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Affect and eating behavior in obese adults with and without elevated depression symptoms

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Abstract

Objective—Although there is a modest relation between obesity and depression, mechanisms that contribute to this co-occurrence are unclear. This study examined mood and eating behavior among obese adults with and without elevated depression symptoms.

Method—Obese adults ($N=50$) were subtyped according to a Beck Depression Inventory (BDI) cutoff of 14, indicating “probable depression.” Participants with (BDI ≥ 14 ; $n=15$) and without elevated depression symptoms (BDI < 14 ; $n=35$) were compared on affect- and eating-related variables measured via questionnaire and ecological momentary assessment (EMA) using ANCOVA and mixed model regression.

Results—After adjusting for group differences in body mass index (BMI; $p=.03$), participants with elevated depression symptoms reported greater emotional eating via self-report questionnaire [$F(1,50)=4.3$; $p=.04$], as well as more frequent binge eating (Wald chi-square=13.8; $p<.001$) and higher daily negative affect (Wald chi-square=7.7; $p=.005$) on EMA recordings. Emotional eating mediated the relationship between depression status and BMI (indirect effect estimate=3.79; 95% CI=1.02–7.46).

Discussion—Emotional eating and binge eating were more commonly reported by obese adults with elevated depression symptoms compared to those without, and may occur against a general backdrop of overall low mood. Intervention and prevention programs for obesity and/or depression should address disordered eating to prevent or minimize adverse health consequences.

Keywords

Obesity; depression; emotional eating; binge eating; ecological momentary assessment

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Disclosure of Conflicts

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Obesity and depression are major public health concerns.¹ There is a relatively high degree of overlap among obesity, depression, and binge eating,² which may compound physical and psychosocial dysfunction.^{3,4} Depression may be a risk factor for obesity,¹ although mechanisms involved in this relation are unclear. Disturbances in eating behavior are common in both obesity⁵ and depression,⁶ and eating to alleviate negative affect may be one pathway to obesity in depressed individuals. The current study aimed to characterize the relations among affect, eating behavior, and body weight in obese adults with and without comorbid depression symptoms.

Emotional eating refers to the tendency to eat in response to aversive affective states.⁷ Emotional eating is associated with obesity^{8,9} and depression symptoms,¹⁰ and cross-sectional data suggest that it may mediate the relation between the two.^{11,12} Binge eating (i.e., the consumption of an objectively large amount of food accompanied by loss of control while eating)⁶ is also associated with obesity and depression¹³ and may be a potential mediator.¹⁴ Emotional eating among obese adults with binge eating disorder (BED) is associated with binge frequency and depression symptoms,¹⁵ indicating that it may be a marker for a more severe phenotype within the BED population.

Taken together, these data suggest a potential model whereby depression symptoms may predispose some individuals to engage in eating as a method of alleviating distress, which then confers a greater risk of obesity. However, existing studies of mediation have been limited by cross-sectional, self-report questionnaire data, which are prone to retrospective recall biases. Ecological momentary assessment (EMA), on the other hand, utilizes “real time” data, allowing for investigation of momentary antecedents and consequences of behavior.¹⁶ Thus, EMA could help elucidate the relation between affect and eating behavior in depressed individuals with obesity.

This study aimed to investigate eating behavior and mood among obese adults with and without comorbid depression symptoms. We expected that obese individuals with elevated depressive symptomatology would endorse greater emotional eating and binge eating on self-report questionnaires and EMA recordings than obese controls, and that these symptoms would mediate the relation between depression symptoms and body mass index (BMI; kg/m²)^{12,14}. A secondary aim was to examine daily affect in participants with and without depressive symptoms; it was hypothesized that individuals with comorbid depression symptoms would experience overall poorer mood than obese controls.¹⁷ This is the first study, to our knowledge, to investigate the relation between affect and eating behavior among obese adults with comorbid depression symptoms, which could have important clinical implications for both conditions.

