. As an extension of our original laboratory paradigm, participants in the current study completed a self-reported dietary recall interview of the 24-h time period including the test meal. Measured food intake in the laboratory was compared to dietary recall data to ascertain the accuracy of participants' recall of the overeating episode. We hypothesized that the overweight/obese control group would report approximately 60% of measured test meal intake, consistent with previous reports [4, 5], while the BED group would be more accurate as observed by Yanovksi et al. [2]. Further, we sought to confirm the positive correlation between total food intake and BMI in those with BED during an overeating episode. A final aim of this paper was to explore the possibility of reduced dietary intake as a potential precursor to binge eating in BED. We compared food intake preceding the laboratory overeating episode to test meal intake to ascertain whether caloric intake before the test meal influences eating during the test meal.

Furthermore, it remains unclear whether those with BED and non-BED individuals report food intake with comparable levels of accuracy. If these groups do not have consistent reporting patterns, food intake data must be interpreted with caution when trying to determine whether they manifest distinctive eating patterns. An improved understanding of the accuracy of self-reported food intake data is central to distinguishing BED from typical obesity, making sound diagnosis, and monitoring response to treatment in patients with BED. In the study reported below, overweight and obese women with and without BED took part in an overeating episode in the laboratory setting. To ascertain the accuracy of their recollection of test meal intake, participants engaged in a telephone interview the following day to document food intake in the laboratory. Data from the dietary recall interview were then compared to measured intake to evaluate the accuracy of self-reported food intake data.

Methods

Participants

Fifteen women meeting DSM-IV criteria for binge eating disorder (BED) and seventeen overweight/obese controls with no history of binge eating behaviors participated in the current study. Participants in the control group had no history of binge eating, purging, or other eating disorder symptoms. Participants were required to be between the ages of 18 and 45 and have a BMI within the range of 27–35 kg/m^2. Recruitment was limited to women because of the increased prevalence of BED in women. These women were recruited as part of a larger study examining food intake and energy expenditure measured via the DLW method [3]. Participants were paid $300 upon completion of the entire study protocol.

Participants were excluded from both BED and control groups if they had unstable medical/psychiatric conditions or a history of substance abuse in the previous 6 months. Those who smoked, were pregnant or nursing, or currently dieting were also excluded because these factors influence energy metabolism. Participants on antidepressant therapy were allowed to enroll if they were on a stable dose of medication for 6 months and had no intention to modify this throughout their involvement in the study. Five participants with BED and two controls were on antidepressants while participating in the study. Women on medication for thyroid disorders were allowed to enroll if they were on a stable dose of medication for 6 months and thyroid function tests were within normal limits. The University of Minnesota Institutional Review Board (IRB) approved the study protocol. All participants took part in the informed consent process and provided written informed consent. Studies were carried out at the General Clinical Research Center (GCRC) of the University of Minnesota.

Procedure

Recruitment was performed by newspaper advertisements inviting overweight women aged 18–55 years to participate in a paid research study at the University of Minnesota. A telephone screen was used to assess preliminary eligibility for the BED and control groups. Participants meeting initial criteria were scheduled for a complete evaluation at the Ambulatory Research Center (ARC) to determine eligibility. During this evaluation, participants were interviewed using the Structured Clinical Interview for DSM-IV Axis I Disorders, Patient Edition (SCID-I/P) [21]; the Structured Clinical Interview for Axis II Personality Disorders (SCID-II) [22]; and the Eating Disorder Examination, version 12.0D (EDE) [23]. These assessments were used to confirm that BED participants fulfilled diagnostic criteria and to rule out any history of eating disorder or psychiatric symptoms in the control group. A physical examination, complete blood count, basic metabolic panel, and thyroid and liver function tests were performed to detect unknown medical conditions that could influence eligibility.

As part of the initial evaluation, participants were interviewed by a registered dietitian (SKR) who was blinded to their diagnostic status to assess typical food intake patterns, food selection, and preferred snack foods. Participants were presented with a standardized list of food items and asked to indicate which appealed to them. In addition, participants were asked whether they had other favorite foods or recipes that they consumed when overeating. Based on this information, the dietitian created a snack tray personalized to each participant's eating preferences for the laboratory overeating episode. Snack trays included 6–10 food items, consisting of both savory and sweet, in quantities 2–3 times what participants reportedly consumed during an overeating episode.

