Online guided self-help Binge Eating Disorder treatment: Prognostic factors of treatment outcome

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Abstract

Introduction: Relatively little research has assessed predictors of both treatment outcomes and attrition in binge eating disorder (BED) treatment. Even fewer studies did so for digital forms of therapy. This study thus aims to contribute to the current pool of knowledge by examining the predictive value of various variables in a recently developed digital BED-treatment: BED-online.

Methods: This study was part of a RCT into the effects of BED-online therapy. Participants were over the age of 18, Dutch-speaking and diagnosed with the DSM-V BED. A total of 180 participants were found to be eligible, of whom 40 (22.2%) dropped-out before the last session. Post-treatment measurements from an interview (EDE) and a self-report questionnaire (EDE-Q) were used to determine the immediate treatment effects. A follow-up (24 weeks post-treatment) EDE-Q measurement determined the long-term effects. These variables served as the dependent variables in three different hierarchical linear regression analyses. A fourth logistical regression analysis was conducted, where treatment-related drop-out formed the dependent variable. The following eight predictor variables were chosen based on literature research: ethnicity, age, gender, educational level, comorbidity, frequency of binge eating episodes, levels of BED pathology and treatment condition. The predictor variables served as the independent variables.

Results: BED pathology at baseline was found to be the only significant predictor of treatment outcomes as measured by the EDE (β=.41, t=3.71, p<.001), EDE-Q (β=.57, t=8.23, p<.001) and at follow-up (β=.47, t= 6.24, p< .001). Attrition could be predicted by both ethnicity and gender, where males were 5.63 times more likely to discontinue treatment prematurely (*OR*=5.63, *95%CI* [1.81, 17.53]) and participants born abroad were 3.91 times more likely to discontinue treatment (*OR*=3.91, *95%CI* [1.43, 8.76]). Other independent variables did not significantly contribute to the final regression models.

Discussion and conclusion: All predictor variables are discussed in detail, reflecting on the results found and comparing them to findings of previous studies. Limitations are elaborated in depth. Due to these limitations, and the modest number of previous studies, further research is encouraged, exploring both the current and other dependent variables.

Laymans abstract

Binge eating disorder (BED) is an eating disorder that is characterized by frequent episodes of extreme overeating in a short period of time (binge eating episodes). There exist various forms of therapy to treat binge eating disorder, among which a recently developed online therapy called BED-online. In this research, it was examined whether characteristics in patients, that are present before starting treatment, predict how much a patient will benefit from BED-online therapy. Secondly, it was examined whether those same characteristics were able to tell in advance whether a patient is likely to terminate treatment before it is finished.

Based on earlier research into similar therapies, eight different characteristics were selected; ethnicity, age, gender, educational level, the presence of other psychological disorders, the frequency of binge eating episodes, the severity of the BED-related symptoms and whether a patient was put on a waiting list before starting treatment. The influence of these characteristics on treatment outcomes was assessed in various ways. Two different measurements allowed to see the effects directly after treatment, and a third made it possible to assess long-term effects (24 weeks after therapy). We also investigated whether patient characteristics were associated with ending treatment prematurely.

Results show that only the severity of BED-related symptoms before therapy predicted the severity of BED symptoms after therapy. Patients who started with more severe symptoms had more severe symptoms after BED-online therapy. Secondly it was found that men and participants born abroad were more likely to end therapy before completing all sessions.

At the report's conclusion, it is speculated as to why the patient's characteristics were or were not associated with the outcome of treatment. There are some limitations to the current study, which are explained in detail. Because of these limitations, the results of this study should be interpreted with caution. As this study is the first of its kind to examine BED-online, it is advisable to further explore this subject in future research, for which several suggestions are made.

Scientific background

This research investigated predictors of success of BED-online treatment for clients with Binge Eating Disorder (BED). BED is a DSM V (2013) disorder in the feeding and eating disorders category. This disorder is characterized by episodes of binge eating in which clients eat significantly more than others in a short period of time and feel out of control. This is often accompanied by a feeling of shame and guilt. Clients often eat such large quantities, that it causes them to experience physical complaints such as abdominal pain from overeating.

BED-online is a guided self-help therapy provided through the internet designed for clients with BED and is based on a proven effective therapy: "Cognitive Behavior Therapy Enhanced". Therapeutic sessions consist of both online assignments and telephone appointments with a psychologist and last 12 weeks. BED-online aims to provide clients with new insights into the maintaining factors of their binge eating and offer them tools that will provide them with more control over their eating behavior in the future. Furthermore, BED-online teaches clients problem-solving skills, to not evaluate their self-worth and confidence based on appearance or weight and teaches clients to break the cycle of excessive dieting and/or exercising. During treatment therapist and client will work on creating a healthy and balanced eating pattern in which binge eating episodes are reduced. Because the treatment is offered online it is more easily accessible, shorter waiting times can be realized (as a client is able to perform a larger part of the therapy independently, therapists are able to treat a larger caseload of clients, thus decreasing waiting times), and the client has more control over his own treatment and the pace of it. Earlier research into other online BED-treatment approaches in Switzerland showed positive effects (Carrard et al., 2011; Wyssen et al., 2021) and a first Dutch study found that BED-online outperforms treatment effects of a waiting list control (Melisse et al., 2023). These studies showed a reduction in the number of binge episodes, body dissatisfaction and perceived hunger; these effects remained at follow up. Important to note is that in both the study of Carrard et al. (2011) and Wyssen et al. (2021) drop-out rates were higher in the BED-online groups compared to treatment as usual, which is a point of concern. Carrard et al. (2011) found that drop-outs tend to have a stronger desire to be thin and more concerns about their bodily shape compared to treatment completers.

BED-online is a recently developed treatment. There is little research on its effectiveness and even less is known about possible predictors of treatment outcome. A predictor of treatment outcome is a variable that is shown to have a predictive value

concerning the results at the end of treatment. Mapping these predictors is of great importance, since this demonstrates the importance of contextual factors and enables therapists to make informed decisions on whether a therapy will be suitable for their clients. Thus, this research aimed to include many possible predictors based on alleged predictors for success in other treatments of binge eating disorder, often cognitive behavioral therapies provided as in-person treatment. For this research, two types of possible predictors were assessed: demographic and clinical patient variables. For both types of variables, it was assessed whether they held a predictive value on treatment success. Treatment success was hereby defined as a reduction in binge eating pathology after completing BED-online treatment, as measured through the Eating Disorder Examination (EDE) or Eating Disorder Examination Questionnaire (EDE-Q). Furthermore, predictors of drop-out were assessed, as drop-out rates tend to be higher in online treatment compared to traditional treatment forms and the knowledge of variables that cause drop-out in online psychotherapy is limited (Melville et al., 2010). By assessing for predictors of drop-out, it may become apparent that online treatment is not suitable for every patient. Patients who possess characteristics that are related to a high chance of drop-out, could then be offered therapy in physical form. Thus, saving time and money otherwise potentially wasted on an uncompleted therapy, as well as possibly counteract the loss of motivation and confidence patients can experience after unsuccessful treatment. This would be beneficial for both therapist and patient.

Regarding demographic predictors, prior research in the USA has shown that African American participants have higher remission rates, but drop-out rates are also found to be higher among these participants (Thompson-Brenner et al., 2013; Lydecker et al., 2019). The current study does not include participants of African American descent but does entail participants with ethnicities other than Dutch. To our best knowledge, no other studies examining the influence of a non-Dutch ethical background on online BED-treatment have been published to this date. Current findings on age are inconclusive, where research has found that an early age of onset (before the age of 16) is predictive of less treatment success (Saferet al., 2002) and currently older participants are more likely to recover (Grilo et al., 2021). However, other studies reported no predictive effect of age, neither the age at onset nor the current age (Masheb & Grilo, 2008). Concerning gender, one study has found men to experience greater weight loss and less eating disorder pathology over the course of treatment compared to women, although frequencies and reductions in binge eating episodes and the rate of remission did not significantly differ (Lydecker et al., 2019). One study stated that lower education attainment (at GED/ high school level or less) predicts less treatment effect

and a higher frequency of bulimic episodes in BED-therapy (Thompson-Brenner et al., 2013). This study took place in the United States, while the current study took place in the Netherlands, where a different school system is installed. In the Netherlands, the high school level is divided into different sublevels. Translating the American high school levels into a Dutch educational level is difficult, since this depends on a number of factors including grade point average, completion of electives and AP or honor classes (Nuffic, z.d.). This makes that for the most accurate compassion between the two school systems, students are to be assessed on an individual level. The Dutch organization for internationalization of education (NUFFIC), however, stated that generally an American high school certificate can be compared to successfully completing the Dutch HAVO educational level (Nuffic, z.d.). GED is an American state exam for those who have not completed high school and is equal to the Dutch VMBO-t educational level (Nuffic, z.d.). In contrast to the findings described above, another (Dutch) study reported no effect of education level on BED-treatment; however, the sample of lower educated participants was small (Lammers et al., 2015).

Regarding comorbidity, prior research showed that clients who reported to be diagnosed with other psychological disorders (in addition to a primary BED diagnoses) are expected to have worse treatment outcomes than clients with no comorbid disorders (Lammers et al., 2015). Comorbid cluster B personality disorders have specifically been shown to predict higher levels of binge eating pathology at post-test (Wilfley et al., 2000). Patients with mood disorder comorbidity were less likely to experience BED remission and the absence of major depression is associated with treatment success (Lydecker & Grilo, 2021; Dingemans et al., 2020). In this current study, participants with acute depression were excluded. However, those who reported depressive symptoms but did not meet the threshold value for major depression diagnoses were able to participate. Thus, in the present study comorbidity will be assessed and defined as the presence of either a secondary diagnoses of a psychological disorders other than BED, or the presence of three or more depressive symptoms.

Respecting baseline severity, one study has found that higher baseline levels of binge eating pathology predict less treatment effect of CBT for BED, both directly after treatment and at follow-up (Lammers et al., 2015). A study by Peterson et al. (2000) specifies this finding, stating that only the frequency of binge eating episodes and no other BED pathology markers predict treatment outcome. In addition to the alleged predictive effect of the severity of the BED complaints, research also shows high levels of BED pathology are associated with higher levels of drop-out (Von Brachel et al., 2014).

