RESEARCH ARTICLE

Predictors of Outcome for Cognitive Behaviour Therapy in Binge Eating Disorder

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Abstract

The aim of this naturalistic study was to identify pretreatment predictors of response to cognitive behaviour therapy in treatment-seeking patients with binge eating disorder (BED; $N = 304$). Furthermore, we examined end-of-treatment factors that predict treatment outcome 6 months later ($N = 190$). We assessed eating disorder psychopathology, general psychopathology, personality characteristics and demographic variables using self-report questionnaires. Treatment outcome was measured using the bulimia subscale of the Eating Disorder Inventory 1. Predictors were determined using hierarchical linear regression analyses. Several variables significantly predicted outcome, four of which were found to be both baseline predictors of treatment outcome and end-of-treatment predictors of follow-up: Higher levels of drive for thinness, higher levels of interoceptive awareness, lower levels of binge eating pathology and, in women, lower levels of body dissatisfaction predicted better outcome in the short and longer term. Based on these results, several suggestions are made to improve treatment outcome for BED patients. Copyright © 2015 John Wiley & Sons, Ltd and Eating Disorders Association.

Introduction

Binge eating disorder (BED) is characterised by recurrent episodes of uncontrollable overeating without the use of regular, inappropriate compensatory behaviours that are typical for bulimia nervosa (BN; American Psychiatric Association, 1994, 2013). Prevalence rates, based on Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV criteria, vary across studies, ranging from 1% to 6.6% in the general population (Grucza, Przybeck, & Cloninger, 2007; Hoek & Van Hoeken, 2003; Preti et al., 2009). Among people applying for weight loss treatment, prevalence rates are as high as 30% (Niego, Kofman, Wiess, & Geliebter, 2007; Spitzer et al., 1993). BED is frequently associated with obesity. About 70% of BED patients suffer from obesity with a body mass index (BMI) between 30 and 40, whereas about 20% suffer from morbid obesity with a BMI equal to or over 40 (Grucza et al., 2007). Although BED and obesity are associated, individuals with BED differ distinctively from obese people who do not binge. For instance, they report higher calorie intake in non-binge meals, more concerns about shape and weight, more psychiatric problems and lower overall quality of life than obese people without BED (Ahrberg, Trojca, Nasrawi, & Vocks, 2011; Grucza et al., 2007; Rieger, Wilfley, Stein, Marino, & Crow, 2005; Telch & Stice, 1998; Wilfley, Wilson, & Agras, 2003; Yanovski, Nelson, Dubbert, & Spitzer, 1993).

Interpersonal psychotherapy, dialectical behaviour therapy and cognitive behaviour therapy (CBT) have all been shown to reduce binge eating substantially, with the latter currently being the treatment of choice for BED (National Institute of Clinical Excellence, 2004; Yager et al., 2012). Abstinence rates for CBT vary across studies and range from 17% to 79% of patients at post-treatment, range from 21% to 59% 1 year after treatment and were found to be 36% 3 years after treatment (Grilo, Masheb, Wilson, Gueorguieva, & White, 2011; Peterson, Mitchell, Crow, Crosby, & Wonderlich, 2009; Ricca et al., 2010; Wilfley et al., 2002). The positive effects of CBT extend to overconcern with eating, weight and shape and to psychosocial functioning, but CBT does not lead to substantial weight loss (Brownley, Berkman, Sedway, Lohr, & Bulik, 2007; Vocks et al., 2010; Wilson, Grilo, & Vitousek, 2007; Wilson, Wilfley,

Agras, & Bryson, 2010). Considering the fact that a substantial number of patients do not reach abstinence from binge eating, it is important to establish predictors of treatment response, as this may lead to more targeted and effective interventions.

Throughout the years, research on predictors of outcome for BED treatment has focussed on the domains of eating disorder pathology, clinical characteristics and demographic variables. Several recent findings on predictors related to eating disorder pathology indicate that higher baseline levels of both self-reported binge eating frequency and eating disorder psychopathology, as conceptualised by the global Eating Disorder Examination (Questionnaire) score, predict more eating disorder pathology at post-treatment and at longer-term follow-up (Castellini et al., 2011; Grilo, Masheb, & Crosby, 2012; Masheb & Grilo, 2008; Thompson-Brenner et al., 2013). However, binge eating frequency at baseline does not predict a diagnostic full recovery (Ricca et al., 2010). In addition, a higher baseline level of body dissatisfaction (i.e. shape and weight concerns) predicts less remission from binge eating after treatment (Grilo et al., 2012; Hilbert et al., 2007), and higher pretreatment levels of body dissatisfaction predict BED outcome at the 12-year follow-up (Fichter, Quadflieg, & Hedlund, 2008). The reduction of eating disorder-related pathology to within normal range at post-treatment is the best predictor of recovery at follow-up (Lock et al., 2013). Some evidence suggests that other predictors related to eating disorder pathology, such as high baseline levels of emotional eating and BMI, predict a poorer treatment outcome (Fichter et al., 2008; Ricca et al., 2010; Thompson-Brenner et al., 2013). The difference between one's current body weight and highest adult body weight, however, is not predictive of percentage reduction in binge eating episodes, nor does it predict abstinence from binge eating (Zunker et al., 2011).