Eligible participants were then scheduled for an overnight inpatient stay at the GCRC during which they would engage in a laboratory overeating episode and subsequently complete a telephone dietary recall of 24-h period including the test meal. Patients were not informed that they were scheduled for a dietary recall interview until after completion of the overeating episode. This was done to ensure that knowledge of the recall would not influence eating behaviors in the laboratory. In addition to collecting food intake data for the test meal, the dietary recall protocol gathered self-reported food intake for the periods preceding and following the overeating episode. This enabled a comparison of pre-binge and post-binge food intake to intake during the test meal.

Laboratory binge eating episode

Participants were instructed not to consume any food or caloric beverages after 12 p.m. and to arrive at the GCRC no later than 5:30 p.m. After admission procedures, participants were presented with a standard hospital dinner plus an excess of their preferential binge foods as ascertained by the dietary assessment. They were instructed to "Let yourself go and eat as much as you like." Participants were left alone to eat and told to notify the research team when they were finished with the meal. This is the same laboratory test meal protocol has been utilized in the previous work by our group [20].

Upon completion of the meal, food trays were removed from the room. All food items presented to participants were weighed in the GCRC metabolic kitchen prior to service, and remaining portions were weighed after

completion of the overeating episode. The exact quantity of each item consumed was calculated by difference in mass. The computer program Nutritionist IV [24] was used to calculate total food intake in kilocalories and grams (g) and macronutrient intake in grams. To compare our results with others, macronutrient values in kilocalories were estimated from measured values in grams by the following standard conversion: 4.0 kcal/g carbohydrate, 4.0 kcal/g protein, and 9.0 kcal/g fat.

Twenty-four-hour dietary recall

On the afternoon following the test meal, participants completed a dietary recall interview for the 24-h time period from midnight to midnight during which they engaged in the overeating episode. The dietary recall interviews involved a detailed discussion of food intake and portion sizes with expert interviewers. The 24-h dietary recall interview protocol has been described in previous studies by our group [25, 26]. Interviews were conducted by experienced interviewers from the Nutrition Coordinating Center (NCC), Department of Epidemiology, School of Public Health, University of Minnesota. Dietary interviewers collected the 24-h dietary recalls using a current version of the database each year. At the end of data collection, nutrients were recalculated for all dietary intake records on the most current version of the Nutrition Data System for Research (NDS-R) software version 4.01, Food and Nutrient Database 30, released in November 1999. NDS-R is developed and maintained by the NCC, University of Minnesota, Minneapolis, MN. The NDS-R system prompts the interviewer to ask detailed questions about food intake over a 24-h period. The interviewer asks the participant to recall the first eating episode during the 24-h period. As the interviewer records food items during that eating episode, the program prompts the interviewer to ask about additional foods that may be typically eaten with the specific item (e.g., condiments with hot dogs or the type of milk or sugar added to cereal). When the first eating episode is fully explored, the interviewer asks about the next eating episode and proceeds in this fashion through the entire 24-h period. Prior to the data collection, participants were trained in the use of food portion visuals (picture of containers and shapes of specific quantities that are drawn to scale) to estimate dietary intake as described by Posner [27]. At the time the dietary recall of the inpatient binge eating episode was collected, all participants had already competed at least one random recall with the NCC interviewers as part of the larger research protocol in which they were participating. Results of these recalls will be reported elsewhere.

Following collection of dietary recall data, eating episodes that occurred during the 24-h period were defined as pre-binge, binge, or post-binge. Pre-binge intake was defined as food consumption beginning at 12 a.m. up to delivery of the test meal. Binge intake included only the test meal administered at the GCRC. Post-binge intake was defined as food consumption after the test meal until 11:59 p.m. This breakdown enabled a comparison of pre-binge and binge intake to examine the role of reduced caloric intake as a precursor to binge eating episodes.