Lastly, although still common in psychological research, some concerns are being raised regarding the use of a waiting list control condition (Cunningham et al., 2013; Mohr et al., 2009). These concerns stem from observing less progress in these participants than would be expected over the waiting period of some studies. This indicates that the waiting list condition appears to influence treatment success. To the best of the researcher's knowledge, no conclusive data concerning the topic has been published thus far.

Thus, based on previous research, it was expected that ethnicity, age, gender, educational level, comorbidity, frequency of binge eating episodes, levels of BED pathology and treatment condition are potential predictors of both treatment success and drop-out.

This research aimed to contribute to the body of knowledge about BED-online by investigating which factors can predict a decrease in BED symptoms and which factors predict a risk of dropping-out. In order to reach this goal, this research investigated a group of subjects who all participated in a BED-online trial (Melisse et al., 2023). By collecting background information and administering questionnaires we gathered information on possible predictors of outcome. By assessing which factors correlate with success or failure of the BED-online treatment, we aimed to learn which factors contribute to the best outcome of treatment. Treatment success was assigned to participants where the binge eating symptoms declined, measured with the EDE-Q (Fairburn & Beglin, 1994) and the EDE (Cooper et al., 1989). The EDE and EDE-Q were both analyzed separately in order to distinguish the self-reported treatment effects formed the observed treatment effects, were the observed effects (EDE) form the primary analyses. The EDE is the primary outcome measure for the primary analyses. Although research shows modest to good agreement between the EDE and EDE-Q, the EDE-Q tends to overestimate the binge eating frequency causing the EDE to be the indicated method for measuring BED pathology (Wilfley et al., 1997). The research question was: which factors predict a decrease in symptoms for BED clients after receiving BED-online therapy. By gathering information about the predictors of success and nonresponse to BED-online, we aim to supply therapists with more knowledge on whether BED-online is a suitable therapy for their client. When a client reports factors that are found to be associated with a higher probability of lesser treatment effects, their therapist will be able to advise and/or decide against starting BED-online and search for a more fitting form of therapy. Thus, this may allow for a more personalized medicine approach, which could help optimize mental healthcare for clients with binge eating disorder.

By also examining the predictors of drop-out we hoped to help therapists to identify patients at risk for dropping-out. This could inform therapists that, given the characteristics of

their patients, special attention is needed to keep patients involved and enrolled in the program. When the therapist does decide in favor of BED-online treatment when potential drop-out risks are present, we hope to aid therapists in adequately monitoring these patients and enable therapists to efficiently deploy additional tools focused on preventing drop-out where necessary. Alternatively, a different form of therapy might be better suited for these patients.

Methods

Design

This research was part of a larger randomized controlled study at Novarum (Melisse et al., 2023). That study aimed to investigate whether BED-online is more effective in reducing eating disorder pathology and increasing binge free days for patients with BED than the control condition. The control condition was a waiting list control, who received the same BED-online treatment as the experimental group after a waiting period of three months. In the current study, pre- and post-test data of the treatment phase of the control condition was merged with the pre- and post-test data of the experimental group. The current study will use this dataset to conduct additional analyses regarding predictors of outcome.

Participants

Participants were at least 18 years old and had a BMI between 19.5 and 40. They all spoke Dutch and met the DSM V diagnosis for a BED. Participants were excluded if they were vomiting, had suicidal ideation, met diagnostic criteria for major depression or psychosis, were pregnant, took medication that may have affected eating behavior or had been treated for BED within the past year. A total of 180 participants were included at the start of the study. 163 participants were female (90,6%) and participants were 19 to 68 years old (M= 39,4; SD=13,1). For their participation in this research and meeting requirements, such as completion of self-report questionnaires, participants received €10, - in gift cards after completing the first 12 weeks, another €10, - after completion of assessments at 24 weeks and €20, - after completing assessments at 36 weeks, making a total of €40, - after completing all assessments of the study.

Sample size

There is no general consensus concerning the minimal required sample size of a hierarchical linear regression analysis. Two widely used guidelines are the those of Stevens (1996) and Tabachnick & Fidell (2013). Stevens states that a threshold of fifteen participants per predictor would suffice, while Tabachnick & Fidell propose a constant of fifty participants should be supplemented with an additional eight participants for every independent variable in the analysis. As the primary analyses composes of eight independent variables and 62 participants, neither of the minimum requirements is met. However, with a total of 140 participants and eight predictors included, the sample size of the secondary analysis sufficed according to both Stevens (1996) and Tabachnick & Fidell (2013). Three participants did not provide follow-up data, but as 137 participants remained in the follow-up analysis no concerns regarding sample size were raised based on both Stevens (1996) and Tabachnick & Fidell (2013) propositions.

Similar to a hierarchical linear regression analysis, there is no generally accepted minimum required sample size for a hierarchical logistic regression analysis. However, concerning logistical regression analyses it is advised to account for a larger sample size as the maximum coefficients are large sample estimates (*Binary Logistic Regression Analysis in SPSS*, 2021). Thus, Leblanc and Fitzgerald (2000) stated that a minimum of 30 participants per independent variable should be maintained, while Field (2013) stated that a study should contain at least 50 participants per predictor. Bujang et al. (2018) proposed a set minimum of 500 participants, or otherwise at least 100 participants with another 50 participants per independent variable. Hosmer et al., (2013) did, however, suggest that 10 subjects per independent variable would suffice, although aiming for a minimum of 20 subjects would be advisable. The current study consists of 178 participants and eight independent variables. This means the requirements of Hosmer et al., (2013) are met, but the sample size is insufficient according to the other suggestions described above.

Predictor variables

In the current study, eight possible predictors were selected based on previous research to form the basis of the analysis, namely; EDE T0, EDE-Q T0, gender, ethnicity, educational level, age, comorbidity, frequency of binge eating episodes (BEE). The operationalization of these variables will be described below. EDE T0 is comprised of the total score of a patient on the Eating Disorder Examination (EDE) at baseline. This aims to represent the true levels of BED pathology before a patient receives treatment.

The EDE-Q T0 predictor had the same aim but utilized the self-reported Eating Disorder Examination Questionnaire (EDE-Q) data to establish the baseline score.

To determine a participant's gender, they were presented with the question “What is your gender?” and could select either male or female.

Ethnicity was determined by the country a participant was born in. A differentiation was made between those who are born within and those born outside of the Netherlands, labeling all countries other than the Netherlands in the latter category.

With respect to educational level, a higher educational level was defined as the successful completion of either a HBO or WO degree, (which is equivalent to either a college or university degree in America) or the successful completion of a HAVO or VWO degree. The latter do not translate well into the American school system but can be viewed as a high school degree with a moderate to high GPA (often including AP- or honor subjects), in which a student is being prepared for education at HBO or WO level, respectively (Nuffic, z.d.). These participants were assigned to the higher education category as most of them were younger than 25 years old, thus it was expected that they would complete either an HBO or WO study in the upcoming years. Other degrees or the absence of one lead to a lower education label.

Participants disclosed their age, which was rounded up to years to form the age predictor.

The condition variable represents the random assignment of participants to either the experimental condition in which the treatment started at baseline, or at the control condition where they received treatment after a three-month waiting period.

Participants were asked to report any psychological complaints other than their eating disorder to assess comorbidity. If they reported at least one other disorder, a comorbid disorder was viewed as present. When participants stated not to experience or to be unaware of other psychological complaints, they received the label ‘no comorbid disorder reported’ unless they reported at least three depressive symptoms (of which at least one the core symptoms) as measured trough the SCID-5-CV. This decision was made as prior research indicated a possible correlation between mood disorders and BED-treatment effects and it was believed those participants do meet the threshold regarding psychological complaints, although not meeting the criteria for a diagnosis (all participants meeting the threshold for a major depressive disorder diagnosis were excluded as this was an exclusion criteria). Thus, participants with depressive symptoms were viewed as having a comorbid disorder.

Frequency of binge eating episodes was measured through a single item of the EDE,

asking the interviewer to report the number of objective binge eating episodes the participant experienced during the 28 days prior to the baseline assessment. An objective binge eating episode was defined, as dictated in the DSM V (2013), by feeling a loss of control over eating an objectively larger quantity of food than is common within a two-hour time period, as perceived by both the patient and interviewer.
An overview of all possible predictor variables mentioned above can be found in Table 1.

Table 1. *Overview of Predictor Variables*

Predictor	Measurement level	Score
EDE T0	Interval	0 - 6
EDE-Q T0	Interval	0 - 6
Gender	Nominal	1.Male
		2. Female
Ethnicity	Nominal	1. Born in the Netherlands
		2. Born abroad
Educational level	Nominal	1. Lower education
		2. Higher education
Age	Ratio	> 18
Condition	Nominal	1. Experimental condition
		2. Control condition
Comorbidity	Nominal	1. Comorbid disorder present
		2. No comorbidity reported
Frequency of BEE	Ratio	> 0

Dependent variables

Concerning the primary analysis, the dependent variable is comprised of the total number of points a participant scored on the EDE measured after treatment (post-EDE), in order to represent true BED pathology levels after receiving BED-online treatment. This included solely the data of participants placed in the experimental condition, as no EDE measurement took place after the control condition finished treatment.

Thus, for the secondary and follow-up analyses, the BED symptoms remaining post-treatment will be represented by the EDE-Q measurement directly after treatment (post-EDE-Q) and after a period of 24 weeks (follow-up EDE-Q), respectively. As participants in the control condition had a waiting list period of 12 weeks, their measurements took place 12 weeks after participants in the experimental condition.

For the drop-out analysis, drop-out was operationalized in a binary fashion, where participants were assigned either to be a drop-out or a treatment completer, based on whether they had completed a post-treatment EDE and/or EDE-Q measurement (treatment completed) or not (drop-out). All participants were asked to report their reason for dropping-out in order to determine the cause of their attrition.

For the fourth analysis (treatment-related drop-out analysis), these causes were assigned to be either circumstantial or treatment-related (see Table 3), where solely treatment-related attrition was viewed as a drop-out. This thus resulted in a binary variable differentiating treatment completers and participants who reported a treatment-related drop-out. Those who reported a circumstantial reason behind their attrition were not included in this analysis.

All dependent variables are listed in Table 2.