Some research on predictors related to clinical characteristics suggests that lower self-esteem and more interpersonal problems at baseline predict more eating disorder pathology at post-treatment (Hilbert et al., 2007; Wilson et al., 2010). Whereas some studies suggest that depression levels predict remission from binge eating (Wilson et al., 2010) and that more negative affect leads to more eating disorder psychopathology (Masheb & Grilo, 2008), other studies do not show such a relationship (Grilo et al., 2012; Ricca et al., 2010). Furthermore, data on concomitant Axes I and II classifications are mixed. In some studies, comorbidity on Axis I (i.e. depression) was found to be a predictor for less remission of binge eating in the longer term (Castellini et al., 2011; Fichter et al., 2008; Wilson et al., 2010), and the presence of personality disorders, particularly cluster C, predicted more post-treatment eating disorder psychopathology (Masheb & Grilo, 2008). In other studies however, no predictive value was found for any Axis I or II disorder (Grilo et al., 2012; Ricca et al., 2010).

The evidence on predictors related to demographic variables is also mixed. Older age of BED *onset* predicted less eating disorder pathology (i.e. remission from binge eating) at post-treatment in one study, but not in another (Grilo et al., 2012, and Masheb & Grilo, 2008, respectively). Age at *presentation* for treatment did not predict levels of eating pathology at post-treatment in one study (Masheb & Grilo, 2008), whereas in another study, older age at presentation for treatment predicted greater reduction in objective bulimic episodes and greater rates of cessation of objective bulimic episodes (Thompson-Brenner et al., 2013). When looking at the long term, lower age was associated with full recovery (Castellini et al., 2011). Additionally, in one study, BED patients with less than a college education were more likely to remit from binge eating at post-treatment than patients with a higher education (Grilo et al., 2012). However, when looking at aggregated data of 11 studies, a lower level of education (less than high school) predicted more objective bulimic episodes at post-treatment (Thompson-Brenner et al., 2013).

All things considered, the body of recent research on predictors of treatment outcome for BED is limited and partly contradictory. A possible explanation for the mixed findings is the relatively small sample size used in most studies. In addition, studies tend to combine data from different interventions such as guided self-help, behavioural weight loss, CBT group therapy and individual interpersonal psychotherapy for predictor-of-outcome analyses (Masheb & Grilo, 2008; Ricca et al., 2010; Wilson et al., 2010; Zunker et al., 2011). Only a few studies report on the longer-term efficacy of treatment (Castellini et al., 2011; Fichter et al., 2008; Hilbert et al., 2007; Ricca et al., 2010; Wilson et al., 2010; Zunker et al., 2011), and only one study examined the predictive value of end-of-treatment outcomes for longer-term recovery status in BED (Lock et al., 2013). Additionally, the focus of most studies is on methodologically sound but ecologically less valid randomised controlled trials (RCTs). Applied exclusion criteria in RCTs include medical conditions that might influence eating or weight (such as diabetes) and the use of psychotropic medication (such as antidepressants; Grilo et al., 2012; Hilbert et al., 2007; Masheb & Grilo, 2008 ; Ricca et al., 2010; Wilson et al., 2010). However, obese BED patients are known to suffer from depression and diabetes (Finkelstein, Brown, Trogdon, Segel, & Ben-Joseph, 2007; Grilo, White, & Masheb, 2009; Telch & Stice, 1998). A naturalistic design could take these patient groups into account. To our knowledge, only three naturalistic treatment intervention studies have been conducted, with two of these using a large sample size (Castellini et al., 2011; Deumens, Noorthoorn, & Verbraak, 2012; Fichter et al., 2008). The study by Deumens et al. (2012) was conducted at our treatment centre. They examined pretreatment predictors of post-treatment outcome, using a composite score of the subscales drive for thinness, bulimia and interoceptive awareness of the Eating Disorder Inventory (EDI)-1 as outcome measure in 182 BED patients. They found that being in a romantic relationship and/or living with one's parents ('high social embedding') and more openness to experience predicted more improvement at post-treatment. In addition, more depressive symptoms, more agoraphobia and more extraversion were significantly related to less improvement after treatment.

The present study builds on the study by Deumens et al. (2012) using partially the same population. This study, however, differs from the one by Deumens and colleagues by its use of a larger patient sample ($N = 304$ completers), the inclusion of follow-up measures 6 months after treatment and its use of a more specific operationalisation of binge eating pathology as outcome measure (EDI bulimia scale scores instead of the composite score used by Deumens et al.). Specifically, we investigated what factors predict who will benefit from treatment in terms of binge eating pathology and what factors at end of treatment predict outcome at follow-up. In searching for these predictors, we focussed on group CBT for BED in an intensive outpatient treatment environment. Potential predictors were chosen to study seemingly unequivocal findings (levels of eating disorder pathology, body dissatisfaction, BMI and

education) and to study less unequivocal findings (level of psycho-pathology, personality characteristics, age and social embedding).

Method

Participants

Participants were 431 patients (399 women and 32 men), who met DSM-IV (American Psychiatric Association, 1994) research criteria for BED. They were all referred to Amarum, a specialist centre for the treatment of eating disorders in the Netherlands,[1] by their general prac-titioner or another clinician. Information about the diagnosis was gath-ered through different channels. An initial screening on eating disorder complaints was conducted by telephone. Next, patients filled out a personal history questionnaire including questions about eating disorder-related behaviour and psychiatric comorbidity. If applicable, in-formation about former treatments was retrieved. Subsequently, a clinical interview by either a licensed psychologist or a psychiatrist was conducted in which, among other things, the presence of BED was determined and a case formulation was phrased. The case formulation and the DSM-IV classification were then reviewed in a multidisciplinary team.