Statistical analysis

Descriptive statistics, Pearson correlation coefficients, and analysis of variance were calculated using SPSS version 17.0. The reporting accuracy was defined by two methods. The first method was the *directional difference,* which was defined as the mean difference of measured intake minus reported intake. Negative values reflect over-reporting, while positive values signify underreporting. The second method to determine reporting accuracy was the *absolute difference*, which was defined as the absolute value of the measured intake less the reported intake. Greater absolute difference values indicated greater inaccuracy overall despite whether the difference arose from under- or over-reporting. Analysis of variance was used to determine between-group differences on total and macronutrient intake, directional and absolute difference between laboratory and dietary recall, and energy consumption throughout the day. The proportion of energy intake from carbohydrate, fat, and protein was examined by dividing the macronutrient intake by total intake. Pearson's correlation coefficient was used to determine the relationship between BMI and total food intake. Student's t tests and paired samples correlation coefficients were used to compare within-group differences on laboratory, dietary recall data, and energy consumption throughout the day. To assess the difference between correlation coefficients between groups, Fischer's r-to-z transformations were used.

Results

Demographics

The mean age of participants was 30.1 years (SD = 6.7) in the BED group and 31.3 years (SD = 8.5) in the control group, with no significant difference between groups (F (1, 30) = 1.81, $p = 0.67$). The mean BMI was 34.3 kg/m^2 (SD = 5.5) with a range of 31.2–37.3 in the BED group and 34.9 kg/m^2 (SD = 7.2) with a range of 31.2–38.6 in the control group. There was no significant difference in BMI between groups (F (1, 30) = 0.08, $p = 0.78$).

Energy and macronutrient intake during an overeating episode: Laboratory vs. dietary recall

Table 1 reports descriptive and test statistics for laboratory and dietary recall intake. Total food intake was significantly greater in those with BED than in those without according to laboratory (2,305.1 vs. 1,461.8 kcal; 466.3 vs. 294.4 g) and dietary recall methodologies (2,091.1 vs. 1,312.8 kcal; 411.1 vs. 261.6 g). Compared to overweight/obese controls, those with BED consumed significantly more grams of carbohydrate (laboratory: 294 vs. 71 g; recall: 251 vs. 151 g) and grams of fat (laboratory: 96 vs. 63 g; recall: 99.7 vs. 59 g) according to both methodologies. There was no significant difference between BED and control participants in protein intake.

The proportion of energy intake from carbohydrate, fat, and protein was also examined. There was no significant difference between BED and control groups in the proportion of intake from carbohydrates and fats. Controls consumed a significantly greater proportion of energy intake from protein than those with BED according to the dietary recall data (15.1 vs. 20.1%). This difference was not significant when measured in the laboratory.

Multiple methods to evaluate accuracy of self-reported food intake data

Paired samples *t* tests demonstrated no significant within-group differences in total food and macronutrient intake between laboratory and dietary recall methodologies in either BED or control groups (Table 1). One exception was the proportion of total intake from fat, with the BED group reporting to consume more % fat in the dietary recall than was measured in the laboratory (24.1 vs. 19.7%).

Accuracy of reporting was further examined by calculating the ratio of self-reported intake assessed by dietary recall to measured intake in the laboratory (dietary recall/laboratory). The proportion of reported to measured food intake measured in grams was 0.94 (SD = 0.040) in the BED group and 0.89 (SD = 0.36) in the control group. There was no significant difference between groups (F (1, 28) = 0.147, $p = 0.704$). Additionally, there was no significant difference between groups when evaluating the dietary recall/laboratory ratio with food intake measured in kilocalories (0.98, SD = 0.45 vs. 0.90, SD = 0.36; F (1, 28) = 0.308, $p = 0.584$).

The correlation between laboratory and dietary recall methodologies was calculated to evaluate accuracy of self-reported data. In both BED and obese control groups, significant within-group correlations were found between laboratory and recall methods for total food intake measured in kilocalories (BED: $r = 0.530$, $p = 0.05$, CON: $r = 0.805$, $p < 0.001$). Total food intake measured in grams was significantly correlated between methods in the control group ($r = 0.777$, $p < 0.001$), but only a trend toward significance in the BED group ($r = 0.465$, $p = 0.09$). The difference between the two correlation coefficients approached significance (kcal: $z = 1.33$, $p = 0.091$, g: $z = 1.36$, $p = 0.086$).