Table 2. *Overview of Dependent Variables*

Predictor	Measurement level	Score
Post EDE	Interval	0 - 6
Post EDE-Q	Interval	0 – 6
Follow-up EDE-Q	Interval	0 – 6
Drop-out	Nominal	1. Treatment completed
		2. Drop-out

Treatment-related drop-out	Nominal	1.Treatment completed 2. Treatment-related drop-out

Measures

Outcome measures: The severity of the binge eating pathology will be explored through the EDE and EDE-Q. The EDE is a semi structured clinical interview which is to be assessed by a clinician or trained healthcare professional (Cooper, Cooper & Fairburn, 1989). The EDE includes 35 items and addresses four main topics: dieting, worrying about food, worrying about body shape and worrying about weight. This enables the administrator to assess the presence of overeating behavior as well as extreme dieting behaviors and determine the severity on a 7-point Likert scale (Cooper et al., 1989). The EDE is currently the recommended instrument to assess eating disorders with good internal, concrete and discriminative validity as well as good test-retest and interrater reliability (Melisse et al., 2023; Berg et al., 2011b). The EDE-Q is a self-report questionnaire of 28 items in which participants address their subjective experience on four main topics: dieting, worrying about food, worrying about body shape and worrying about weight (Fairburn & Beglin, 1994). The EDE-Q addresses the frequency of occurrence of these behaviors over the last 28 days and scores them on a 7-point Likert scale; were 0 = 0 days of the past 28 days, going in intervals toward 6 = every day of the past 28 days (Fairburn & Beglin, 1994). Research results show the EDE-Q to have an acceptable test-retest reliability and internal consistency as well as moderate to good discriminative validity, although the construct validity of the four subscales could not be confirmed (Aardoom et al., 2012; Berg et al., 2011b). The post-treatment total score of both the EDE and EDE-Q were used as outcome variables, where the pre-test measurements were included in the predictor variables. For the EDE, post-test measurement was available only for participants of the experimental condition. With regards to the EDE-Q, a 24-week post-treatment measurement took place which was included as an outcome variable as well.

Predictor measures: As described above, the pre-test measures of the EDE and EDE-Q served as predictor variables. Furthermore, the SCID-5-CV was used to check for the presence of depressive symptoms that did not meet the threshold for a diagnosis, since acute depression was an exclusion criterion (First et al., 2016). The SCID-5-CV is a semi structured

clinical interview including 347 questions in which all DSM V syndrome disorders are assessed. The SCID-5-CV can be conducted by a clinician or trained mental health professional who is familiar with the DSM V classifications. The professional will assess, with aid of the listed questions, whether the diagnostic criteria for DSM V syndrome disorders are present or not. The SCID-5-CV offers guidelines to make this distinction (First et al., 2016). The SCID-5-CV is one of the most frequently used diagnostic tools in the world, with an excellent reliability score and good external and internal validity (Osório et al., 2019). Furthermore, participants provided a list of demographic information (e.g., age, gender, ethnicity, educational level and comorbid disorders) before the onset of the experiment. With the exception of age, the obtained demographic information listed above was used to create binominal variables (see Table 1).

Procedure

In this study, all participants underwent a pre-assessment consisting of the SCID-5, weight & height measurement and an interview addressing live events and further relevant demographics to evaluate if they met the inclusion criteria. Afterwards, they were all asked to read part one of *Overcoming Binge Eating, The Proven Program to Learn Why You Binge and How You Can Stop* by Christopher Fairburn (2013) (either in Dutch or English) for psychoeducational purposes. When participants fail to read the book, they are asked to still do so in the first weeks of the therapy. Next, a (semi-structured) EDE interview was conducted as well as the administration of the self-report questionnaires in order to establish the baseline severity level (pre-test assessment). After baseline, a randomly selected subgroup of 50% of the participants immediately received the BED-online treatment. The other half of the subjects were assigned to a waiting period of 12 weeks, thus completing every phase described below 12 weeks later. The treatment phase lasted for 12 weeks and consisted of online exercises where various themes were addressed, evaluation sessions and weekly 20-minute telephone contact with the practitioner. The therapy comprised of three phases: 1. Establishing regular eating patterns /alternatives for binge eating 2. Evaluating progress and designing the further course of therapy 3. addressing dietary restraint or shape concerns, ending with a focus on minimizing relapse. Participants filled out questionnaires tracking their progress after week five and twelve. If during the treatment it became apparent that a participant had experienced an adverse event, they were excluded from the research and received in person treatment instead. After completing the treatment program, participants

were still able to visit the online therapy environment. Treatment was deemed a success when participants' binge eating symptoms (as measured through the EDE or EDE-Q total score) had lowered after completing treatment. This was measured directly after completing treatment through the administration of the EDE-Q (Fairburn & Beglin, 1994) and the EDE (Cooper, Cooper & Fairburn, 1989) (post-test assessment). The EDE and EDE-Q were analyzed separately, where the EDE formed the primary analysis and the EDE-Q formed the basis of both a secondary and a follow-up analysis. This allowed researchers to check whether there were great discrepancies between the self-reported and observed binge eating pathology rates and/or changes. A follow-up analysis 24 weeks after completing treatment allowed for the evaluation of whether variables predicted long-term treatment effects.

Ethics

This study utilizes human subjects from an existing dataset. Participants gave informed consent when participating in the study at Novarum- Arkin, which was approved by the Medical Research Ethics Committees United in Nieuwegein, the Netherlands named MEC-U. The MEC-U approved the study in August 2019 with reference number NL 6958.100.19. After data collection, all data have been anonymized, which eliminated the need for a second approval by the Leiden University psychology ethics committee.

Statistical analyses

For the primary analysis, a hierarchical linear regression analysis was conducted, where post-test score on the EDE served as a dependent variable and the pre-test EDE score as well as all other predictors served as independent variables. As the post-treatment EDE measurements were solely conducted for the experimental condition, participants in the waiting list control condition were excluded from this analysis. The hierarchical regression was conducted stepwise in order to find the most parsimonious set of predictors that significantly predicted outcome. Before conducting the analyses, a boxplot was made to check for outliers (Pallant, 2016). To check whether the data met the assumptions of a hierarchical linear regression analysis; the Variance Inflation Factor (VIF) was determent to assess multicollinearity, the Durbin-Watson test was determent to assess independence of error, a scatterplot was executed to asses homoscedasticity and linearity, skewness and kurtosis were assessed to check for normality of the variables and the Shapiro-Wilk test of normality was conducted to assess normality of the dependent variable. (Pallant, 2016). In a similar fashion, a secondary analysis and a follow-up analysis were conducted utilizing EDE-Q data as the dependent

variable and one of the predictors instead. In this analysis, participants in both the experimental and control condition were included, thus increasing the sample size by more than 50%.

For the drop-out analysis, a hierarchical logistic regression analysis was conducted on the binary dependent variable “treatment-related drop-out or treatment completed”. All participants who reported a circumstantial cause for their attrition were excluded. T0 EDE score together with the other variables listed in the primary analysis served as independent variables. The data was checked on the assumptions required as described above. In order to be able to use the dependent variables that are measured at a ratio scale, they will be transformed into binary variables with the use of dummy variables (see Measures).

Results

Descriptives

A total of N = 180 participants had completed baseline testing, of which 40 participants dropped-out after baseline testing (22.2%). The motivation participants stated to have caused their drop-out, has been documented and reported in Table 3. Solley the participants who reported treatment-related causes for their attrition were eligible for the drop-out analysis (N= 172), of whom 86 were assigned to the experimental condition (50.0%). The ages of the participants ranged between 19 and 68 years old (*M*=39.48, *SD*=13.28). A total of 157 participants have been stated to be female (91.3%). The descriptives of the other possible predictors were as follows; 148 subjects were born in the Netherlands (86.0%), 111 received higher education (64.5%), 80 reported a psychological disorder other than BED (46.5%), subjects reported an average of 17,52 (*SD*=14.56 *min*=0, *max*=98) objective binge eating episodes in the month prior to the start of the experiment, score 3.02 (*SD*=.92, *min*=.63, *max*=4.88) on average on the EDE T0 and score 3.51 (*SD*=1.01, *min*=.64, *max*=5.50) on average on the EDE-Q T0.

Regarding the other analysis, solely participants who were considered treatment completers (providing post-treatment EDE and/or EDE-Q data) were eligible. The group of treatment completers comprised a total of 140 (*N*) participants, aged between 19 and 68 years old (*M*=40.01, *SD*=13.58) of whom 132 (94.3%) identified themselves as women. Sixty-nine participants were placed in the experimental condition (49.3%). With respect to the other

possible predictors; 125 subjects were born in the Netherlands (89.3%), 95 received higher education (67.9%), 66 reported psychological complaints other than BED (47.1%), subjects reported an average of 17.01 (*SD*=14.98, *min*=0, *max*=98) objective binge eating episodes in the month prior to the start of the experiment, scored 2.99 (*SD*=.86, *min*=1.42, *max*=4.85) on average on the EDE T0 and scored 3.54 (*SD*=.97, *min*=.68, *max*=5.50) on average on the EDE-Q T0.

Table 3. *Reported Causes of Drop-out*

Cause	Frequency	Percentage
Physical problems*	3	7.5
Practitioner ill*	1	2.5
Loved one passed away*	1	2.5
Breakup*	1	2.5
Corona/lockdown*	2	5.0
Treatment elsewhere	4	10.0
Treatment does not match client's wishes/expectations	10	25.0
Unable to give sufficient motivation/priority to treatment	12	30.0
Wish to lose weight	2	5.0
Out of touch	4	10.0
Total	40	100.0

*Labelled as a circumstantial cause

Correlation of the EDE and EDE-Q

As mentioned above, post-treatment EDE measurement was not available for all participants, which prompted the discussion to perform multiple analyses utilizing either the EDE or EDEQ data. In order to aid the interpretation of the findings as a whole, the Pearson correlations of the EDE and EDE-Q data were assessed. This showed a strong positive correlation (r= .79, p <.001, *95%CI* [.73, .84]) for the data of the whole sample at pre-test. The EDE and EDE-Q baseline scores of the treatment completers indicated a strong positive correlation (r= .77, p <.001, *95%CI* [.69, .83]). The scores of the participants who were in the experimental condition and completed treatment showed a strong positive correlation (r= .78, p <.001, *95%CI* [.66, .85]). The post-test EDE and EDE-Q data of the experimental condition correlated strongly as well (r= .76, p <.001, *95%CI* [.64, .85]). Thus, an overall strong correlation between the EDE and EDE-Q was found for all samples distinguished within this research. It was thus assumed that the secondary and follow-up analyses (where EDE-Q is the dependent variable) gave representative results, despite the use of self-reported data.