Exclusion criteria for participating in the treatment programme were concurrent treatment for BED or weight problems (yet those who have undergone bariatric surgery can be included), co-morbid psychiatric conditions that warrant immediate attention (e.g. suicidality and acute psychosis), medical conditions that preclude outpatient treatment, conditions that preclude participation in group treatment (e.g. mental retardation), pregnancy and age below 18 or above 65 years. All participants started treatment between September 2003 and April 2011 and provided written informed consent.

Of these 431 patients, 341 patients (316 women and 25 men) completed their treatment programme. A total of 90 patients dropped out of treatment (83 women and 7 men). Reasons for dropping out were the patient's unilateral belief that he or she had improved sufficiently or in accordance with advice from the therapist because the therapist had doubts about the patient's re-silience or because a comorbid disorder required attention first. For some patients, reasons were unknown.

Of the 341 patients who completed treatment, 304 completed the post-treatment measurement (these patients will be used for post-treatment prediction), and 190 completed the 6-month follow-up measurement (these patients will be used for follow-up prediction).

Of the 304 patients that completed both treatment and measures at post-treatment, mean age at pretreatment was 36.38 (SD = 9.35, range 18–60) years. Mean pretreatment BMI was 41.92 kg/m^2 (SD = 6.90, range 25–66 kg/m^2). Of these patients, 2.0% were over-weight (BMI 25–29.9 kg/m^2), 12.2% were Grade I obese (BMI 30–34.9 kg/m^2), 30.4% were Grade II obese (BMI 35–39.9 kg/m^2) and 55.4% were morbidly obese (BMI 40 kg/m^2 and higher).

Age and BMI distribution for treatment-completing patients that completed follow-up measures were similar to those reported earlier.

Materials

Eating disorder-related measures

The Dutch translation of the EDI-1 was used as a measure for eating disorder psychopathology (Garner, Olmstead, & Polivy,

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[1]Treatment is offered either in Zutphen or in Nijmegen.

1983; Schoemaker, Van Strien, & Van der Staak, 1994). The EDI-1 consists of 64 items concerning psychological and behav-ioural eating disorder symptomatology. Items such as 'I feel ex-tremely guilty after overeating' are answered on a 6-point Likert scale. The EDI-1 consists of eight subscales: drive for thinness (DT), bulimia (B), body dissatisfaction (BD), ineffectiveness (I), perfectionism (P), interpersonal distrust (ID), interoceptive awareness (IA) and maturity fears (MF). Higher scores indicate higher eating disorder psychopathology. The bulimia subscale was used as the measure for binge eating pathology. The reliability and the validity are considered to be good for use in eating disor-der patient groups (e.g. Garner et al., 1983; Van Strien & Ouwens, 2003; Welch, Hall, & Norring, 1990), and internal consistency was found to be good in the present sample (α = .805).

The Dutch version of the Body Attitude Test (BAT) was used to measure subjective body experience and attitude towards one's body (Probst, Vandereycken, Van Coppenolle, & Vanderlinden, 1995). The BAT consists of 20 items such as 'When I compare myself with my peers' bodies, I'm dissatisfied with my own', which are answered on a 6-point Likert scale. The BAT consists of three subscales: negative appreciation of body size, lack of fa-miliarity with one's own body and general body dissatisfaction (and a rest factor). Higher scores indicate a more deviant body ex-perience. The reliability and validity of the BAT are considered to be good (Probst et al., 1995; Probst, Pieters, & Vanderlinden, 2008), and internal consistency was found to be good in the pres-ent sample (α = .755).

General psychopathology

The Dutch version of the Symptom Checklist 90 (SCL-90) was used to measure general psychopathology (Arrindell & Ettema, 2003). The SCL-90 consists of 90 items related to the frequency of experienced physical (e.g. suffering from headache) and psy-chological (e.g. feeling lonely) complaints in the last week, which are answered on a 5-point Likert scale. The SCL-90 comprises eight subscales: agoraphobia, anxiety, depression, somatisation, insufficiency, distrust, hostility and sleeplessness. The items can be summed for a total score indicating a general level of psycho-pathology. Higher scores indicate a higher level of psychopathol-ogy. The reliability and validity of the SCL-90 are good (Arrindell & Ettema, 2003), and internal consistency was found to be excellent in the present sample (α = .974).

The Beck Depression Inventory (BDI) was used to measure levels of depression (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). The BDI consists of 21 questions about the severity of de-pressive complaints in the last week. These questions are an-swered on a scale of 0–3 (e.g. 0: *I do not feel sad*; 1: *I feel sad*; 2: *I am sad all the time and I can't snap out of it*; 3: *I am so sad or un-happy that I can't stand it*). The 21 items are summed for a total score. Higher scores indicate higher levels of depression. The reli-ability and validity of the BDI are good (Beck, Steer, & Garbin, 1988; Bouman, Luteijn, Abersnagel, & Van der Ploeg, 1985), and internal consistency proved to be good in the present sample (α = .857).