METHODS

Participants

Participants were 50 obese adults (BMI>30; $M=40.3\pm8.5$), aged 18–65 ($M=43.0\pm11.9$), recruited through community advertisements and flyers. Participants were primarily female ($n=42$; 84%) and Caucasian ($n=38$; 76%), followed by African-American ($n=7$; 14%), Asian (6%, $n=3$), or other ($n=2$; 4%). Most were well-educated, with 76% ($n=38$) having at least attended or completed college. Exclusion criteria included current or past diagnosis of anorexia nervosa or bulimia nervosa, previous gastrointestinal surgery, being pregnant or breastfeeding, concurrent treatment for obesity, and inability to read and understand English. Concurrent treatment for depression or emotional eating were not exclusion criteria.

Procedures

The study was approved by the University of Minnesota Institutional Review Board. A phone screen was conducted to assess initial study eligibility. Participants then attended an informational session at the research facility at which they provided written informed consent, completed in-person assessments to ensure study eligibility, and were trained in how to use the handheld computer for the EMA protocol. The eating disorders module of the Structured Clinical Interview for DSM-IV Axis I Disorders/Patient Edition (SCID-I/P)¹⁸ was used to diagnose current or lifetime eating disorders, including BED.

Participants were instructed to complete EMA recordings of affect and eating behavior each time they initiated and completed an eating episode; before bedtime; and after 6 semi-random prompts by investigators, which occurred every 2–3 hours between 8:00am and 10:00pm. Each participant completed a two-day trial period to ensure understanding of EMA procedures; all 50 participants completed the trial period, although trial data were not included in the analyses. After training, participants were instructed to complete EMA recordings for the next two weeks. During this assessment period, participants attended two in-person visits during which data from the handheld computer were uploaded and monitored for compliance, and research coordinators provided feedback to participants about the quality of the data. Participants received \$150 for completing the two-week assessment period and an additional \$50 for completing at least 90% of assessments within 45 minutes of semi-random prompts.

Measures

The Beck Depression Inventory-II (BDI-II)¹⁹ was completed at baseline to assess depressive symptoms. The BDI-II has good reliability and validity²⁰ and corresponds relatively well to clinical diagnoses of mood disorders in obese adults.²¹ Participants were subtyped by presence or absence of depression symptoms according to a BDI-II cutoff of 14, indicating “probable depression.”¹⁹ The BDI has produced a superior subtyping scheme as compared to the SCID in previous studies of depressive symptoms,²² perhaps because the BDI assesses a wider range of negative affect. The Dutch Eating Behavior Questionnaire (DEBQ)²³ emotional eating scale was administered at baseline to measure self-reported tendency to eat in response to affective cues. The scale contains 13 items scored from 1 (never) to 5 (often). The DEBQ is psychometrically sound²³ (current study $\alpha=.94$). The Positive and Negative Affect Scale (PANAS)²⁴ was administered via EMA to assess momentary affect. The Negative Affect scale represents the sum of 11 items (e.g., afraid, upset) rated on a 5-point scale, with a score of “1” indicating “Not at all” and a score of “5” indicating “Extremely” for each affective state ($\alpha=.91$).

Participants recorded the occurrence of all eating episodes on the handheld computers, including the extent to which the episode was characterized by overeating and/or loss of control. Ratings for overeating (“To what extent do you feel that you overate?”) and loss of control (“While you were eating, to what extent did you feel a sense of loss of control?”) were made on a 1- to 5-point Likert-type scale (1=“not at all,” and 5=“extremely”). Episodes in which both overeating and loss of control were present (i.e., a rating of at least 3 on both constructs, corresponding to “moderately”) were classified as binge eating to correspond with DSM-5 criteria.