Primary analysis - predictor analysis of post-treatment EDE scores

Assumptions for the primary analysis

In order to examine whether the seven variables described above hold predictive power over the post BED-online treatment EDE scores, a hierarchical linear regression analysis (HLR) was conducted. Prior to the analyses, the assumptions required for a HLR analysis were evaluated (N= 69). As addressed above, one of the participants reported having 98 binge eating episodes in the month before baseline scores were assessed and thus scored more than three IQR above the third quartile. It was therefore examined whether or not this outlier heavily influenced both the mean and the results of the HLR. After running the HLR both with and without this subject, it became apparent that he/she had no impact on the significance of any of the seven possible predictors. As the score is realistic for a patient with binge eating disorder and does not appear to be a measurement error, it was decided not to remove the subject from the study.

On the other predictors no scores were three or more IQR above or below the third and first quartiles, respectively. The minimum and maximum standard residuals of the dependent variable (post EDE score) stayed between the range of -3 and 3 (*min*= -1.69; *max*= 1.87), giving no indication of an outlier. The scatterplot of the standardized residuals plotted against their predicted values confirmed the lack of outliers on the dependent variable, as no

residuals exceeded a value of 3.3. Thereby, Cooks distance had a maximum value of .166, thus not indicating a highly influential datapoint.

The data does not indicate multicollinearity, nor singularity, as all Pearson correlations are below .70 (*min*= -.35, *max*=.27) and the VIF values are below 10 (*min*= 1.00, *max*= 1.45). When testing for independence of error, the Durban-Watson test indicated a positive serial correlation (*DW*= 1.58). The skewness and kurtosis scores of all variables measured on ratio level were assessed, respectively, giving the following results for the Dependent variable (0.87 and 0.51), EDE total score at pre-test (.15 and -.63), age (.43 and -.89) and frequency of BEE (2.38 and 8.75). Only the latter indicated a violation of normality. Shapiro-Wilk, however, gave reason to believe the dependent variable is not normality distributed (*W (*60) =.96, *p*=.010), while Kolmogov-Smirnov indicated no significant deviation from normality (*D (*60) =.11, *p*=.068). When assessing the scatterplot of the standardized residuals plotted against their predicted values, no clear visual violation of homoscedasticity is found, nor a pattern deviating from linear.

Bivariate correlations of the predictors and the dependent variable of the primary analysis.

The Pearson correlations of each of the possible predictors individually paired with the dependent variable (post-treatment EDE score) were evaluated to explore if a relationship was present when other variables were not taken into account. This showed a moderate correlation for EDE T0 (*r* = .41, *p* <.001, *95%CI* [.19, .59]), meaning a high EDE score at baseline correlates with a high EDE score after treatment. The Pearson correlations of BEE frequency (*r* = .29, *p* =.017, *95%CI* [.05, .49]), comorbidity (*r* =.17, *p* =.174, *95%CI* [-.08, .39]), gender (*r* =.14, *p* =.240, *95%CI* [-.10, .37]) and age (*r* = -.13, *p* =.296, *95%CI* [-.35, .11]) presented as weak, where women and those with comorbid disorders had slightly higher EDE scores after completing treatment. Concerning both BEE frequency and age, higher scores were related to higher post-treatment EDE scores. Table 4 displays all bivariate correlations.

Table 4. *Bivariate Correlations of the Predictor Variables with Post-EDE Score of the Primary Analysis*

	r	p	95%CI	
			LB	HB
EDE T0	.41	<.001*	.19	.59
Gender	.14	.240	-.10	.37
Ethnicity	.01	.092	-.23	.25
Educational level	-.08	.539	-.31	.17
Age	-.13	.296	-.35	.11
Comorbidity	.17	.174	-.08	.39
Frequency of BEE	.29	.017*	.05	.49

* Significant p value with α=.05

Outcome of the primary HLR analysis

As the regression analysis was performed in a forward, stepwise fashion, only the variables that made a significant contribution were included in the final model. To define a significant contribution, a *p value* of at least .05 for F change was set as a requirement.

This led to a model (F (1,67) = 13.76, p< .001) containing only pre-test EDE as a predictor. Apart from the pre-test EDE score, no other variables predicted post-test EDE severity. In total, the model containing the baseline assessment of BED was able to explain 15.8% of the variance (R^2adj). The model showed a positive direction for the beta coefficient, where an increase of one on EDE T0 score was expected to lead to an increase of .41 on the post-EDE score (β=.41, t=3.71, p<.001), although at the end of treatment, most participants (95.7%) showed a decrease of EDE total score (Table 5).

Table 5. *Coefficients of the Independent Variables of the Primary Analysis Model*

	B	95%CI		β	t	p
		LB	UB			
EDE T0	.44	.20	.68	.41	3.71	<.001*
Constant	.39	-.35	1.14		1.05	.296

* Significant p value with α=.05

Secondary analysis- predictor analysis of post-treatment EDE-Q scores

Assumptions for the secondary analysis

Prior to conducting the secondary analyses, the assumptions that accompany a hierarchical regression analysis were re-evaluated, now including all participants. This meant that in addition to the one participant mentioned in the primary analysis, a second participant was flagged as an outlier as their reported binge eating frequency (84 episodes in the month prior to the research) was more than three IQR above the third quartile. Once again, removing the two outliers from the analyses did not result in different findings of the HLR. As it only concerned two subjects and scores were not labelled as measurement errors, it was decided not to remove the two outliers with extreme values. No other predictors presented scores that deviated three or more IQR from either the first or the third quartile. The minimum and maximum standard residuals of the dependent variable (post EDE-Q score) did not indicate an outlier, as they did not exceed -3 or 3 (*min*= -2.92, *max*= 2.32). The scatterplot of the standardized residuals plotted against their predicted values supported this finding, as no residuals exceeded a value of 3.3. No highly influential datapoint was found, as Cooks distance had a maximum value of .12. No signs of multicollinearity nor singularity have been found, as all Pearson correlations are below .700 (*min*= -.209, *max*=.565) and the VIF values are below 10 (*min*= 1.01, *max*= 1.11). The Durban-Watson test alerted to a positive serial correlation (*DW*= 1.05). The normality of all variables measured on ratio level was assessed with Skewness and Kurtosis, giving the following results for the dependent variable (.42 and -.14), EDE-Q total score at pre-test (-.45 and .04), age (.34 and -1.02) and frequency of BEE (1.20 and 1.58). As the Skewness and Kurtosis values of the frequency of BEE and age exceeded a value of 1, this raises concerns regarding normality. A Shapiro Wilk test,

however, gave reason to conclude that the dependent variable does not follow a normal distribution as well (*W (*140) =.97, *p*= .196), while Kolmogov-Smirnov indicated no significant deviation from normality (*D (*140) =.08, *p*= .200). When assessing the scatterplot of the standardized residuals plotted against their predicted values, no clear visual violation of homoscedasticity was found, nor a pattern deviating from linear.

Bivariate correlations of the predictors and the dependent variable of the secondary analysis.

The Pearson correlations of each of the possible predictors individually paired with the post-treatment EDE-Q scores for all participants who have completed treatment showed a moderate correlation for EDE-Q T0 (*r* = .57, *p* <.001, *95%CI* [.45, .67]), thus higher EDE-Q scores at baseline correlate with higher EDE-Q score post-treatment. Regarding BEE frequency (*r* = .11, *p* =.017, *95%CI* [-.06, .27]), comorbidity (*r* =.18, *p* =.035, *95%CI* [-.01, .33]), gender (*r* =.13, *p* =.140, *95%CI* [-.04, .29]), educational level (*r* = -.13, *p* =.136, *95%CI* [-.29, .04]) and age (*r* = -.13, *p* =.127, *95%CI* [-.29, .04]) presented as weak, where women, those with at least one comorbid disorder and those with lower educational levels had higher EDE-Q severity scores directly after completing treatment. Concerning both BEE frequency and age, higher scores correlated with higher EDE-Q scores after treatment. In Table 6, all bivariate correlations are listed.

Table 6. *Bivariate Correlations of the Predictor Variables and Post-EDE-Q Score of the Secondary Analysis*

	r	p	95%CI	
			LB	HB
EDE-Q T0	.57	<.001*	.45	.67
Gender	.13	.140	-.04	.29
Ethnicity	.08	.365	-.09	.24
Educational level	-.13	.136	-.29	.04
Age	-.13	.127	-.29	.04

Condition	.06	.503	-.11	.22
Comorbidity	.18	.035*	-.01	.33
Frequency of BEE	.11	.017*	-.06	.27

* Significant p value with α=.05

Outcome of the secondary HLR analysis

The secondary HRA was conducted in a similar fashion as the primary analysis, entering the independent variables in a forward manner when contributing at least significantly (p <.05) to F change when corrected for other variables previously added in the model. This resulted in just one model (*F (*1,138) = 67.74, *p*< .001). This model could explain 32% of the variance (R^2adj) and is comprised solely out of EDE-Q T0, after which no variable could make a significant contribution to F change. The beta coefficient had a positive direction and showed that an increase of one on the EDE T0 score was anticipated to lead to an increase of .62 on the post-treatment EDE-Q score, despite the fact that the majority of participants (95.7%) had lower overall scores at the end of treatment (*β*=.57, *t*=8.23, *p*<.001). Table 7 displays the coefficients of the independent variables.