Personality

The Dutch version of the Revised Neuroticism–Extraversion–Openness Personality Inventory (NEO-PI-R) was used to assess

personality characteristics (Hoekstra, Ormel, & de Fruyt, 1996; original version by Costa & Widiger, 1994). This questionnaire was added to the test battery in August 2004, resulting in 378 patients filling out the NEO-PI-R at pretreatment. The NEO-PI-R consists of 240 items such as 'I sometimes have wild ideas', which are answered on a 5-point Likert scale. The NEO-PI-R consists of five personality dimensions, each measured with 48 items: extraversion, neuroticism, openness, agreeableness and conscientiousness. Higher scores indicate a higher level of the specific personality dimension. The reliability and validity are considered to be good (e.g. Costa & Widiger, 1994; Hoekstra et al., 1996; Hoekstra, Ormel, & De Fruyt, 2003; Piedmont, 1998).

Background variables

In addition to the aforementioned questionnaires, patients were measured for height and weight (through which we computed their BMI: kg/m^2) and were asked about gender, age, work, marital status, living situation and level of education.[2] We combined marital status and living situation (e.g. living with parents) to calculate social embedding. Those patients that were in a romantic relationship or lived with their parents were rated as having a high social embedding, whereas those patients that did not have a romantic relationship and did not live with their parents were rated as having a low social embedding.

Treatment

Patients were offered 20 days of group therapy, one day per week. One such day consisted of three therapy components of 75 minutes each: discussing daily self-monitoring of eating behaviour, cognitive therapy and psychomotor therapy (a body-oriented and movement-oriented therapy). In addition, weight was monitored weekly. The main objectives of treatment were to help patients regain control over eating (i.e. establish a regular and sufficient eating pattern and stop bingeing), to develop a more realistic body image, to decrease body dissatisfaction and to diminish the influence of shape and weight on self-esteem. These goals were targeted in the different modules with techniques such as psycho education, discussion of registered eating behaviour, identifying triggers for binge eating, challenging thoughts, conducting behavioural experiments, doing mirror exposure, stopping body checking and practising relaxation and awareness exercises. Weekly weighing was introduced to monitor the course of weight and to support the process of diminishing the influence of shape and weight on self-esteem. All patients were actively involved in the different modules, and helpful group dynamics (such as seeking support and exchanging experiences) were stimulated. This intensive outpatient treatment programme was based on the manual developed by Fairburn, Marcus, and Wilson (1993) and was led by a psychologist, a sociotherapist and a psychomotor therapist. Patients were allowed to miss a maximum of 3 out of 20 days. Additionally, six informative group meetings of 90 minutes each were held for patients and their partners. The main objective was to enhance mutual understanding and support during the process of

change. A maximum of nine patients could participate in each round of the 1-day group treatment. The group treatment had a half-open group format: new patients could enter every 10th week.

After treatment had been completed, 99 (out of 304) patients received an additional intervention focussing on maintenance of treatment effect and relapse prevention. Furthermore, 58 (out of 304) patients received extended treatment for the eating disorder with a focus on getting around maintaining factors, and 11 (out of 304) patients received further psychotherapy for psychopathology not related to their eating disorder. These 'additional treatments' were controlled for in the post-treatment prediction analyses (by treating this information as a covariate).

Test procedure

Patients who gave consent to participate in the present study were tested directly before entering the group therapy, on their last day of group therapy and 6 months after completion of treatment. Patients received all questionnaires on each test occasion, with the exception of questions regarding marital status, living situation and level of education (only at pretreatment).

Data analysis

Treatment outcome (binge eating pathology) was defined as the score on the bulimia subscale of the EDI-1 at post-treatment and at 6-month follow-up.

To compare characteristics of treatment completers with treatment dropouts, we performed Student's *t*-tests to test for differences between the two groups on eating disorder psychopathology (EDI-1 and BAT), general psychopathology (SCL-90 and BDI) and personality (NEO-PI-R), BMI and age. χ^2 tests were conducted to test for differences on gender, social embedding, level of education and employment. For the tests described earlier, α was set at .05.

Treatment effects (pretreatment versus post-treatment and post-treatment versus follow-up) were tested using repeated-measures analyses of variance (ANOVAs) with time as the within-subject variable and bulimia scale scores or BMI as the outcome variable. For treatment effects, to correct for multiple testing, α was set at .01.

Pretreatment predictors for post-treatment bulimia scale scores were determined using hierarchical linear regression analysis (using $n = 304$: treatment completers that also completed the post-treatment assessment). Initial predictors were pretreatment bulimia scale scores, the remaining pretreatment EDI subscales and the subscales and total scores of the SCL-90 and the BAT, as well as the NEO-PI-R scales, BDI total score and background variables (gender, age, BMI, social embedding and level of education), which were selected using a backward manual stepwise elimination using $p > .10$. The outcome measure was the post-treatment bulimia scale score.

Similar analyses were conducted to predict follow-up bulimia scale scores based on the post-treatment predictors (using $n = 190$: treatment completers that also completed the follow-up measurement). Missing data were left missing; no data imputations were conducted. For each individual test, listwise deletion was performed, resulting in a somewhat different *n* between tests.