To further explore the accuracy of self-reported intake, we performed a between-group comparison of the directional difference and the absolute value of the mean difference for total food and macronutrient intake assessed by laboratory and dietary recall methods (Table 2). Results demonstrated that the BED participants had much greater variability in their self-reported data as can be seen by the standard deviation of the group means and the magnitude of the absolute values of the mean for the majority of the comparisons in Table 2. There was a trend toward the absolute value of the difference being significantly greater in those with BED than obese controls.

Relationship between total food intake and BMI

Examining BED and obese control groups together, BMI and total food intake were not significantly correlated according to laboratory (kcal: $r = 0.192$, $p = 0.292$; g: $r = 0.199$, $p = 0.274$) or dietary recall methodologies (kcal: $r = 0.214$, $p = 0.265$; g: $r = 0.206$, $p = 0.284$). In the control group, BMI was significantly correlated with food intake in the laboratory (kcal: $r = 0.541$, $p = 0.025$; g: $r = 0.562$, $p = 0.019$) and dietary recall data (kcal: $r = 0.540$, $p = 0.038$; g: $r = 0.543$, $p = 0.036$). In those with BED, BMI and food intake were not significantly correlated according to laboratory (kcal: $r = -0.057$, $p = 0.840$; g: $r = -0.054$, $p = 0.849$) or dietary recall data (kcal: $r = -0.108$, $p = 0.714$; g: $r = -0.123$, $p = 0.675$).

Patterns of energy consumption throughout the day

Table 3 reports descriptive and test statistics for patterns of energy consumption throughout the day. There were no significant differences between BED and obese control groups in pre-binge or post-binge caloric intake. No significant correlations were found between pre-binge and binge intake or post-binge and binge intake in the BED group. In the obese control group, pre-binge intake was significantly correlated with binge intake ($r = 0.576$, $p = 0.025$), and post-binge intake was marginally significant ($r = 0.505$, $p = 0.055$). Pre-binge intake and post-binge intake were significantly positively correlated in those with BED ($r = 0.616$, $p = 0.019$), obese controls ($r = 0.564$, $p = 0.028$), and overall ($r = 0.465$, $p = 0.011$).

Table 1 Mean total energy and macronutrient intake during a laboratory overeating episode: laboratory measurement vs. dietary recall interview

	Laboratory test meal			Dietary recall interview			Laboratory vs. recall	
	BED ($n = 15$) Mean (SD)	CON ($n = 17$) Mean (SD)	F (1, 31) (p)	BED ($n = 14$) Mean (SD)	CON ($n = 15$) Mean (SD)	F (1, 28) (p)	BED t (p)	CON t (p)
Total kcal	2,305.1 (834.0)	1,461.8 (641.9)	10.41 (0.003)	2,091.1 (1,044.1)	1,312.8 (847.5)	4.89 (0.036)	0.859 (0.406)	1.240 (0.235)
Total grams	466.3 (158.2)	293.4 (123.6)	12.02 (0.002)	411.1 (200.0)	261.6 (159.6)	4.98 (0.034)	1.059 (0.309)	1.364 (0.194)
CHO								
Grams	294.1 (97.9)	176.9 (70.9)	15.29 (< 0.001)	251.2 (128.1)	150.9 (84.9)	6.26 (0.019)	1.376 (0.192)	1.585 (0.135)
%	63.7 (6.2)	60.6 (5.0)	2.43 (0.129)	60.8 (8.5)	58.0 (8.3)	0.812 (0.375)	2.015 (0.650)	1.682 (0.115)
Estimated kcal	1,176.2 (391.6)	707.66 (408.9)	15.29 (< 0.001)	1,004.8 (512.4)	603.6 (339.7)	6.26 (0.019)	1.376 (0.192)	1.585 (0.135)
Fat								
Grams	96.3 (47.5)	62.8 (32.4)	5.57 (0.025)	99.7 (54.6)	59.0 (45.5)	4.78 (0.038)	−0.131 (0.897)	0.563 (0.582)
%	19.7 (5.7)	21.0 (4.6)	0.471 (0.498)	24.1 (5.1)	21.9 (5.3)	1.32 (0.260)	−2.426 (0.031)	−1.195 (0.252)
Estimated kcal	867.1 (427.4)	565.2 (291.3)	5.57 (0.025)	897.2 (491.2)	531.2 (409.4)	4.79 (0.038)	−0.131 (0.897)	0.563 (0.582)
Protein								
Grams	75.9 (35.1)	53.7 (29.0)	3.84 (0.059)	60.2 (28.8)	51.7 (38.9)	0.438 (0.514)	1.133 (0.278)	0.921 (0.372)
%	16.5 (5.1)	18.4 (4.1)	1.25 (0.272)	15.1 (4.8)	20.1 (6.3)	5.83 (0.023)	1.117 (0.284)	−0.838 (0.416)
Estimated kcal	303.5 (140.3)	214.7 (116.1)	3.84 (0.059)	240.7 (115.1)	206.8 (155.8)	0.438 (0.514)	1.133 (0.278)	0.921 (0.372)

