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Testing of a Novel Combined Eating-Disorder and Weight-Loss Online Guided-Self Help
Intervention for Young Adults with a Binge-Type Eating Disorder and Overweight or Obesity

by

Grace E. Monterubio, M.A.

A dissertation presented to
The Graduate School
of Washington University in
partial fulfillment of the
requirements for the degree
of Doctor of Philosophy

August, 2022

St. Louis, Missouri

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Grace E. Monterubio

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ABSTRACT OF THE DISSERTATION

Testing of a Novel Combined Eating Disorder and Weight-Loss Online Guided-Self Help Intervention for Young Adults with a Binge-Type Eating Disorder and Overweight or Obesity

by

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Doctor of Philosophy in Psychological & Brain Sciences

Washington University in St. Louis, 2022

Professor Denise Wilfley, Chair

Binge-type eating disorders (EDs) and obesity-related health concerns are two serious medical issues, though study of their treatment has largely remained separate. This study implemented an online, guided self-help ED intervention that concurrently offered Cognitive Behavioral Therapy (CBT)-based tools to improve ED symptoms, while also teaching energy-density food principles of behavioral weight loss (BWL), for individuals with clinical/sub-clinical binge-type EDs with comorbid overweight/obesity. The study aimed to examine change in weight, change in ED symptoms, and program engagement between a combined intervention (CBT + BWL) and an ED-only intervention. Participants in the combined intervention group received weekly session content pertaining to ED and weight-loss interventions and participants in the control group received sessions with ED-only intervention content. Outcomes from the combined intervention group and the ED-only intervention group did not significantly differ from each other. While both groups achieved a reduction in EDE-Q Global scores ($p < .001$) and binge episodes ($p < .001$) from baseline to post-intervention, one group did not reduce outcomes more than the other ($ps > .05$). These results suggest that more research is needed in order to address the gap in treatment for those with comorbid binge-type EDs and overweight/obesity.

Introduction

Eating disorders (EDs) are serious mental health disorders (American Psychiatric Association, 2013; Brownell & Walsh, 2017; Hudson, Hiripi, Pope, & Kessler, 2007) that are categorized into three main types: anorexia nervosa (AN), bulimia nervosa (BN), and binge eating disorder (BED) (American Psychiatric Association, 2013). The American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM-5; American Psychiatric Association, 2013) describes the diagnostic criteria of BED as frequently recurrent binge-eating episodes, which are defined as eating an objectively large amount of food in a discrete period (2 hours) with a sense of lost control during the episode. These episodes must meet at least three of the following criteria: (1) eating much more rapidly than normal; (2) eating until feeling uncomfortably full; (3) eating large amounts when not feeling physically hungry; (4) eating alone because of embarrassment by how much one is eating; and (5) feeling disgusted, depressed, or very guilty after binge eating (American Psychiatric Association, 2013). These binge episodes must occur at least 12 times over a period of three months (on average, once a week for three months). Binge-eating episodes are a core criterion for the diagnosis of BED and BN. Though, BN is distinct from BED in that it is also accompanied by compensatory behaviors to offset the binge-eating episodes in an attempt to lose weight or prevent weight gain. Compensatory behaviors are characterized as self-induced vomiting, fasting, excessive exercise, and the misuse of laxatives or diuretics (American Psychiatric Association, 2013). These behaviors also must occur at least 12 times over a period of three months.

Individuals who experience these disorders exhibit symptoms that may lead to weights on extreme ends of the weight status spectrum (American Psychiatric Association, 2013). While the symptoms of BN and BED can lead to overweight or obesity (overweight/obesity), having a

premorbid overweight/obese weight status can also make one more at risk for developing unhealthy weight management behaviors. Maintaining a healthy weight is important to health as having a weight status on either end of the spectrum can lead to serious health complications and even death (Brownell & Walsh, 2017; Dietz, 1998; Hudson, Hiripi, Pope, & Kessler, 2007; Bass & Eneli, 2015). While the low weight associated with AN has been heavily studied and interventions have been developed to help these individuals return to a healthy body mass index (BMI) (Fairburn, 2008; Lock & LeGrange, 2013), there are few interventions that simultaneously address overweight/obesity as well as ED symptoms in those who experience binge-type EDs (BED and BN). Many interventions address the primary symptom that can be associated with weight gain, binge eating; however, interventions are limited in their approaches to weight regulation (Fairburn, 2008). As such, there exists a gap in ED treatment to simultaneously address the commonly comorbid condition of overweight/obesity in binge-type EDs.