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[2]We also asked for duration of the eating disorder (at pretest, post-test and follow-up). It was found that patients answered this question inconsistently across time points. We therefore excluded this variable from our analyses.

Results

Differences between treatment completers and treatment dropouts

Treatment completers did not differ from treatment non-completers with respect to eating disorder psychopathology or general psychopathology. Some significant differences in personality existed: treatment completers are more agreeable and more conscientious than non-completers. In addition, treatment completers have significantly higher social embedding than non-completers. The groups did not differ on any of the other variables (Table 1).

For the following part, only treatment completers will be considered.

Improvement after treatment

Table 2 shows differences over treatment with respect to bulimia scale scores as well as with respect to BMI. As can be seen, patients improve on both measures. A repeated-measures ANOVA with time (pretreatment/post-treatment) as the within-subject factor

Table 2 Pretreatment and post-treatment means (SD) of EDI bulimia scale scores and BMI for treatment completers

	Pretreatment	Post-treatment
EDI bulimia scale scores*	7.70 (4.286)	2.12 (2.933)
BMI*	41.95 (6.91)	40.85 (7.30)

Note. BMI, body mass index; EDI, Eating Disorder Inventory.
*$p < .010$

and bulimia scale scores as the dependent variable showed that patients' bulimia scale scores significantly decreased during treatment: $F(1, 287) = 582.170$, $p < .01$, $\eta^2 = .670$. The effect size indicates that the decrease in bulimia scale scores was large. A repeated-measures ANOVA with time (pretreatment/post-treatment) as the within-subject factor and BMI as the dependent variable showed that patients' BMI scores significantly decreased during treatment: $F(1, 303) = 53.113$, $p < .01$, $\eta^2 = .149$. The effect size indicates that the decrease in BMI was moderate.

Table 1 Pretreatment means (SD), or percentages where relevant, on eating disorder psychopathology, general psychopathology and personality characteristics for treatment completers and treatment non-completers

	Treatment completers ($n = 341$)	Treatment non-completers ($n = 90$)	Test statistics
EDI total score	68.42 (21.91)	70.86 (21.64)	$t(423) = 0.857$ $p = .351$
BAT total score	67.06 (14.83)	69.60 (12.35)	$t(424) = -1.481$ $p = .139$
SCL-90 total score	187.72 (51.42)	199.37 (59.09)	$t(425) = -1.842$ $p = .066$
BDI-1	18.65 (8.33)	20.32 (9.14)	$t(425) = -1.660$ $p = .098$
NEO-PI-R: neuroticism	163.30 (23.37)	167.42 (19.16)	$t(374) = -1.458$ $p = .146$
NEO-PI-R: extraversion	143.43 (19.69)	142.21 (22.14)	$t(374) = 0.482$ $p = .630$
NEO-PI-R: openness to experience	154.82 (17.35)	156.51 (18.81)	$t(374) = -0.760$ $p = 447$
NEO-PI-R: agreeableness*	174.34 (15.17)	169.59 (15.95)	$t(373) = 2.455$ $p = .015$
NEO-PI-R: conscientiousness*	149.32 (19.01)	144.05 (19.00)	$t(374) = 2.211$ $p = .028$
Gender	92.7% female	92.2% female	$\chi^2(1, N = 431) = 0.021$ $p = .886$
Age	36.79 (9.35)	36.78 (10.33)	$t(427) = 0.011$ $p = .991$
BMI	42.09 (6.95)	42.29 (8.16)	$t(427) = -0.233$ $p = .816$
Social embedding**	24.7% low social embedding	48.9% low social embedding	$\chi^2(1, N = 430) = 19.906$ $p < .01$
Level of education	12.3% low level 49.9% medium level 37.8% high level	8.9% low level 54.4% medium level 36.7% high level	$\chi^2(2, N = 431) = 1.042$ $p = .584$
Employment	74.3% employed 19.5% unemployed 6.2% in college	63.3% employed 25.6% unemployed 11.1% in college	$\chi^2(2, N = 428) = 4.776$ $p = .092$

Note. EDI, Eating Disorder Inventory; BAT, Body Attitude Test; SCL-90, Symptom Checklist 90; BDI, Beck Depression Inventory; NEO-PI-R, Revised Neuroticism–Extraversion–Openness Personality Inventory; BMI, body mass index.
*$p < .05$, **$p < .01$.

Table 3 Final model (and test statistics) for the prediction of post-treatment EDI bulimia scale scores as predicted from pretreatment measures

Model summary ($n = 245$)	$F(8, 237) = 11.693$ $p < .01$ $R^2_{adj} = .259$		
	β	t	p
EDI bulimia scale scores	0.366	5.517	<.01
EDI drive for thinness	−0.119	−1.882	.06
EDI interoceptive awareness	0.126	1.763	.08
EDI ineffectiveness	0.227	2.511	.01
EDI perfectionism	−0.106	−1.807	.07
SCL-90 depression	−0.440	−3.040	<.01
SCL-90 total score	0.505	3.719	<.01
NEO-PI-R extraversion	0.173	2.602	.01

Note. EDI, Eating Disorder Inventory; SCL-90, Symptom Checklist 90; NEO-PI-R, Revised Neuroticism–Extraversion–Openness Personality Inventory.