BED binge eating disorder, *CON* control, *Kcal* kilocalories, *CHO* carbohydrate, *g* grams, *SD* standard deviation, *F* between-group *F* test, *t* within-group paired sample *t* test, Kcal values were estimated from measured macronutrient values in grams using the following standard conversions: 4 kcal/g CHO, 4 kcal/g protein, 9 kcal/g fat

Table 2 Mean differences of total energy and macronutrient intake between laboratory and dietary recall methodologies

	Directional difference			Absolute value of mean difference		
	BED MD (SD)	CON MD (SD)	F (1, 28) (p)	BED |MD| (SD)	CON |MD| (SD)	F (1, 28) (p)
Total kcal	215.7 (939.0)	160.9 (502.4)	6.03 (0.021)	779.1 (527.5)	438.6 (272.1)	3.83 (0.061)
Total grams	54.0 (190.7)	35.4 (100.6)	0.11 (0.744)	158.9 (110.9)	87.3 (57.6)	4.87 (0.036)
CHO (g)	42.2 (114.7)	28.0 (68.5)	4.21 (0.050)	97.0 (70.3)	56.8 (45.6)	2.30 (0.141)
Fat (g)	−1.5 (43.2)	3.4 (23.3)	5.00 (0.034)	35.0 (23.4)	19.4 (12.4)	6.99 (0.014)
Protein (g)	13.3 (43.9)	4.02 (16.9)	4.00 (0.055)	30.7 (33.2)	14.1 (9.6)	4.85 (0.036)

BED binge eating disorder, *CON* control, *Kcal* kilocalories, *g* grams, *CHO* carbohydrate, *SD* standard deviation, *MD* mean difference between laboratory and dietary recall, |*MD*| absolute value of mean difference between laboratory and dietary recall

Table 3 Patterns of energy consumption throughout the day: pre-binge, binge, and post-binge food intake

Food intake (kcal)	BED Mean (SD)	CON Mean (SD)	BED vs. CON F (1, 28) (p)
Pre-binge	1,188.9 (449.9)	1,038.0 (346.3)	1.032 (0.319)
Binge	2,091.1 (1,044.1)	1,312.8 (847.5)	4.889 (0.036)
Post-binge	182.6 (152.0)	270.7 (338.6)	0.798 (0.380)
Correlations	BED r (p)	CON r (p)	Overall r (p)
Pre-binge and binge	−0.145 (0.620)	0.576 (0.025)	0.206 (0.284)
Post-binge and binge	0.107 (0.715)	0.505 (0.055)	0.234 (0.222)
Pre- and post-binge	0.616 (0.019)	0.564 (0.028)	0.465 (0.011)

BED binge eating disorder, *CON* control, *Kcal* kilocalories, *SD* standard deviation, *r* Pearson's correlation coefficient

Discussion

In an attempt to replicate previous findings, one aim of the present study was to confirm that differences in energy intake exist between overweight and obese women with and without BED when instructed to overeat in the laboratory setting. Consistent with previous findings by our group and others, BED participants consumed significantly more total food than overweight/obese controls. This finding was detected by both laboratory (2,305 vs. 1,462 kcal) and dietary recall methodologies (2,091 vs. 1,313 kcal). These findings are remarkably consistent with previous work by our group in which obese women with and without BED engaged in a laboratory overeating episode and consumed 2,151 (SD = 430) and 1,609 kcal (SD = 700), respectively [20]. This work utilized an identical laboratory protocol to the current study. Other researchers have observed greater variability in food consumption during a multiple-item laboratory overeating episode, with intake ranging from 1,515 [14] to 2,963 kcal [19].