Statistical Analyses

Data were analyzed using SPSS 19.0. Descriptive analyses were conducted using chi-square and *t*-tests. Differences between participants with and without elevated depressive symptoms on DEBQ-measured emotional eating, EMA-measured frequency of binge eating, and mean daily PANAS-measured negative affect were investigated using ANCOVA, adjusting for

BMI (results were the same when BMI was not included as a covariate). Levels of PANAS-measured negative affect prior to self-reported non-binge and binge eating episodes were examined using multilevel modeling with linear functions centered on the time of the behavior. Mixed models included a random effect for subject, and fixed effects for group (elevated vs. non-elevated depression symptoms), BMI, mean daily PANAS-measured negative affect, time in relation to the event (linear component), and group-by-time. On days in which multiple binges occurred, only the first event was analyzed to minimize the possibility that affect surrounding the behavior was associated with the occurrence of additional behavior.

Two mediation models were examined. For both models, depressive symptom status (elevated vs. non-elevated) was the independent variable and BMI was the dependent variable. Separate models examined DEBQ-reported emotional eating and EMA-reported weekly binge eating frequency as mediators. Bootstrapping methods with $k=1,000$ re-samples and 95% bias-corrected confidence intervals (CIs) were used to evaluate indirect effects.²⁵ Mediation was considered to have occurred if the 95% CIs for the indirect effect generated by the bootstrapping method did not contain zero.

Due to the largely female sample, we re-ran the analyses on women only. The pattern of results was the same except that participants with and without elevated depression symptoms no longer differed on DEBQ-measured emotional eating ($p=.14$; Cohen's $d=2.36$). The results reported henceforth are based on analyses including both men and women.

RESULTS

Descriptive characteristics

Participants with (DEP; $n=15$) and without elevated depression symptoms (CON; $n=35$) were equivalent in terms of age, race/ethnicity, gender, and likelihood of being diagnosed with BED ($p>.09$). DEP participants had a significantly greater mean BMI than CON participants [$t(50)=2.3$; $p=.03$; see Table 1].

Participants completed, on average, 13.9 ($SD=2.5$) days of EMA recordings, including 68.5 ($SD=26.0$) recordings prior to or subsequent to eating, over the two-week study period. Participants reported an average of 1.8 ($SD=1.8$) binge eating episodes per week during the protocol (range=0–6.4), and 80% reported at least one episode. There was 80.8% compliance to responding to semi-random signals within 45 minutes and completing end-of-day recordings. A total of 92% of participants completed the two-week protocol, with the remaining 8% terminating early due to personal circumstances or perceived burden of completing EMA recordings. Both drop-outs were in the CON group. These participants were included in all study analyses.

Affect and eating behavior

DEBQ emotional eating and EMA-recorded binge eating were highly correlated ($r=.59$; $p<.001$). Relative to CON, DEP participants reported greater DEBQ-measured emotional eating [$F(1,50)=4.3$; $p=.04$] and more frequent binge eating on EMA recordings (Wald chi-square=13.8; $p<.001$). DEP participants reported greater average levels of daily negative affect on EMA recordings than CON (Wald chi-square=7.7; $p=.005$). DEP and CON participants did not differ with respect to negative affect prior to non-binge (linear estimate=0.0; $SE=0.2$; $p=.89$) or binge eating episodes (linear estimate=0.0; $SE=0.4$; $p=.92$; see Table 1).

Mediation analyses

DEBQ-measured emotional eating tendencies mediated the relation between depressive symptom status and BMI (indirect effect estimate=3.79; 95% CI=1.02–7.46; see Table 2). Conversely, binge eating frequency was not a significant mediator (indirect effect estimate=4.05; 95% CI=-0.33–9.25).

DISCUSSION

The current study examined daily affect and eating behavior among obese adults with and without comorbid depression symptoms. Mean levels of emotional eating were comparable to previous studies in obese samples (e.g.,²⁶). Relative to obese controls, participants with elevated depressive symptomatology reported more binge eating and greater tendencies to eat in response to negative emotions, although these latter findings were not supported using EMA methodology; similar inconsistencies between self-report and EMA data have been previously documented in the eating and weight disorders literature²⁷ and may be related to demand characteristics. In the full sample, emotional eating mediated the relation between depression symptoms and BMI. These findings may explain the reciprocal prospective relations among depression and obesity:²⁸ recurrent binge eating or emotional eating may be related to the onset or maintenance of obesity, which may in turn exacerbate depression symptoms. Future studies should aim to disentangle the temporal order of depression symptoms, obesity, and affect-driven eating behavior in order to inform intervention efforts.