Prediction of post-treatment bulimia scale scores

A hierarchical linear regression analysis was conducted to determine predictors for the post-treatment level of bulimia scale scores. The following pretreatment variables were entered as predictors, using a backward model building approach: EDI bulimia scale scores, the remaining EDI subscales (BD, DT, I, P, ID, IA and MF) and the subscales and total scores of the SCL-90 and the BAT, as well as the NEO-PI-R subscales, BDI, BMI, social embedding, level of education, gender and age. The final model significantly predicted post-treatment bulimia scale scores and consisted of eight relevant predictors. Pretreatment EDI bulimia, EDI ineffectiveness, SCL-90 total score and NEO-PI-R extraversion were significant positive predictors for post-treatment bulimia scale scores. Furthermore, EDI interoceptive awareness was a marginally significant positive predictor: Lower scores on either of these pretreatment predictors were predictive of lower post-treatment bulimia scale scores. Pretreatment SCL-90 depression was a significant negative predictor for post-treatment bulimia scale scores, and EDI drive for thinness and EDI perfectionism were marginally significant negative predictors: Lower scores on either of these pretreatment predictors were predictive of higher post-treatment bulimia scale scores. See Table 3 for an overview of the final model and for test statistics for both the model and the predictors.[3]

Means, standard deviations and correlations between pretreatment predictors and post-treatment outcome are presented in supplementary tables (Tables S1–S3).

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[3]When repeating the analysis with only female patients ($n = 225$), the EDI ineffectiveness scale no longer reached the predetermined $p < .10$ criterion and was therefore excluded from the final model. Three new predictors did reach the $p < .10$ criterion and were now included in the model: SCL-90 somatic complaints and SCL-90 distrust (both negative predictors) and BAT total score (positive predictor). All other predictors showed results similar to those reported earlier (in the data on men and women).

Prediction of follow-up bulimia scale scores

Improvement after treatment

A repeated-measures ANOVA with time (post-treatment/follow-up) as the within-subject factor and bulimia scale scores as the dependent variable showed that patients' bulimia scale scores did not change between post-treatment and follow-up: $F(1, 179) = 0.322$, $p = .571$. A similar repeated-measures ANOVA with BMI as the dependent variable showed that patients' BMI scores significantly decreased between post-treatment and follow-up: $F(1, 187) = 11.754$, $p < .01$, $\eta^2 = .059$. The effect size of this decrease was weak. See Table 4 for the means and standard deviations.

Post-treatment predictors

A hierarchical linear regression analysis was conducted to determine post-treatment predictors for follow-up level of bulimia scale scores. All predictors were similar to the hierarchical regression analysis reported earlier, with the exception that, this time, post-treatment measures were used as predictors. In addition, social embedding and level of education could not be used as predictors because these were not measured at post-treatment. The final model can be seen in Table 5 and consists of 10 relevant predictors. Post-treatment bulimia scale scores, EDI interoceptive awareness, SCL-90 anxiety, SCL-90 insufficiency and BAT lack of familiarity with one's own body were

Table 4 Post-treatment and follow-up means (SD) of EDI bulimia scale scores and BMI for treatment completers who completed the follow-up measure

	Post-treatment	Follow-up
EDI bulimia scale scores	2.25 (2.918)	2.12 (3.133)
BMI*	41.01 (7.36)	39.90 (8.14)

Note. BMI, body mass index; EDI, Eating Disorder Inventory.
*$p < .01$.

Table 5 Final model (and test statistics) for the prediction of follow-up EDI bulimia scale scores as predicted from post-treatment measures

Model summary ($n = 158$)	$F(10, 148) = 11.682$ $p < .01$ $R^2_{adj} = .403$		
	β	t	p
EDI bulimia scale scores	0.375	4.654	<.01
EDI drive for thinness	−0.195	−2.360	.02
EDI interoceptive awareness	0.204	2.405	.02
SCL-90 anxiety	0.218	2.230	.03
SCL-90 somatic complaints	−0.172	−1.671	.10
SCL-90 insufficiency	0.246	2.299	.02
SCL-90 hostility	−0.186	−2.267	.03
BAT lack of familiarity with one's own body	0.265	2.848	<.01
BMI	−0.105	−1.675	.10
NEO-PI-R conscientiousness	0.139	1.752	.08

Note. EDI, Eating Disorder Inventory; SCL-90, Symptom Checklist 90; BAT, Body Attitude Test; BMI, body mass index; NEO-PI-R, Revised Neuroticism–Extraversion–Openness Personality Inventory.

significant positive predictors for follow-up bulimia scale scores, and NEO-PI-R conscientiousness was a marginally significant positive predictor. Lower scores on these post-treatment predictors were predictive of lower follow-up bulimia scale scores. Post-treatment EDI drive for thinness and SCL-90 hostility were negative predictors for follow-up bulimia scale scores, and SCL-90 somatic complaints and BMI were marginally significant negative predictors. Lower scores on these post-treatment predictors lead to higher follow-up bulimia scale scores.[4,5] See Table 5 for an overview of the final model and for test statistics for both the model and the predictors.

Means, standard deviations and correlations between post-treatment predictors and follow-up outcome are presented in supplementary tables (Tables S4–S6).

Discussion

This study investigated possible baseline predictors of outcome at post-treatment, and end-of-treatment predictors of outcome at follow-up in an intensive outpatient group CBT for BED.