Macronutrient intake data measured by both methodologies indicated that those with BED eat significantly greater amounts of carbohydrate and fat than obese controls during a laboratory overeating episode. However, there were no differences in the proportion of total energy intake derived from carbohydrates and fat between groups. This suggests that the differences in total carbohydrate and fat intake observed were secondary to increased food intake in BED participants and do not reflect differences in food selection. This is consistent with previous work by our group in which those with BED consumed significantly more total fat than obese controls, but the proportion of energy intake from fat was not significantly different between groups [20]. Dietary recall data indicated that control participants consumed a significantly greater proportion of total energy from protein compared to the BED group. However, this difference was not significant according to laboratory measurements, which is the gold standard for measuring dietary intake. Results of our previous study detected no difference in total or proportion of protein intake between groups [20]. We suspect that this finding represents differences between groups in accuracy of reporting rather than a true difference in macronutrient consumption.

Other research groups have examined macronutrient intake when obese women with and without BED are instructed to overeat in the laboratory. Yanovski found that

those with BED consumed significantly more fat (38.9 vs. 33.5%) and less protein (11.4 vs. 15.4%) than obese controls [19]. Guss reported that obese women with BED (BMI > 28) consumed a significantly greater proportion of energy from fat than normal weight controls (BMI 19–23), but observed no difference between obese women with and without BED [19]. In contrast, Goldfein reported no difference in the proportions of macronutrient intake between obese women with and without BED when instructed to overeat in the laboratory [14]. Given these findings and those of the present study, it remains unclear whether differences in macronutrient intake exist between obese women with and without BED. The three studies discussed above utilized an identical laboratory paradigm. Direct comparison of these findings with the current study is difficult because macronutrient consumption reflects both food selection and food presentation, which varies by laboratory protocol.

To expand on the findings above, we compared measured food intake in the laboratory to dietary recall estimates of intake to ascertain the accuracy of self-reported data in obese women with and without BED. To the best of our knowledge, this is the first study to compare laboratory and dietary recall measurements of a specific eating episode in adult women with BED. According to dietary recall interviews, BED and obese control groups reported 90% and 98% of measured food intake during an overeating episode in the laboratory, respectively. Furthermore, there were no differences between groups in the accuracy of self-reported carbohydrate, fat, or protein intake.

When comparing random 24-h dietary recall data with TDEE assessed using the DLW method in these same participants, we noted that the BED and obese control groups reported daily food intake at 80 and 68% of TDEE, respectively [3]. Since accuracy of self-reported data for an isolated laboratory overeating episode was examined in the current study, direct comparisons with the results above cannot be made. Further research is required to determine whether these findings can be replicated and, if so, what factors facilitate the observed improvement in reporting. It is possible that the participants in this study may have reported with greater accuracy because the laboratory environment and unique food presentation made the episode more memorable than eating in the natural environment, thus resulting in improved recall of intake.

While there is not total consistency throughout the results, the three methods used to examine the accuracy of self-reported food intake together suggest that those with BED were less accurate than obese controls. Within-group comparisons demonstrated no significant differences between laboratory and dietary recall methods in total food or macronutrient intake in either group. Significant positive correlations between measured and self-reported intake were observed in both groups. However, the correlation coefficients were larger in the control group ($r = 0.805$ vs. 0.530), indicating that they were on average more accurate than those with BED. There was a trend toward a significant difference between these correlation coefficients ($p = 0.09$). We also examined the directional difference and the absolute value of the mean difference between reported and measured intake to examine the direction and magnitude of the inaccuracies in the two groups. Mean differences indicated that both groups underreported intake, but those with BED did so to a greater extent (215 vs. 160 kcal, $p = 0.021$). The mean of the absolute value of the difference suggests that the BED group tended to be less accurate at reporting their intake overall than controls (779 vs. 438 kcal, $p = 0.061$). The BED group also demonstrated greater variability in reporting as evidenced by standard deviations that were larger than those noted in controls. Overall, these findings are suggestive that those with BED tended to be less accurate with self-reported intake than obese controls.

