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Factor structure and clinical utility of the Beck Depression Inventory in patients with binge eating disorder and obesity

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ABSTRACT

Objective: The Beck Depression Inventory (BDI) is often used to assess depression symptoms, but its factor structure and its clinical utility have not been evaluated in patients with binge eating disorder (BED) and obesity.
Methods: A total of 882 treatment-seeking obese patients with BED were administered structured interviews (Structured Clinical Interview for *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* Axis I Disorders) and completed self-report questionnaires.
Results: Exploratory and confirmatory factor analyses supported a brief 16-item BDI version with a three-factor structure (affective, attitudinal and somatic). Both 21- and 16-item versions showed excellent internal consistency (both α=0.89) and had significant correlation patterns with different aspects of eating disorder psychopathology; three factors showed significant but variable associations with eating disorder psychopathology. Area under the curves (AUC) for both BDI versions were significant in predicting major depressive disorder (MDD; AUC=0.773 [16-item], 73.5% sensitivity/70.2% specificity, AUC=0.769 [21-item], 79.5% sensitivity/64.1% specificity) and mood disorders (AUC=0.763 [16-item], 67.1% sensitivity/71.5% specificity, AUC=0.769 [21-item], 84.2% sensitivity/55.7% specificity). The 21-item BDI (cutoff score $\geq$16) showed higher negative predictive values (94.0% vs. 93.0% [MDD]; 92.4% vs. 88.3% [mood disorders]) than the brief 16-item BDI (cutoff score $\geq$13).
Conclusions: Both BDI versions demonstrated moderate performance as a screening instrument for MDD/mood disorders in obese patients with BED. Advantages and disadvantages for both versions are discussed. A three-factor structure has potential to inform the conceptualization of depression features.

1. Introduction

Binge eating disorder (BED), now a formal eating disorder category in the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*), *Fifth Edition* [1], is defined by regular binge eating (eating large quantities of food while experiencing a subjective sense of loss of control), marked distress about the binge eating and the absence of extreme weight compensatory behaviors that define bulimia nervosa. BED is prevalent (estimated as 2.6% in the United States) [2] and associated strongly with obesity [3]. BED is also associated with heightened biopsychosocial problems and high rates of psychiatric comorbidity [2–4].

Increased risk for psychiatric comorbidity, particularly mood disorders, has been found for obesity [5] and for BED [2,3]. Individuals with obesity and BED are significantly more likely to have comorbid mood disorders, other psychiatric disorders [6,7] and medical problems [6] than individuals with obesity without BED. Current mood disorders overall and major depressive disorder (MDD) are generally reported to be found in roughly 20% of patients with BED [4,8]. The presence of mood disorders and of elevated depressed levels are both associated with more severe BED symptoms [4,9]. Depression has also been associated with poorer weight loss outcomes after lifestyle modifications [8,10] and bariatric surgery [10,11] and with BED outcomes [12], although some have reported no association [13–15]. Some have also suggested that depression symptoms may mediate the relationship between BED and weight loss [16,17]. Thus, proper screening and identification of mood disorders is important for treatment formulation and intervention for persons with obesity and persons with BED.

Self-report measures of depression symptoms are often used as a quick screening tool. The Beck Depression Inventory (BDI; revised in 1987 as the BDI-1A) [18,19] remains a widely used measure of depressive symptoms and features in the mental health and obesity fields, including the major Look AHEAD study [20]. The BDI was originally designed as a unidimensional measure, but factor analyses with healthy and medical samples have suggested multifactor structure with great variations in items representing the factors (see Ref. [21], for a review). The reliability and validity of BDI in assessing depression symptoms and discriminating clinical depression has been well-established in normal and psychiatric populations although there is some variability in the factor structure across psychiatric samples [21]. However, the psychometric properties and validity of the BDI in populations with other medical conditions, including obesity, have been questioned due to difficulties disentangling

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true depression symptoms from somatic symptoms associated with medical conditions [22,23]. This issue seems especially important in the case of BED — a psychiatric disorder associated strongly with obesity.

We are unaware of any psychometric studies of the BDI in BED, but there are relevant recent studies with severely obese patients. Hayden et al. performed confirmatory factor analyses on BDI data from 285 bariatric surgery candidates testing five different factor solutions reported in the literature for various samples [24]. This study supported 2 three-factor models; one model consisted of three factors labeled negative self-attitudes, negative mood and performance impairment, and another, with negative self-attitudes, negative mood and somatic concerns. The clinical utility of the BDI as a screening measure for mood disorders has also been supported in bariatric surgery candidates with some variation in cutoff score [25,26] but noted that it significantly overestimated the potential presence of mood disorders.

To our knowledge, the factor structure and clinical utility of BDI has not yet been tested in obese patients with BED despite the clinical relevance reviewed above (i.e., high comorbidity rates between BED and mood disorders and heightened severity of BED associated with mood disturbances). Thus, the present study had three aims. First, the study evaluated the factor structure of BDI in treatment-seeking obese patients with BED using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to test and validate it in the other half of the study group. Second, the study evaluated the criterion-related validity of the identified structure in addition to the original 21-item structure. Third, the study assessed the performance of the BDI for identifying current mood disorders and MDD against the criterion standard of diagnoses generated independently using semistructured diagnostic interviews.