Cognitive behaviour therapy was effective in reducing binge eating pathology (as measured by the bulimia subscale of the EDI), but not in reaching relevant weight loss at post-treatment. Effects stabilised up until 6 months after treatment for binge eating pathology, while BMI showed further improvement, resulting in a weight reduction of more than 3% from pretreatment to follow-up.[6] We found several robust predictors over the two analyses, namely levels of binge eating pathology, drive for thinness and interoceptive awareness. In addition, body dissatisfaction predicted outcome in the short term for women and was an overall post-treatment predictor for follow-up.

Most of our main results are in line with findings in the literature. First, our results support the notion that higher pretreatment levels of eating disorder pathology predict more eating disorder pathology at post-treatment (Masheb & Grilo, 2008; Thompson-Brenner et al., 2013; Wilson et al., 2010). Moreover, more binge eating pathology at the end of treatment predicted worse outcome at follow-up, which seems to be in line with the only study known to us addressing this issue (Lock et al., 2013).

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[4]We also checked whether patients had received additional treatment (either within our clinic or elsewhere). This information was dummy coded and added as a predictor [additional treatment no/yes (0, 1)] in the analysis. This led to exactly the same results, from which we can conclude that additional treatment was not a relevant factor in follow-up outcome.

[5]When repeating the analysis with only female patients ($n = 169$), EDI interoceptive awareness, SCL-90 somatic complaints, SCL-90 hostility and NEO-PI-R conscientiousness no longer reached the predetermined $p < .10$ criterion and were therefore excluded from the final model. One new predictor did reach the $p < .10$ criterion and was therefore included in the model: SCL-90 total score, which was a negative predictor. All other predictors showed results similar to those reported earlier (in the data on men and women).

[6]The average drop in BMI was 2.62% between pretreatment and post-treatment and 4.89% between pretreatment and follow-up. As weight maintenance has been defined as less than 3% weight change, a weight reduction of 3% or more can be considered weight loss. Expert opinion holds that a weight loss of 5–10% of body weight is sufficient to affect health (Stevens, Truesdale, McClain & Cai, 2006).

Secondly, a more disturbed body experience predicted worse outcome in the short term for women. This underlines previous findings showing that higher pretreatment body dissatisfaction predicts more eating disorder pathology after treatment (Grilo et al., 2012; Hilbert et al., 2007). The present study adds to this by showing that lesser familiarity with one's own body at the end of treatment results in more binge eating pathology at follow-up. The fact that body dissatisfaction did not show up as a pretreatment-to-post-treatment predictor in the group as a whole can possibly be explained by the finding that women with BED generally report significantly greater body dissatisfaction than men with BED (Barry, Grilo, & Masheb, 2002; Carano et al., 2006).

Thirdly, more interoceptive awareness at baseline predicted better outcome in the short term and remained a post-treatment predictor for follow-up, which is in line with 12-year follow-up results (Fichter et al., 2008). To our knowledge, this is the first study to address the predictive value of interoceptive awareness in BED shortly after treatment. This could indicate that stimulating patients to be more aware of their inner world, helping them to discriminate between sensations and feelings and between hunger and satiety, helps to overcome binge eating both in the short and long term. It should be noted that replication and studies into the causal relationship are needed.

Besides similarities, differences do exist between our results and what we expected to find. First, BMI at baseline was not predictive of treatment outcome. In fact, our study shows that a higher BMI at post-treatment predicts less binge eating pathology at follow-up. An explanation could be that, contrary to that of Thompson-Brenner et al. (2013), our sample represents patients with a relatively high average BMI (42.25) and consists of about 55% of patients with BMI ≥ 40. Awareness of the risks associated with such morbid obesity can be an extra motivation to address binge eating.

In addition, unlike previous observations (Thompson-Brenner et al., 2013), a low level of education did not predict a positive outcome in the present study. This could indicate that level of education is a less well-established predictor than currently considered. It should, however, be noted that our sample consisted of relatively few low-educated patients, which could have limited the predictive power for education.

Apart from this, our analyses revealed several other interesting findings. First of all, a higher level of drive for thinness at baseline predicted better outcome in the short term and remained a post-treatment predictor for follow-up. This robust finding seems remarkable, as a high drive for thinness among women with lifetime diagnosis of BN has been found to be associated with a decreased likelihood of recovery (Keski-Rahkonen et al., 2013). When looked at more closely, however, the drive for thinness subscale of the EDI is likely to measure something different in BN patients with an average weight within the normal range than in obese BED patients. Firstly, drive for thinness scores are lower in obese BED patients than in BN patients (Brewin, Baggott, Dugard, & Arcelus, 2014; Jordan et al., 2014). Secondly, obese people with and without BED do not differ on drive for thinness (Ramacciotti et al., 2008). Some preoccupation with thinness and with fear of becoming fat in obese BED patients seems to reflect a realistic way of interpreting the risks associated with obesity and can therefore be an extra motivation to stop binge eating.

In addition, higher pretreatment scores on general psychopathology (as measured by the SCL-90 total score) predict more post-treatment binge eating pathology. It is likely that higher general levels of psychopathology at the start interfere with addressing binge eating in treatment. At the same time, however, higher post-treatment scores on general psychopathology predict less binge eating pathology at follow-up in women. We do not currently understand how this relationship can be explained. Future studies should show whether this is a robust finding.