Our findings suggest that the overweight/obese control participants demonstrated a trend to be more accurate at estimating total energy and macronutrient intake. It is possible that decreased accuracy of dietary recall data in participants with BED may be the result of subjective loss of control and consumption of an extremely large amount of food in a short period of time. Both of these factors may impair awareness of food consumption in BED relative to control participants. Further research is needed to confirm that BED participants are less accurate at reporting food intake than non-BED overweight/obese and to understand the mechanism of impaired accuracy.

Researchers have observed a positive correlation between food intake and BMI when participants with BED were instructed to binge eat in the laboratory [18]. In the current study, we sought to confirm that eating in proportion to BMI accounts for the variability in food intake reported in those with BED. Our results indicated that BMI and food intake were significantly correlated in the obese control group, but not in the BED group. These findings are not consistent with those reported by Guss and colleagues [18], who noted a positive correlation between meal size and BMI in the BED group under binge eating conditions. Significant correlations were not observed in the BED group when they were instructed to eat a normal meal or in obese control participants under binge or normal eating conditions. These results are not consistent with our findings and question the role of BMI in modulating food intake during a single eating episode in those with BED. Methodological differences between these studies make comparison of results difficult and demonstrate the need for further research addressing this issue.

A final aim of this study was to explore the role of reduced caloric intake as a potential precursor to binge eating in BED. To analyze patterns of energy consumption throughout the day, total daily caloric intake assessed by dietary recall was categorized as pre-binge, binge, or post-binge intake. There were no significant correlations detected between pre-binge and binge intake or binge and post-binge intake in the BED group. These findings suggest that food intake preceding and following an overeating episode is not associated with food consumption during the overeating episode alone. In contrast, in the obese control group, there were positive correlations between all of the comparisons, suggesting that those who eat more before the overeating episode also eat more during and afterward. Further, significant positive correlations were noted between pre-binge and post-binge food intake in both groups. This observation suggests that those who tended to consume a larger amount of food preceding the overeating episode also tended to eat more following it. Likewise, those who ate less before the overeating episode also ate less following it. Failure to compensate for overeating with reduced dietary intake may contribute to the development of obesity.

The findings of this study are limited by the small sample sizes and high standard deviations of energy and macronutrient intake values. As discussed above, multiple laboratory studies have reported great variability in food intake during binge eating episodes in BED. This presents a challenge to the assessment of food intake, and further research with larger sample sizes is needed to describe eating behaviors with greater specificity. In addition, there were aspects of our methodology which may have influenced food intake during the laboratory test meal. From the onset of the study, participants were aware that they would engage in an overeating episode in the laboratory. This prior knowledge may have influenced their eating behaviors and sense of loss of control during the binge eating episode.

A final limitation of this project is inherent in all laboratory studies of eating behaviors. While laboratory studies provide an objective, precise measurement of intake, they remove the individual from their natural environment and by doing so may influence eating behaviors. In the dietary recall of the test meal intake, self-reported food intake reached 90–98% of measured intake. The accuracy of self-reported data in these groups is surprising, given evidence that most obese individuals report daily energy intake at 60% of predicted energy requirements [4, 6]. This degree of accuracy can, at least in part, be attributed to the training participants received prior to the dietary recall interviews (see Methods section). As stated above, it may also be the case that the unique experience of eating in a laboratory is more memorable and ultimately increases the accuracy of self-reported recall. This raises the concern that laboratory studies place participants in a unique eating environment, devoid of typical precipitants of binge eating, and may not generalize to the natural environment.

Secondary findings from this study reinforced that obese women with and without BED have distinct eating behaviors and support the inclusion of BED as a diagnostic category within the eating disorder section of the DSM-V. Further research will clarify with increasing precision the quantity, nutrient composition, and food selections that characterize binge eating episodes in BED. Characterizing the eating behaviors associated with BED—both in the laboratory and through self-reported data—will facilitate accurate diagnosis and assessment of treatment response.

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Conflict of interest The authors declare no conflict of interest.

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