Table 7. *Coefficients of the Independent Variables of the Secondary Analysis Model*

	B	95%CI		β	t	p
		LB	UB			
EDE T0	.62	.47	.77	.57	8.23	<.001*
Constant	-.18	-.73	.36		-.66	.509

* Significant p value with α=.05

Follow-up data analysis- predictor analysis of 24-week post-treatment EDE-Q scores

Assumptions testing of the follow-up data

For the follow-up analysis, once again all assumptions were tested with the 24-week post-treatment effect as the dependent variable (N= 138). Assessing the boxplot of the dependent

variable, no extreme value differentiating more than three IQR above the third quartile nor below the first quartile was found. This also applied to the independent variables, with the exception of BEE frequency as described above. After visual observation, the scatterplot of the standardized residuals plotted against their predicted values did not show a distinct violation of homoscedasticity, nor a pattern other than linear. Thereby, the scatterplot showed no values exceeding 3.3, indicating no outlier. Regarding the minimum and maximum standard residuals of the dependent variable, the minimum standard residual was below -3 (-3.10) thus indicating a possible outlier, while the maximum value did not as it did not exceed three (2.21). According to Cooks distance (.09), the dependent variable did not contain a highly influential datapoint, thus no datapoint was removed. With the new dependent variable, all Pearson correlations remained below .70 (*min*= -.22 *max*=.48) and the VIF values below 10 (*min*= 1.00, *max*= 1.12), thus showing no sign of multicollinearity nor singularity. The data showed signs of positive serial correlation (*DW*=1.17). The Skewness and Kurtosis of the independent continuous variables were assessed, which showed that EDE-Q total score at pre-test appeared to be normally distributed (-.42 and .05), but age (0.33 and -1.03) and frequency of BEE (1.21 and 1.58) alarmed to a possible deviation from normality. The Skewness and Kurtosis values of the dependent variable were .51 and -.13, respectively. This did not alarm to a deviation of normality. Neither did the Kolmogorov-Smirnov test (*D (*140) =.09, *p*= .200). The Shapiro-Wilk test, however, did alert to a significant deviation from a normal distribution (*W (*140) =.95, *p*= .021). After visual observation, the plot did not show a distinct violation of homoscedasticity, nor a pattern other than linear.

Bivariate correlations of the predictors with the dependent variable of the follow-up analysis.

All possible predictors were individually matched with the follow-up EDE-Q data in order to view the Pearson correlations. The EDE-Q data at baseline (EDE-Q T0) revealed a moderate correlation (*r* = .47, *p* <.001, *95%CI* [.33, .59]). This means that higher EDE-Q scores at baseline correlate to higher EDE-Q scores post-treatment. Regarding BEE frequency (*r* = .15, *p* =.088, *95%CI* [-.02, .31]), comorbidity (*r* =.13, *p* =.145, *95%CI* [-.04, .29]), gender (*r* =.18, *p* =.038, *95%CI* [.01, .33]), educational level (*r* = -.17, *p* =.046, *95%CI* [-.33, -.00]) and age (*r* = -.18, *p* =.037, *95%CI* [-.33, -.01]) the correlations presented as weak. Participants with at least one comorbid disorder scored higher on the EDE-Q at the follow-up assessment, as did woman and those with lower educational levels. High scores on BEE frequency and age are

associated with higher EDE-Q at follow-up. An overview of all bivariate correlations can be found in Table 8.

Table 8. *Bivariate Correlations of the Predictor Variables with Follow-up EDE-Q Scores of the Follow-up Analysis.*

	r	p	95%CI	
			LB	HB
EDE-Q T0	.47	<.001*	.33	.59
Gender	.18	.038*	.01	.33
Ethnicity	.09	.324	-.08	.25
Educational level	-.17	.046*	-.33	-.00
Age	-.18	.037*	-.33	-.01
Condition	.00	.968	-.17	.16
Comorbidity	.13	.145	-.04	.29
Frequency of BEE	.15	.088	-.02	.31

* Significant p value with α=.05

Outcome of the follow-up data analysis

The follow-up analysis was carried out by entering the independent variables in a forward stepwise direction if F change was significant ($p < .05$), similar to the primary and secondary analyses. After entering the pre-test EDE-Q score, no other variables contributed significantly to the model. Thus, the model contained a single predictor (F (1,136) = 38.99, p.001), which could account for 22% of the variance (R^2adj). According to the beta coefficient, which had a positive direction, an increase of one point on the EDE T0 relative to other participants led to a .61-point increase in the post-test EDE-Q score, even though overall scores had decreased for most (95.7%) participants at the end of treatment (β=.47, t= 6.24, $p < .001$) (Table 9).

Table 9. *Coefficients of the Independent Variables of the Follow-up Analysis Model*

	B	95%CI		β	t	p
		LB	UB			
EDE T0	.61	.41	.80	.47	6.24	<.001*
Constant	-.06	-.77	.64		-.17	.863

* Significant p value with α=.05

Drop-out analysis- predictor analysis of treatment-related attrition

In this drop-out analysis, exclusively treatment-related drop-out was considered, as it was believed this would uncover predictors that are most representative for generalization purposes. Eight participants reported circumstantial causes for their attrition and were therefore excluded from the subsequent analysis. To ensure the robustness of the findings, a sensitivity analysis was conducted to explore whether the results presented below would remain constant when assessing all cases of drop-out. In doing so, the same conclusions were reached.

Assumptions testing of the treatment-related drop-out analysis

The drop-out analysis concerns a hierarchical logistic regression analysis, due to the binary character of the dependent variable, which is accompanied by mostly, although not fully similar assumptions to the ones described for linear regression analysis (N= 172). The sample of the current analyses showed no outliers that deviated more than three IQR from the first or third quartile for all variables. No sign of multicollinearity nor singularity was found, as each Spearman's ρ (*min*= -.33, *max*=.12) and tetrachoric correlation (*min*= -.21, *max*=.21) stayed below .70 and the VIF values stayed below 10 (*min*= 1.02, *max*= 1.22). The distribution of the categorical variables was assessed through a Chi square (X^2), which yielded no significant results (*p min*= .072 , *p max*= .990), thus giving no reason to suspect either multicollinearity or singularity. The skewness and kurtosis scores of EDE total score at pre-test (-.02 and .71) and age (.37 and -.91) fall within the margins for normality. Frequency of BEE, however, did appear to violate normality based on both skewness and kurtosis (2.00 and 7.00).

Bivariate correlations of the predictors and the dependent variable of the treatment-related drop-out analysis.

Prior to conducting the drop-out analysis, tetrachoric correlations (bivariate variable) or Pearson correlations (continuous variables) of each predictor variables combined with treatment-related drop-out (dependent variable) were assessed. This showed moderate correlations for both gender (r_{tet} =-.39, , p =.003, *95%CI* [-.61, -.12]) and ethnicity (r_{tet} =.38, p =.008, *95%CI* [.09, .62]), where men and participants born outside the Netherlands dropped-out more often for treatment-related causes. A weak correlation was found for educational level (r_{tet} = -.23, p =.054, *95%CI* [-.45, .01]), were those who completed a lower educational level dropped-out more often due to treatment-related causes. Table 10 displays the bivariate correlations presented above. For the binary variables, cross tables are presented in Table 11, which indicates that; men, participants with comorbid disorders, participants with a lower educational level, participants who were born abroad, and participants who were placed in the experimental condition were more likely to drop-out.

Table 10. *Bivariate Correlations of the Predictor Variables and Drop-out of the Treatment-related Drop-out Analysis.*

	r	p	95%CI	
			LB	HB
EDE T0	.06	.457	-.09	.21
Gender**	-.39	.003*	-.61	-.12
Ethnicity**	.38	.008*	.09	.62
Educational level**	-.23	.054	-.45	.01
Age	-.08	.274	-.23	.07
Condition**	.05	.707	-.20	.29
Comorbidity**	-.04	.741	-.29	.21

Frequency of BEE	.07	.338	-.08	.22

* Significant p value with α=.05

**Tetrachoric correlation

Table 11. C*rosstable Displaying the Association of the Independent Variables and Treatment-related Drop-out for the Treatment-related Drop-out analysis*

	Treatment N (%)	Drop-out N (%)	Total N (%)
Man	8 (53.3)	7 (46.7)	15 (8.7)
Woman	132 (86.0)	25 (14.0)	157 (91.3)
No comorbidity reported	74 (80.4)	18 (19.6)	92 (53.5)
Comorbid disorder present	66 (82.5)	14 (17.5)	80 (46.5)
Born in the Netherlands	125 (84.5)	23 (15.5)	148 (86.0)
Born abroad	15 (62.5)	9 (37.5)	24 (14.0)
Lower education	45 (73.8)	16 (26.2)	61 (35.5)
Higher education	95 (85.6)	16 (14.4)	111 (64.5)
Control condition	71 (82.6)	15 (17.4)	86 (50.0)
Experimental condition	69 (80.2)	17 (19.8)	86 (50.0)
Total	140 (81.4)	32 (18.6)	172 (100)

Outcome of the treatment-related drop-out analysis

The treatment-related drop-out analysis was conducted in a similar fashion to the drop-out analysis, which led to a significant model (X^2 (2, N= 172)= 13.90 , p< .001). This means that the model appears to be able to distinguish participants who have dropped-out of the BED-online treatment due to treatment-related causes from those who have completed the study treatment. The Hosmer and Lemeshow test was non-significant, which underlines this observation (X^2 (1)= .02, p=.903). The model as a whole proved to be able to explain between 7.8% (Cox & Snell R^2) and 12.6% (Nagelkerke R^2) of the variance. Of the 172 participants, 141 participants were correctly classified. This correlates with an observed group membership of 82.0%, where the model specificity amounts to 100.0%, while the sensitivity amounts to 3.1%. The variables that are presented as predictors in the model are both gender and ethnicity (Table 12), where gender is shown to be the most influential in predicting treatment-related attrition. Males appear 5.63 times more likely to drop-out of treatment due to treatment-related causes compared to women (*OR*=5.63, *95%CI* [1.81, 17.53]). Regarding ethnicity, participants born outside of the Netherlands had a 3.91 times greater likelihood of dropping-out of the treatment than those who were born within the Netherlands (*OR*=3.91, *95%CI* [1.43, 8.76]).

Table 12 . *Logistic Regression Predicting the Likelihood of BED-online Treatment attrition*

	B	SE	Wald	df	p	OR	95%CI OR	
							LB	UB
Gender	1.73	.58	8.88	1	.003*	5.63	1.81	17.53
Ethnicity	1.36	.50	7.54	1	.006*	3.91	1.48	10.33
Constant	-.22	.53	.17	1	.678	.80		

* Significant p value with α=.05

Discussion & Conclusion

After Melisse et al. (2023) showed promising results regarding the treatment gains of a new online BED-treatment: BED-online, the current study aimed to find predictors for both a decrease in BED-related symptoms and drop-out of the treatment.