Features of Binge-Type Eating Disorders

Binge-type EDs share many features of their core symptomology (loss of control during binge-eating episodes resulting in guilt and shame); however, BN and BED have some distinctions in onset and demographic representation. Regarding BN, the disorder typically develops in adolescence or young adulthood (American Psychiatric Association, 2013), with average ages of onset between 16-20 years old (Stice et al., 2013). Diagnosis of BN tends to affect women more commonly than men, with a ratio of 10:1 (American Psychiatric Association, 2013). The rate of mortality due to medical complications of BN is reported as 2% of those affected per decade (American Psychiatric Association, 2013). Like BN, the onset of BED typically occurs in adolescence or young adulthood (American Psychiatric Association, 2013), with average ages of onset between 18-20 years old (Stice et al., 2013), though it can also onset in later adulthood.

Distinct from BN, BED tends to affect females and males at a relatively equal rate (American Psychiatric Association, 2013; Grucza, Pryzbeck, & Cloninger, 2007).

Another common feature of BN and BED is the prevalence of high weight-status that is associated with these binge-type EDs. Weight status indicates the categorization of BMI by underweight ($BMI < 18.5$), normal weight ($18.5 \leq BMI \leq 24.9$), overweight ($25.0 \leq BMI \leq 29.9$), or obese ($BMI \geq 30$) (National Center for Disease Control and Prevention, 2020), with a grouping of high weight status referring to those who have overweight/obesity ($BMI \geq 25$). BED has been consistently found to correlate with higher weight status. One study found BED to be correlated with a 6.3 point increase in BMI when adjusting for demographic differences (average BMI = 27.8 in typical population compared to BMI = 33.6 in BED participants)(Grucza, Pryzbeck, & Cloninger, 2007). Roughly 70% of those with BED had obesity ($BMI > 30$), and 20% had a BMI > 40 ; BED was also associated with lower mental health-related quality of life (Grucza, Pryzbeck, & Cloninger, 2007). Reviews of research comparing samples of individuals with overweight/obesity with and without BED revealed significant differences between the two groups (Wilfley, Wilson, & Agras, 2003; Hudson et al., 2006). As such, treatment for obesity alone does not address the specific concerns that are faced by those with comorbid BED (Wilfley, Wilson, & Agras, 2003). BED is not the only ED to be associated with overweight/obesity. Research on BN has also revealed that the majority of these individuals also have a BMI of at least 25. In a community sample of 1964 women, researchers found that of those with BN ($n = 131$), 68.7% had overweight/obesity, with 44.9% having a BMI of at least 30, and 14.4% with BMI of at least 40 (Masheb & White, 2012). These rates indicate that amongst those with binge-type EDs, the majority also have comorbid overweight/obesity (Hudson, Hiripi, Pope, & Kessler, 2007). Comparatively, of those *without* an ED diagnosis, 34.1% had overweight, and 15.8% had obesity

(Kalarchian et al., 2007). As such, the majority of those affected by clinical binge-type EDs also have comorbid overweight/obesity. This suggests that treatment for binge-type EDs should account for the presentation of high weight status and provide the option of weight management material for those who are interested in losing weight while addressing their binge-type ED.