Furthermore, the level of depression (as measured with the BDI) did not predict binge eating pathology even though there was a wide range of depression severity within our sample. At the same time, however, more depressive complaints at baseline (as measured by the subscale depression of the SCL-90, which is highly correlated with the BDI in our sample) did predict lower levels of binge eating pathology at the end of treatment. Our results therefore underline the ambiguous predictive relationship between levels of depression and treatment outcome in BED (Grilo et al., 2012; Masheb & Grilo, 2008; Ricca et al., 2010; Wilson et al., 2010).

Additionally, higher post-treatment scores on insufficiency were found to predict higher follow-up binge eating pathology. Insufficiency, as measured by the SCL-90, relates to thoughts, impulses and problems in the execution of behaviour and focusses on the cognitive domain (Arrindell & Ettema, 2003). There are some, albeit inconclusive, indications that both people with bulimic eating disorders and people with obesity show difficulties in executive functioning (e.g. set shifting, planning and problem solving) as assessed with neuropsychological tests (Fitzpatrick, Gilbert, & Serpell, 2013; Roberts, Tchanturia, Stahl, Southgate, & Treasure, 2007; Van den Eynde et al., 2011). Perhaps obese BED patients could benefit from cognitive remediation therapy as is currently being studied in patients with anorexia nervosa (Tchanturia, Lloyd, & Lang, 2013). Besides insufficiency, lower levels of anxiety and, remarkably, higher levels of hostility at post-treatment predicted better outcome. The same applies to more somatic complaints. One might argue that somatic complaints motivate targeting of binge eating pathology.

Looking at personality characteristics, lower pretreatment levels of ineffectiveness and higher levels of perfectionism predicted better outcome. The same applies to higher pretreatment levels of extraversion. These findings seem to suggest that feeling less ineffective, being more perfectionistic and being more extraverted helps one to engage in the process of change that is required in treatment. Remarkably, higher post-treatment levels of conscientiousness predicted worse outcome at follow-up. This seems to be contradictory to the finding that being more perfectionistic leads to better outcome yet could perhaps be explained by the lack of differentiation of the EDI between self-oriented and socially prescribed perfectionism (Sherry, Hewitt, Besser, McGee, & Flett, 2004).

Lastly, contrary to Deumens et al. (2012), we found no evidence for social embedding, openness (NEO-PI-R), depressive symptoms (BDI) and agoraphobia (SCL-90) as predictors for binge eating pathology. In addition, the predictive value of extraversion (NEO-PI-R) was reversed, and we found predictors that Deumens and colleagues did not find. These differences might be explained by the fact that, although we made use of partly the same sample, we used a larger sample and a more specific outcome measure as operationalisation of binge eating pathology

(EDI bulimia scale scores instead of the composite score used by Deumens et al., 2012).

We have to be careful in translating the present findings to clinical practice, as the causal status of the predictors found has yet to be established. For now, the present results could mean that patients can benefit from an enhanced focus on body dissatisfaction (more specifically, lack of familiarity with one's own body) and interoceptive awareness. Specific techniques such as mirror exposure, mindfulness and bodily awareness exercises can be helpful apart from more traditional cognitive and behavioural techniques. Furthermore, it might be helpful to optimise drive for thinness within the boundaries set by a regular and sufficient eating pattern. This can be performed by giving clear information on both the consequences of (morbid) obesity and the risks of strict dieting. Future research, however, should show whether influencing these factors does actually lead to improvement of treatment outcome.

This study has several limitations. Although we were as precise as possible in our expert-informed assessment procedure, we did not use a standardised diagnostic instrument to confirm BED and comorbid diagnoses. In addition, we did not use BED diagnosis or binge frequency as outcome measures. Moreover, our CBT intervention was broader than the original CBT protocol as developed by Fairburn et al. (1993). These issues possibly limit the generalisability of our conclusions. Several other limitations are consistent with limitations of other prediction studies. Our follow-up was limited to 6 months after treatment, and we did not take into account all potentially relevant predictors that showed up in other studies, such as binge eating frequency, the overvaluation of shape and weight, emotional eating, self-esteem, interpersonal problems and personality disorders. The fact that the sample consisted mainly of female patients might be considered a limitation as it does not reflect the estimated even distribution of BED among men and women (Grucza et al., 2007). This however is commonly seen in treatment-seeking BED samples (e.g. Hilbert et al., 2007; Ricca et al., 2010).

Definite strengths of this study are the large sample size, the naturalistic setting and therefore the possible clinical relevance. In addition, contrary to most prediction studies in eating disorder research, this study used end-of-treatment variables to predict 6-month follow-up. An advantage of this approach is that it not only gives an idea of who can be identified at pretreatment as needing extra attention, but also who needs extra attention during and / or after treatment in order to maintain or further improve treatment outcome in the long term.

In conclusion, we found that those patients that start treatment with higher levels of binge eating pathology do improve but end with higher levels of binge eating pathology. Furthermore, our data suggest that higher levels of drive for thinness, higher levels of interoceptive awareness and, in women, lower levels of body dissatisfaction lead to better treatment outcome in the short and longer term. Future research should look into the potential causal effects of these predictors on treatment outcome.

Acknowledgements

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