Participants with increased depressive symptomatology reported greater mean daily negative affect than controls. This finding is consistent with the existing literature on mood disorders¹⁷ and suggests that eating behavior in depressed adults with obesity may occur against a general backdrop of overall aversive mood. Persistent low mood may promote the use of eating to alleviate distress, although further research is necessary to identify markers for this tendency. Additional research is also needed to better understand antecedents of negative affect, as well as whether specific affective patterns precipitate problematic eating episodes in obese individuals with depressive symptoms.

Consistent with previous studies, emotional eating was found to mediate the relation between depressive symptom status and BMI.¹² Thus, one pathway between depressed mood and elevated weight status may involve emotional eating, although further prospective studies are needed. In contrast, binge eating was not found to be a significant mediator, perhaps because its frequency was relatively low in the full sample. Emotional eating is more common in obese individuals than recurrent binge eating,¹¹ and thus may represent a more common mechanism for explaining weight gain and/or excess weight status in obesity. This may be due to under-reporting of binge eating symptoms relative to emotional eating symptoms, as obese adults may perceive emotional eating to be more socially acceptable than binge eating involving loss of control. However, it may be that other factors besides negative affect (depression symptoms in particular) drive binge eating in relation to weight gain and obesity in individuals with elevated depressive symptomatology (e.g., hunger). Alternatively, depressed individuals may tend to “numb out” in relation to binge eating due to concurrent alexithymia,¹¹ and thus lack the emotional awareness to label their emotions during binge eating episodes. These hypotheses would be consistent with our findings that negative affect did not precede binge eating in the current study and should be explored further.

Emotional eating and binge eating may be important clinical targets when treating depressive symptoms in obese individuals. Simultaneously, weight loss treatments may require tailoring for those with comorbid depression symptoms. Clinicians should carefully assess eating patterns in obese patients presenting with depressive symptoms, as persistent

eating in response to negative affect and the potential for concomitant weight gain could worsen existing depression symptoms. Interventions for obesity and depression symptoms both have been shown to reduce bulimic symptoms,^{29,30} even when not explicitly focused on binge eating; similarly, weight loss treatment often positively impacts depression symptoms even when not directly targeting these symptoms.³¹ Thus, it may not be necessary to directly address emotional/binge eating and mood-related symptoms when treating comorbid depression and obesity. However, for some patients, introducing healthier coping skills for managing negative emotions may be beneficial in reducing negative affect and minimizing or reversing weight gain.

Study strengths included the use of EMA to characterize eating behavior, which allowed us to temporally examine affective precursors to eating in the natural environment. Moreover, the community-based sample enhances study generalizability. Our high retention and completion rates reflect the acceptability of EMA methodology to examine affect and eating behavior in obese individuals. Qualitative participant feedback indicates that while the handheld computers were somewhat onerous, offering financial incentives for completing EMA recordings enhanced compliance, all of which could be used to improve future studies (e.g., using Smartphone devices).

Nevertheless, several limitations should be noted. The sample was relatively small and restricted to severely obese adults who were primarily Caucasian and female, which may limit the generalizability of our findings, particularly to obese males. Participants were not excluded on the basis of concurrent depression or emotional eating treatment, which could have biased our results. Although the BDI is a well-validated measure of current depressive symptoms,²⁰ clinical diagnoses of current or lifetime depression were not available and it is thus unknown if results can be generalized to individuals with a DSM-5 diagnosis of a mood disorder.²¹ Relatedly, there was no measurement of personality variables, and it is possible that the constellation of increased depression symptoms and emotional eating/binge eating reflects an underlying construct such as neuroticism, which may manifest in a tendency to over-report psychosomatic complaints.³² Binge eating was self-reported and may not correspond to DSM-5-defined binge eating as assessed by clinical interview. Finally, directionality regarding the onset of depression symptoms, obesity, and specific eating patterns could not be established.