2. Method

2.1. Participants

Participants were 882 treatment-seeking obese (body mass index [BMI]≥30 kg/m^2) patients with *DSM*, *Fourth Edition* (*DSM-IV*), *Text Revision* [27] BED. Participants were respondents to media advertisements for treatment studies at a university-based medical school in an urban center. Exclusion criteria included the following: current treatments for eating/weight disorders (including current antidepressant medication), severe psychiatric problems (lifetime bipolar disorders and schizophrenia as well as current substance dependence), severe medical problems (e.g., cardiac and liver diseases) and uncontrolled hypertension, thyroid conditions or diabetes. Mean BMI was 38.2 (S.D.=6.5) (based on measured height and weight using a high-capacity digital scale). Participants' mean age was 45.0 (S.D.=10.3) years, and racial/ethnic composition was 63.1% Caucasian, 22.5% African American and 14.4% Hispanic/other; 18.5% completed high school, 34.6% attended some college and 45.5% completed college. Written informed consent was obtained from participants and the research was approved by the Yale Human Investigation Committee.

2.2. Assessment and measures

Participants were assessed by doctoral-level research clinicians who were trained and 'certified' by C.M.G. in axis I psychiatric disorder classification, differential diagnosis, eating disorder psychopathology and specific nature and clinical administration of the research assessment interviews. Assessors received on-going supervision and were monitored (e.g., taped) throughout the study to prevent interviewer and diagnostic drift.

The Structured Clinical Interview for *DSM-IV* Axis I Disorders (SCID-I/P) [28] was used to assess axis I psychiatric disorders, including BED and nonbipolar mood disorders (MDD, dysthymic disorder and depressive disorder not otherwise specified [NOS]) — which were the focus of this study. Kappa coefficients for MDD and for other mood disorders were 0.80 and 0.76, respectively.

The Eating Disorder Examination (EDE) interview [29] was used to assess eating disorder psychopathology and to confirm the BED diagnosis. The EDE interview assesses eating disorder psychopathology with a focus on the previous 28 days, except for diagnostic items that are rated for the *DSM*-based duration stipulations. The EDE assesses the frequency of different forms of overeating, including objective bulimic episodes (OBE; i.e., binge eating defined as unusually large quantities of food coupled with a subjective sense of loss of control), which corresponds to the *DSM*-based definition of binge eating. The EDE also comprises four subscales: Restraint, Eating Concern, Shape Concern and Weight Concern. Questions related to these four scales were rated on a 7-point scale (0–6 range), with higher scores reflecting greater severity or frequency. An EDE global score was calculated as the mean of the four scales. The EDE interview is a well-established measure [30] with good interrater and test–retest reliability in studies with BED [31]. Based on 71 subjects, spearman rho coefficient was 0.94 for OBE frequency and .91 for EDE global (range .73 to .93 for the EDE scales).

The BDI (BDI-1A) [18,19] is a 21-item self-report measure of depression symptoms and levels. Respondents rate the 21 questions regarding severity of depression symptoms for the past week on a 4-point scale (0–3). Although the BDI was further modified (BDI-II) in 1996, the BDI (BDI-1A version revised in 1987) remains a widely used measure of depression symptoms and levels given with its demonstrated reliability and validity across many clinical and nonclinical adult groups [21]. The two versions perform well psychometrically and generally converge [32,33]. The BDI (1A) is the depression measure used in the major Look AHEAD obesity study [20] and across clinical [21] and treatment studies of BED [34–36].

2.3. Analysis

First, with randomly split half of the sample, EFA was completed for one- to four-factor structures (n=441). Next, using the second half of the sample (n=441), CFA was performed to validate the factor structure identified through EFA. Factor analyses were performed using the Mplus version 7 [37]. For both EFA and CFA, a weighted least-squared means and variance-adjusted estimator was used because it is suitable for ordinal data [38]. For EFA, a geomin oblique rotation was used, which is a default option in the Mplus. EFA and CFA model fits were evaluated based on the following fit indices: the comparative fit index (CFI; ≥0.95), the Tucker–Lewis index (TLI; ≥0.95), the root mean square error of approximation (RMSEA; ≤0.05) and the standardized root mean square residual (SRMR) for EFA (≤0.07) or the weighted root mean square residual for CFA (WRMR; ≤1.00) [39]. As alternative competing models, the identified model was also compared with the 2 three-factor models with bariatric surgery candidates showing good-fit statistics in the Hayden et al. [24] study. This analysis was completed to evaluate the similarity and differences in the factor structure of the BDI across between treatment-seeking individuals with comorbid BED and obesity and bariatric surgery candidates.

The criterion-related validity of the identified subscales were then examined through correlation analysis between BDI and eating disorder features, as well as comparison of BDI scores between those with current MDD vs. no current MDD and between current any mood disorder vs. no current mood disorder. These analyses were completed by the Statistical Analysis System (SAS) (release 9.3, 2002–2010, SAS Institute). Finally, using the receiver operating characteristics (ROC) analysis, we evaluated the accuracy of BDI as a diagnostic tool for MDD and mood disorder in the participants. The area under the curve (AUC) is a measure of the accuracy of the test, suggested as small (0.5<AUC≤0.7), moderate (0.7<AUC≤0.9) and high (0.9<AUC≤1) [40]. The sensitivity, specificity, positive predictive value (PPV; the percentage of truly depressed out of those identified as being depressed) and negative predictive value (NPV; the percentage of those truly nondepressed out of those identified as nondepressed) were calculated for criterion-related validity. The optimal cutoff score was determined by maximizing Youden index (Y^b=sensitivity+specificity−