Results show that neither ethnicity, age, gender, educational level, comorbidity, frequency of binge eating episodes, nor treatment condition held predictive power over treatment success. Only levels of BED pathology at baseline predicted the levels of BED pathology after treatment, where higher pre-test scores were related to higher post-test scores as measured through both the EDE and EDE-Q at post-test and follow-up. In total, the models created were able to explain 15.8%, 22.0%, and 32.0% of the variance, respectively. The frequency of objective binge eating episodes presented two extreme scores, but it was decided not to exclude the two extreme scores, as (1) the datapoints were shown not to be of great influence and (2) the amount of binge eating episodes reported is remarkably high but not unrealistic when compared to other research (Carrard et al., 2011; Schreiber-Gregory et al., 2013; Peterson et al., 2009).

In total, an attrition rate of 22.2% was established (40 participants), which is comparable to other (binge) eating disorder studies (Vroling et al., 2016). Generally, the average drop-out rate is found to be higher in online and guided self-help therapies (Grilo et al., 2021; (Linardon et al., 2018). In the present study, the drop-out analysis (X^2 (2, N= 172)= 13.90 , p< .001) revealed that males as well as participants born abroad were more likely to drop-out of treatment due to treatment-related causes, making both gender and ethnicity predictor variables. When non-treatment-related causes of attrition were taken into account in an exploratory manner, similar results were found, demonstrating the robustness of the findings. Males were shown to be 5.63 times more likely to drop-out of treatment before the last session than woman, while participants born abroad were shown to be 3.91 times more likely to terminate treatment prematurely than participants born in the Netherlands. The model was able to explain 7.8% and 12.6 of the variance, which is fairly limited, but comparable to other drop-out analyses that focus on eating disorders (Vroling et al., 2016). The model provided in the treatment-related attrition analysis was able to correctly identify all patients who would remain in the study (specificity = 100%), but it became apparent that the specificity of the model amounted to only 3.1%, meaning the model tends to underestimate the amount of attrition, which translates into an observed group membership of 82%. As the model's specificity is particularly low, the predictive effects of both variables

should be regarded with care.

The lack of effect found for most variables is in line with some previous studies, but contradictory to others.

Concerning binge eating severity, the current findings displaying a moderate to high correlation with post-treatment scores (where a display of more severe symptoms resulted in higher symptoms after completion of BED-online, as measured through both the EDE and EDE-Q at post-test and at follow-up) are in line with Lammers et al. (2011) and Masheb and Grilo (2008). Thompson-Brenner et al. (2013) found that more severe binge eating pathology at baseline (as measured through the EDE global score) and high BEE frequency both predicted higher binge eating pathology after treatment. Peterson et al. (1999) however, noted that not baseline severity scores as a whole (EDE(-Q) total), but only BEE frequency was responsible for the predictive power. Castellini et al. (2011) did find a higher BEE frequency at baseline to be related to higher pathology levels post-treatment as well, but in this study subjective binge eating episodes (in which a person perceives their calorie intake as overeating while others do not) rather than objective binge eating episodes were assessed. Within the current study objective BEE frequency and general BED-related psychopathology levels were both regarded, but no evidence was found to support the notion of Peterson et al. (1999). Although the frequency of binge eating episodes did show a weak correlation ($.11 < r < .29$) with treatment results, indicating participants with a lower BEE rate yield more favourable results, when controlling for the other variables assessed in this study the effect was lost and no longer significant. As BEE frequency is included in the EDE total score that forms the binge eating severity score, a likely explanation could be that this overlap makes that BEE frequency does not explain any additional variance. However, the mutual correlation was found to be low ($.05 < r < .11$). A noticeable difference between the current research and the studies named above exploring the relationship between BEE frequency and post-treatment pathology levels, is that objective binge eating episodes were assessed using the DSM V criteria for BED, while the others used the criteria of the DSM IV. Although fairly similar, the diagnostic criteria between the two editions do vary as the DSM IV required a minimum of 2 BEE every week for at least the past six months, while the DSM diminished the criterion to one episode every week for at least three months (DSM IV, 2000; DSM V, 2013). When comparing the BEE frequencies reported, Thompson-Brenner et al. (2013) did find a higher average (19.34) than the current study (17.01), while Peterson et al. (1999) reported a lower average (16.47). It was thus not expected that the different DSM criteria have clouded the comparison. The previous studies did, however, evaluate traditional

in-person CBT therapy. Mitchel et al. (2011) found that, contrary to classic CBT, in the case of guided self-help higher eating disorder pathology was associated with better performances. As BED-online is considered to be guided self-help, it is striking that the current results contradict this finding. This, however, did concern a study of subjects with Bulimia Nervosa (BN), an eating disorder similar to BED with regard to the occurrence of binge eating episodes and a multitude of patient characteristics, but with pronounced differences in inappropriate compensatory behaviour, higher levels of body dissatisfaction, and a greater drive for thinness (Striegel-Moore et al., 2001). Lammers et al. (2011) have found that a higher drive for thinness predicted better outcomes post-treatment, which indicates the importance of differentiating the different diagnoses, as it is possible that the effects found by Mitchel et al. (2011) are limited to BN only. Furthermore, the current study operationalized treatment outcome in a continuous manner (assessing post-test EDE(-Q) score), while Mitchel et al. (2011) took a categorical approach to outcome (remission, abstinence, or insufficient treatment effects found). Neither binge eating pathology, nor the frequency of BEE occurrence were found to predict attrition, which is in line with other research focusing on BED (Lammers et al., 2011; Thompson-Brenner et al., 2013; Castellini et al., 2011). Vroling et al. (2016), as well as other studies focusing on BN, did find a positive correlation between baseline pathology and drop-out (Von Brachel et al., 2014; Vall & Wade, 2015). These mixed findings on the topic of attrition could (in part) be due to varying definitions of attrition, as will be a point of attention when interpreting all research describing drop-out rates (Linardon et al., 2018).

In traditional BED-therapies ethnicity is scarcely examined as a possible predictor variable. To date, there are two known studies that have found Afro-American heritance to be associated with slightly more favourable treatment results, while also being more prone to attrition (Thompson-Brenner et al., 2013; Lydecker et. al., 2019). In these studies, no Asian, Arabic, Roma, nor Native American participants were included and the population of Latin Americans (which was only included in the study of Thompson-Brenner et al. (2013)) was small, limiting the power. Some research focusing on psychological disorders other than binge eating disorder found that ethnic minorities did have less favourable results after treatment completion and a greater likelihood of attrition, although ethnicities other than Afro-American, Latin American and Caucasian were rarely included (Lesser et al., 2007; Saloner et al., 2014; Mennis et al., 2019; Taylor et al., 2017; Sibrava et al., 2019; Peris et al., 2020). The working mechanism behind this occurrence cannot be determined with certainty. A possible explanation could be the higher rates of stigma and shame regarding mental

illnesses that were found within i.a Afro American, Latin American and Asian cultures (Misra et al., 2021). Amichai-Hamburger et al. (2014) suggested that online therapy could potentially alleviate feelings of shame and stigma within a patient regarding mental illnesses. This could thus possibly explain why ethnicity was not shown to be a significant predictor of poorer treatment results in the current study, nor was there a correlation found ($.01 < r < .09$). This hypothesis is further supported by findings that feelings of shame result in poorer treatment alliances (Black et al., 2013). This line of reasoning, however, does not explain why ethnicity has been found to be a predictor of treatment attrition. An alternative explanation to account for this effect is that not shame, but language is the underlying mechanism causing the predictive effect. This would mean that some of the non-native participants mastered the Dutch language insufficiently in order to achieve the desired treatment effects, which could explain why treatment potentially did not live up to their expectations, causing them to end it prematurely. On the other hand, sufficient proficiency in the Dutch language was an inclusion criterion for this study. This was assessed by self-report and thus could be viewed as not airtight, but it is possible that this has intercepted or distorted the effects of ethnicity if caused by language. In the purely therapeutic setting where BED-online treatment will take place, a language screening will likely not be performed at the start of treatment and is thus something to be mindful of as a possibly larger effect of ethnicity could present itself based on this hypothesis. Another reason for the lack of effect of ethnicity on treatment outcomes could be that all other studies known to the researchers have taken place in the United States of America, where racial segregation is known to be very pronounced and many people of ethnic minorities are known to be confronted up front of this fact in their day-to-day lives (Findling et al., 2019; Findling et al., 2019b; McMurtry et al., 2019; Bleich et al., 2019; Solorzano et al., 2000). The World Justice Project (2022) examined whether citizens of 140 countries received equal treatment & absence of discrimination and whether the civil justice is free of discrimination, and ranked each country and gave them an index score (between 0 -1) for their performance. In this research, the United States was ranked in the 103rd (*index*= .48) and 121st (*index*= .36) place, for equal treatment and civic justice, respectively. The USA were deemed a lot less equal than the Netherlands, who scored 6th (*index*=.80) and 4th (index=.84) place, respectively (WJP, 2022). It is important to note that discrimination was examined in a broad sense and therefore also included gender (identity), religion, socio-economic status, and sexual orientation. The differences in (perceived) discrimination in both countries may have caused the POC community in America to feel more estranged from the identity of American citizen than Dutch people of

foreign origin feel estranged from the Dutch identity, which could disturb the therapeutic alliance and trust in the treatment process, which in turn could explain why ethnicity was found to be a predictor variable of treatment success in some American studies, but not in the current Dutch study.

Grilo et al. (2021) did find age to be a predictor of more bed remission. More specifically, an increase of one year in age was equal to an 18% increased chance of remission. In the current study, age showed no predictive power over treatment effects, but when assessed individually a weak correlation was found where older age correlated negatively with post-test severity level ($-.18 < r < -.13$). A noteworthy difference, however, is that the treatment effects in the study of Grilo et al. (2021) are conceptualized in a binary manner; remission or not, while the current study used continuous scores (Grilo et al., 2021). This could possibly account for the difference in predictive ability found. This hypothesis is supported by the study of Masheb and Grilo (2008) which did take a continuous approach as well and were also unable to detect a significant relation. More specifically, remission in the study of Grilo et al. (2021) was defined as the absence of objective binge eating episodes for at least the past month. The importance of the dissimilairity in definitions is stressed by another study as well, which found age not to be predictive of BED severity post-treatment as measured through the EDE total score, but did find older participants to report higher BEE frequency after treatment completion (Thompson-Brenner et al., 2013).