The current findings indicate that emotional eating and binge eating are reported by a subset of obese adults with elevated depression symptoms, and thus may have an important role in the maintenance of obesity and/or depression in this population. Future studies should clarify causal relations among obesity, depression, and emotional eating to optimally inform intervention efforts. Treatments for obesity and/or depression should consider how specific eating patterns may maintain or exacerbate both conditions.

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Table 1

Full sample characteristics and comparisons of participants with and without elevated depression symptoms on demographic and psychosocial variables¹

Variable	Full Sample (N=50)	DEP (n=15)	CON (n=35)	Test Statistic for DEP vs. CON Comparison	Effect Size
<i>Demographic variables</i>					
Age, y	M=43.0; SD=11.9	M=41.1; SD=11.9	M=43.8; SD=11.9	$t(50)=-0.74$; $p=.46$	Cohen's $d=-.23$
Body mass index, kg/m ²	M=40.32; SD=8.51	M=45.47; SD=11.81	M=38.11; SD=5.50	$t(50)=2.31$; $p=.03$	Cohen's $d=.93$
Sex, % female (n)	84.0 (42)	100.0 (15)	77.1 (27)	Fisher's exact, $p=.09$	Odds ratio=1.56
White	76.0 (38)	60.0 (9)	82.9 (29)		
Race, % (n)				Fisher's exact, $p=.15$	Odds ratio=3.22
Other	24.0 (12)	40.0 (6)	17.1 (6)		
<i>Psychosocial variables</i>					
DEBQ Emotional Eating Scale	M=3.2; SE=0.1	M=3.5; SE=0.2	M=2.9; SE=0.2	$F(2,50)=4.31$; $p=.04$	Cohen's $d=1.05$
SCID-I/P diagnosis of binge eating disorder, % (n)	10 (5)	5.7 (2)	20 (3)	Fisher's exact, $p=.15$	Odds ratio=4.13
EMA binge eating frequency	M=0.6; SE=0.1	M=1.1; SE=0.2	M=0.4; SE=0.1	Wald chi-square=13.75; $p<.001$	Cohen's $d=5.56$
PANAS daily negative affect	M=16.4; SE=0.8	M=18.8; SE=1.4	M=14.0; SE=0.9	Wald chi-square=7.72; $p=.005$	Cohen's $d=4.69$
PANAS negative affect prior to non-binge eating episodes	M=13.7; SE=0.8	M=13.9; SE=0.1	M=14.0; SE=0.1	linear estimate=0.0; SE=0.2; $p=.89$	Cohen's $d=3.85$
PANAS negative affect prior to binge eating episodes	M=18.8; SE=0.2	M=18.7; SE=0.3	M=18.8; SE=0.3	linear estimate=0.0; SE=0.4; $p=.92$	Cohen's $d=3.06$

¹ DEP=participants with elevated depression symptoms; CON=participants without elevated depression symptoms; DEBQ=Dutch Eating Behavior Questionnaire; SCID-I/P=Structured Clinical Interview for DSM-IV Axis I Disorders/Patient Edition; EMA=ecological momentary assessment; PANAS=Positive and Negative Affect Scale

Table 2

Summary of mediation results

Independent variable (IV)	Mediating variable (MV)	Dependent variable (DV)	Effect of IV on MV (a)	Effect of MV on DV (b)	Direct effect (c')	Indirect effect (a b)	Total effects (c)
Depressive symptom status	Emotional eating	Body mass index	1.03 (SE=0.30) *	3.70 (SE=1.05) *	3.58 (SE=2.44)	3.79 (SE=1.60) *	7.36 (SE=2.43) *
Depressive symptom status	Binge eating	Body mass index	2.41 (SE=0.43) *	1.68 (SE=0.79) *	3.32 (SE=3.02)	4.05 (SE=2.30)	7.36 (SE=2.43) *

* $p < .05$