No clear relation between age and attrition was found, which is in line with most (Grilo et al., 2021; Vroling et al., 2016; Masheb and Grilo, 2008; Von Brachel, 2014), although not all prior research (Thompson-Brenner et al., 2013). In the study of Thompson-Brenner et al. (2013), older participants were more likely to drop-out of treatment, but this effect was described as small (OR=1.35, $p < .01$). In this study, the average age of the participants was not noted and thus no comparison can be made in this regard (Thompson-Brenner et al., 2013). Other research found that elderly patients have trouble accessing and comprehending digital therapy (Eberly et al., 2020; Vaportzis et al., 2017). The lack of relation between age and attrition in the current study can be interpreted as evidence that less familiarity with online resources did not cause elderly participants to terminate the treatment prematurely. It should be noted however, that the oldest participant in the current sample was 68 years of age (M= 39.41), thus a great portion of the elderly population was not accounted for. On the other hand, Linnet et al. (2023) found younger participants to be more likely to drop-out of online (CBT based) BED-treatment, a trend that was not replicated in the current study.

Prior studies found gender not to be predictive of treatment outcome, as did the current study (Shingleton et al., 2015; Grilo et al., 2014; Lydecker et al., 2019). Analysis did, however, reveal that for men who displayed low levels of shape/weight concern, shorter treatment led to a higher chance of remission, while for both women and men with high levels of shape/weight concern longer treatment increased the chances of remission (Shingleton et al., 2015). In the current study neither shape/weight concern nor treatment length were assessed. However, as BED-online would be regarded as a short treatment (12 weeks) by Shingleton (2015) guidelines, this could possibly explain the (weak) correlation witnessed where men tended to portray lower BED severity post-treatment ($.13 < r < .18$). Results indicate that males were more likely to drop-out of treatment. However, when looking at traditional treatment options for binge eating disorder, it was found that drop-out rates between males and females were equal at 21.4% (Agüera et al., 2017). The high attrition rates (46.7%) within the male sample found in the current study do thus suggest that males might benefit more greatly from in-person treatment, even though the males that do complete the treatment were seen to yield similar results as were observed within the female sample. The female participants in the current study showed lower rates of attrition (15.9%) compared to the in-person study described above. It is noteworthy, however, that although the sample sizes of the male participants were approximately equal (15 males in the current study, 14 in the study of Agüera et al.,(2017)), the current study included a lot more females (157 versus 17) which should be borne in mind when interpreting the percentages. Agüera et al. (2017) did also assess patients with BN, where a predictive effect of gender was found; males were more likely to drop-out of treatment but did yield more treatment gains when completing therapy. Linnet et al. (2023) were also unable to detect a predictive effect of gender in an online therapy setting. In this study, there was also a skewed distribution of men (N= 23) and women (N= 178). The drop-out rates of males were comparable to the current study (43.5%), but the drop-out rate among females was noticeably higher (42.1%) (Linnet et al., 2023). Thus, it is possible that the lack of effect found could be attributed to the overall high attrition rates within the study. When regarding psychotherapy as a whole, it was found that male participants were 33% less likely to access mental health services in general, and when they do start treatment, they were found to be more likely to end treatment before the agreed-upon amount of session than women (Seidler et al., 2021). Specifically, feelings of demasculation were often associated with less attendance at therapy and higher attrition rates in men (Seidler et al., 2021; Osherson & Krugman, 1990). This cult thus possibly (in part) explains the low number of male participants that participated in the current study, as well as the higher

attrition rates observed.

As education was not predictive of outcome, it is not suggested that participants require a certain level of education in order to be able to reap the benefits of online BED-treatment and to adhere to its treatment regime. These findings were replicated by multiple studies (Lammers et al., 2011; Grilo et al., 2014). Other research did, however, find that participants with a lower educational level (high school or less) were more likely to remain experiencing binge eating episodes after receiving treatment (Thompson-Brenner et al., 2013). In this study, the data from 11 studies was assessed. Most of the studies presented participants with in-person treatment (Thompson-Brenner et al., 2013). It is possible that some of the predictive effect of education was due to treatment being too complicated and too fast-paced. The online nature of BED-online enables participants to go through the therapeutic material at their own pace (while sticking to a weekly planning). Thus, if a patient struggles to understand a certain part or has an overall slower processing speed, they are able to take their time and revise the material. In traditional therapies this would require a patient to report their misunderstanding to the therapist, which can be a confronting task to do, especially in group settings. If participants did not feel comfortable doing so, it is possible they were unable to reach the level of understanding necessary to yield optimal treatment results. However, this hypothesis is contradicted by the study of Grilo et al. (2012), where (in traditional CBT) participants who received lower education (defined as less than college education) had a greater likelihood of remission. It is remarkable that in this study, the percentage of lower educated participants was small (13%), especially when compared to the current study (35.5%) and the study of Grilo et al. (2014) (61.5%). Lammers et al. (2011) divided educational level into three categories (were all other studies mentioned above had two) but did not mention how the categories were operationalised, thus it is unknown how they relate to the other research. The proportions were recorded and are labelled as follows; low level (11.6%), medium level (50.8%) and high level (37.6%) (Lammers et al., 2011). Thompson-Brenner et al. (2013) did not report the demographics at baseline. Lastly it should be mentioned that, as is described in the scientific background, the current study took place in the Netherlands where the school system is arranged in a manner that differs from the United States of America. For a detailed description of the differences, see scientific background. This should be taken into consideration when interpreting and comparing the other studies mentioned above, with the exception of Lammers et al. (2011) which was a Dutch study as well. No effects of education on drop-out rates were found, thus the current research adds to the results found in other studies regarding BED (Thompson-Brenner et al., 2013; Grilo et al.,

2021; Lammers et al., 2011). It is noteworthy however that a weak correlation was found (r= -.23), where lower educated participants were more likely to drop-out. However, when corrected for the other variables this effect was lost in the final model. To the best of the researcher's knowledge, no studies have previously been able to demonstrate an association between attrition and educational level in (online) BED-therapy.

The results of other studies on the topic of comorbidity are ambiguous. Most found no significant effect, as is the case in the current study (Grilo et al., 2014; Lydecker &Grilo, 2021; Grilo et al., 2021a; Grilo et al., 2021b; Ricca et al., 2010; Peterson et al., 2000; Grilo et al., 2012). Some however did; the meta-analysis of Vall and Wade (2015) found that patients with fewer comorbidities experienced less BED-related symptoms post-treatment. In the current study, it is unknown how many comorbidities a patient has. It was solely assessed whether a comorbid disorder was present on the basis of the SCID-5-CV. It is thus possible that an effect of comorbidity was clouded (in the current study as well as others that did not report an association) as the patients could all have had one or few comorbidities. Possibly, only a large number of comorbid disorders would result in an effect. The study of Vall and Wade (2015) is the only study that, as far as known to the researchers, assessed current comorbidity in a quantitative manner. It is important to note that many studies differentiate between the influence of comorbidity as a whole and depression specifically, as patients often report having had a negative mood before experiencing a binge eating episode (Dingemans et al., 2017). In the study of Lammers et al. (2015) lower levels of binge eating pathology were associated with better treatment outcomes both post-treatment and at follow up. Concerning depressive symptoms, Lammers et al. (2015) found higher levels of depression as measured through the SCL-90 to be predictive of less BED pathology post-treatment, while depression as measured through the BDI did not hold significant predictive value. Dingemans et al. (2020), however, found the contrary; patients with no or mild depressive symptoms (as measured through the BDI-II) were faster at achieving abstinence from BEE and a 50% reduction in baseline BED symptoms. In the study of Lydecker and Grilo (2021) patients with mood disorders (as measured through the SCID-5-CV) were less likely to obtain remission, while general comorbidity did not hold predictive value. As mentioned in the scientific background, having an acute depression was an exclusion criterion for the present study. Thus, not depression, but depressive symptoms as measured through the SCID-5-CS were assessed. It is therefore possible that, if depression has a predictive effect on BED-online therapy outcomes, the research design was unable to detect this. Thereby, both the severity of the comorbid disorder and whether patients were receiving treatment for the

reported comorbidity is unknown. Regarding attrition, there seems to be consensus that no predictive effect of comorbidity nor depression is found (Vall & Wade, 2015; Dingemans et al., 2020; Grilo et al., 2021a; Grilo et al., 2021b; Lammers et al., 2015). The current study adds to that notion, as no effect was found in a correlation nor in the final model. The association between drop-out and comorbidity/ depression is, however, less frequently examined than the association with treatment outcomes.

No prior studies have examined the predictive ability of treatment condition (immediate treatment or a waiting list control) on either BED-therapy gains or attrition. Nevertheless, it was chosen to include this variable in the current analysis, as some studies have found that participants who had been placed in a waiting list control condition tend to improve less after receiving psychotherapy (Cunningham et al., 2013; Mohr et al., 2009). However, no conclusive data concerning the topic seems to have been published thus far. In the current study, no predictive effect of treatment delay was found on both BED-therapy gains ($.00 < r < .06$) and attrition ($r=.05$). The waiting time for the participants in the control condition amounted to a total of 12 weeks, which could be too short to find an effect. As many news outlets report waiting times for therapy for eating disorders to be long in the Netherlands, it is possible that patients did not experience the waiting period of the control condition as exceptional (NOS, 2021; RTL Nieuws, 2021; RTL Nieuws, 2022; Boogaard & Moeliker, 2023).

Strengths and Limitations

It is noteworthy that in most of the studies listed above, fewer predictor variables were included at once. The relatively large number of independent variables included in the current study forms both a strength as well as a weakness, as it enables to correct for the effects of a multitude of other variables and thereby clarifying the specific effects of each individual variable, but created the risk of overfitting and resulted in a relatively low number of subjects per predictor variable.

The current study has limitations and findings should be interpreted with care. The subjects scored rather homogeneously on several of the independent variables (for gender and ethnicity in particular, as few identified as men or reported being born abroad). Although it is true that data suggest that eating disorders, among BED, are more prevalent in females, the differences appear to be less extreme than the current sample would indicate. Stice and Bohon (2012) found a lifetime prevalence of 0.2% to 3.5% for females and 0.9% to 2.0% for males. Thus, females appear no more than twice as likely to get a BED diagnosis, while in the

current study only 8.7% of the participants identified as male, which translates to females being about 10 times more likely to get a BED diagnosis. Consequently, generalizability of the findings for males is questionable. The *Central Bureau voor Statistiek* (CBS, 2023) (who are tasked by the Dutch government to compose and publish reliable statistics) reported that in 2022, 14.5% of the population living in the Netherlands was born abroad. This rate agrees with 14% found in the current study. But despite the fair representation of the true population, this disproportionate distribution makes that there is less data available of this subpopulation.

It was chosen to approach all categorical variables in a binary manner. This might have compensated for- or obscured differences that would appear when more categories are used. Regarding educational level, for instance, the binary split made that participants who have quit high school fall into the same category as those who followed a profession-focused education (MBO), which is the most common form of post-secondary education in the Netherlands (consisting of 40% of the students under 25) (CBS, 2022). Within profession-focused education, four substantially different levels are distinguished, which could be ordered in an ordinal manner, but which are in the current study regarded as equal.
Within the sample, none of the participants reported to have no high school degree and very few reported to have graduated from an LBO or VMBO. Thus, it is possible that the present design cloaked the results for this subgroup and although no predictive power for education was found, the lowest educated could still be more prone to poorer treatment outcomes and attrition. Regarding ethnicity, a large portion of the subjects born abroad reported to be born in a European country other than the Netherlands, but due to the binary measure they were placed in the category “born outside of the Netherlands” together with those born on another continent. It could be debated if those participants identify as an ethnic minority and face the same challenges as those who were born outside of Europe, in a culture that might differ more from the Dutch culture. The current distribution works best if it is assumed that language (not being a native speaker) holds the predictive power, but perhaps culture is the underlying mechanism.

Another limitation could be, that as post-treatment EDE data was not available for all participants, the study had to rely on EDE-Q data for all participants who were placed in the control condition and the long-term measurements. Although research shows modest to good agreement between the EDE and EDE-Q, the EDE-Q tends to overestimate the binge eating frequency’s causing the EDE to be the preferred method for measuring BED pathology (Wilfley, Schwartz, Spurrell & Fairburn, 1997). Thus, the current research design offers the

possibility to speculate about the likely EDE post-treatment results for participants in the control group (and thereby possible predictors of success and attrition), but this can only be regarded as an indicator. However, the current correlations between the EDE and EDE-Q were shown to be strong.

As no post-treatment EDE data was available for the control condition, the primary analysis was conducted including only participants in the experimental condition. As a result, the sample size was halved which could jeopardize the validity of the findings. There exist different opinions regarding the minimal required sample size for both hierarchical linear regression and logistic regression. Although the secondary and follow-up analyses seem to be of acceptable size according to both Stevens (>119 participants) (1996) and Tabachnick & Fidell (>111 participants) (2013), the primary analysis was done on a sample comprising about half the number of subjects they proposed. The treatment-related drop-out analysis also falls short on sample size for logistic regression with eight independent variables according to Field (2013) (>399 participants), Bujang et al. (2018) (>499 participants) and Leblanc and Fitzgerald (2000) (>239 participants). Hosmer et al., (2013) recommend at least 80 participants for a logistic regression analysis with eight independent variables, which the treatment-related drop-out analysis exceeds. This should be taken into account with the interpretation of the current results.

When interpreting the results of the drop-out analysis, it is important to note that participants participated in the BED-online treatment, provided in the context of a randomized controlled study. It is possible that some of the subjects decided to discontinue participation due to the burden of completing extra questionnaires or did no longer consent to their data being utilised for research. This would imply that their attrition would not have occurred outside of a research-setting and thus could not be relied on when wanting to distinguish predictors for a therapeutic setting. On the other hand, the research context could also have kept subjects in the trial (and in treatment) who otherwise would have dropped-out prematurely. No figures are known regarding the differences between attrition in research and drop-out in everyday therapy. With regards to the treatment-related drop-out analysis, it became apparent that although the model specificity was impeccable at 100%, the model sensitivity was merely 3.1%. This means that although the model was able to perfectly predict which participants would finish their treatment, it showed difficulty predicting who would drop-out, which is not preferable.

Implications for therapists

Being male and being born outside the Netherlands were associated with increased attrition rates. Knowing this may help to improve treatment for those with these characteristics. However, in order to do so properly, more research has to establish the reasons for these effects, as the suggestions made in the current research could only be regarded as hypotheses. Nevertheless, the current research enables therapists to be more attentive towards the risk of attrition in patients with these characteristics and monitor their treatment progress more closely to allocate additional resources were needed or to decide a different treatment might be better suited for the patient.

In order to reduce drop-out rates further, therapists may consider providing information regarding the treatment process in more detail, as 32.3% of the participants who dropped-out of treatment due to treatment-related causes, reported that this was caused by a discrepancy between their expectations & wishes and the treatment that was provided.

Another frequently cited cause for attrition (37.5%) was an inability to provide the motivation and/or priority required, which, as other research suggests, might be (partially) predicted by assessing motivation at baseline through a questionnaire such as TRE-MORE, the TMQ or the TCU Self-Rating Form (Cresci et al., 2010; Ryan et al., 1995; Simpson & Joe, 1993; Vall & Wade, 2015). Using these tools can aid therapists in making an informed decision on whether BED-online is indicated. Furthermore, if it is decided to start therapy despite a low motivation score, they are advised to monitor the client's motivation and progress closely.

Not only the variables that did show predictive effect can aid in improving treatment, but also those who did not hold predictive power although initially suspected to do so, provide new knowledge. The lack of effect of education does for instance indicate that the treatment appears to be understandable for all participants despite the education they have and/or have not received. Likewise, a patient's age, gender, ethnicity, the frequency of their binge eating episodes and the presence or absence of comorbid disorders do not restrain them from yielding positive treatment effects. The results do thus indicate that BED-online not require any alterations in this regard. Furthermore, as described above, these variables were found to hold predictive power over treatment outcomes in traditional in-person therapies. This thus suggests that for participants who are observed to yield less favourable outcomes in traditional therapies, BED-online might be a better suited alternative.

Knowing that none of the variables included in this study (other than baseline scores) seemed to correlate with poor treatment effects and earlier research displayed favourable treatment effects (Melisse et al., 2023), shows that BED-online treatment is a promising treatment option that could be implemented broadly.

Recommendations for future research

The current study is the first of its kind and thus comes with several limitations and unknowns. Future research on the subject is therefore highly recommended. In this research, it is strongly advised to either limit the number of predictors or increase the number of subjects in order to increase statistical power. To determine the appropriate sample size, the studies mentioned in "sample size" could be referenced. To add to the pool of knowledge, future studies could explore if the current findings persist when the independent variables are divided into more categories and or with a larger representation of the more extreme values (e.g., include more participants who have characteristics that are concerned the highest and lowest scores on each variable where relevant) or a more even distribution among the different categories where applicable.

Based on the current findings, new questions arise concerning the mechanism driving males and participants born abroad to discontinue treatment prematurely. It is possible, but thus far unclear whether language, shame or the current research design could (in part) explain the effects on attrition. Future research can contribute to identifying the underlaying mechanism in order to better adapt the BED-online treatment and or develop other treatments that better cater towards participants with those characteristics. Thereby, it is important to know if the same predictors associated with poorer treatment outcomes and attrition in BED-online are found in the currently available alternative treatment options for BED. If so, it could be explored if those patients perhaps yield greater treatment effects with the help of BED-online compared to the other treatments and thus (although not experiencing the same benefits as women and those born in the Netherlands) BED-online would be better suited for this population.

There are many more patient characteristics that could be explored. For instance; employment status, treatment history, medication use, motivation, social network, social skills, attachment style, coping strategies and BMI at baseline. There are many different directions one could take when exploring these variables. When looking at employment status, you could focus on whether the patient is employed, if they report feeling like they

have a meaningful interpretation of their day, whether they experience their job as being stressful, if their work demands more physical or mental labour or even explore differences between various work fields. Regarding treatment history, being in psychotherapy before can be assessed in a binary fashion, but another approach would be looking at the kind of treatment, if it was deemed successful, how recent the treatment was and if it was catered towards BED or another diagnosis. Medication use can be measured at the time of treatment, or past use can be included. A differentiation can be made between various types of medication, or between psychotropic and non-psychotropic medication. A patient's attitude regarding medication and treatment at baseline can be assessed; does the patient have more faith in one over the other. For motivation, it can be assessed how motivated the patient is to change, if it concerns intrinsic or extrinsic motivation and how much faith the patient reports having in the treatment at baseline. When assessing social skills, it could be relevant how outgoing a participant is, if they tend to be more introverted or extraverted, how they present in group settings, in one-on-one situations and online, or how easily they open up to new people, the use of body language, intonation and gestures in their communication and their ability to receive feedback. When looking at the social network of a patient, inquiries can be made about whether or not the patient feels like they have a support system, the size of the social network and how often the patient is able to see and/or speak to them. It could be relevant if it concerns an in-person meeting, if the support system consists out of relatives or 'chosen family', if the supersystem is aware of the treatment the patient is going to start and if any of them have experience with either psychotherapy or psychopathology of their own. Regarding attachment, the predictive power of different attachment styles can be explored. For coping strategies, the various coping styles can be viewed separately, or a distinction can be made between problem-focused and emotion-focused coping styles, or passive and active coping styles. It could be relevant if a patient is aware of their own coping styles and fallacies. Lastly, baseline BMI can be used as a possible predictor variable, where it could be taken into account if a patient's weight has fluctuated a lot over a period of time and if they report having a desire to lose weight.

Conclusion

To conclude, it could not be established that ethnicity, age, gender, educational level, comorbidity, frequency of binge eating episodes or treatment condition were predictive of treatment success when receiving BED-online treatment. Only the severity level of BED pathology at baseline were related to severity level of BED pathology post-treatment. Ethnicity and gender, however, were associated with (both treatment-related and circumstantial) treatment adherence; men and those born abroad were more at risk of attrition. The set of variables the model comprises of can be viewed as a starting point, but should not be viewed as conclusive or final. The limitations of the study are being recognized and addressed extensively. Further research is recommended with other predictor variables and with larger samples.

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