Long-Term Outcomes of Obesity

Chronic obesity into adulthood comes with a multitude of long-term health implications, including an increased risk for diabetes, and coronary heart disease, certain cancers, and other fatal illnesses (Blüher, 2019; Finer, 2015; Kopelman, 2000). These medical comorbidities associated with obesity have been long studied and indicate the importance of treating weight status in disorders such as binge-type EDs, which have symptoms that can contribute to weight gain. Additionally, sleep-breathing disorders (such as sleep apnea) can occur for adults with obesity, which can have cascading medical impacts on physical health (Blüher, 2019; Finer, 2015; Kopelman, 2000).

Binge-Type Eating Disorders and Overweight or Obesity as Risk Factors

While the main symptom of binge eating can contribute to increased weight, having a high weight status can also be a risk factor for developing an ED (Decaluwé & Braet, 2003; Fairburn et al., 1998; Haines & Neumark-Sztainer, 2006; Hsu, 1997; Kessler et al., 2014). Findings of the early interactions between high weight status and binge-type EDs suggest they are both contributing risk factors, such that experiencing one condition can lead to the development of the other. Many studies demonstrate that a high weight status preceded the development of binge eating and ED symptomology (Decaluwé & Braet, 2003; Burrows & Cooper, 2002; Byrne, LeMay-Russell, & Tanofsky-Kraff, 2019; Neumark-Sztainer et al., 2006). High shape and weight concerns (being unhappy with the size, shape, or weight of one's body) contributes to unhealthy

weight regulation behaviors (such as restriction or limiting certain foods) and ultimately puts one at risk for binge eating episodes (Gormally, Black, Daston, & Rardin, 1982; Kessler et al., 2014, Tanofsky-Kraff, Faden, Yanovski, Wilfley, Yanovski, 2005). This dieting and unhealthy weight-control behavior is associated with weight gain in the long term (Goldschmidt et al., 2018; Masheb, White, & Grilo 2013). Disordered dieting was also associated with significantly increased weight gain and ED symptomology over a longitudinal study of adolescents (Neumark-Sztainer, 2006). The study found that those that had overweight and unhealthy weight control behaviors at the time of first assessment had a higher risk of binge eating at the second assessment compared to those not using any weight control behaviors at the initial assessment. Another mechanism for the development of concurrent binge-type ED and overweight/obesity is through the symptom of binge eating. The high energy consumption (in calories) of binge episodes associated with binge-type EDs can lead to weight gain. This is especially common in the case of BED, which does not have the compensatory behaviors that are associated with BN (American Psychological Association, 2013). However, compensatory behaviors of vomiting, restricting, laxative use, and excessive exercise, do not completely compensate for the energy consumed and the resulting weight gain. Past research on the effectiveness of compensatory behaviors found that vomiting retained roughly 2100-2500 calories regardless of how much was binged, and laxatives only reduced calorie absorption by 12% (Kaye, Weltzin, Hsu, McConaha, & Bolton, 1993; Bo-Linn, Santa Ana, Morawski, & Fordtran, 1983). As such, binge eating may be a contributor to the development of obesity in susceptible individuals (Fairburn, et al., 1998; Hsu, 1997; Stice, Presnell, Shaw, & Rhode, 2005; Goldschmidt, Aspen, Sinton, Tanofsky-Kraff, & Wilfley, 2008). These findings demonstrate that having overweight/obesity is not simply a *symptom* of experiencing binge eating; but in fact, having a high weight status can put one *at risk* for

developing binge-type ED symptoms and suggests the need for more effective strategies to address these behaviors in this population.

Some studies suggest that obesity alone does not predispose individuals to the development of an ED, and that other vulnerability can increase the risk for development of a binge-type ED in those with obesity (Hudson et al., 2006; Neumark-Sztainer et al., 2007; Puhl, Moss-Racusin, & Schwartz, 2007). One contributing factor includes experiencing weight-stigmatization (Ashmore, Friedman, Reichmann, & Musante, 2008; Neumark-Sztainer et al., 2002; Neumark-Sztainer et al., 2007; Puhl, Moss-Racusin, & Schwartz, 2007). Weight-based stigmatization, or weight-teasing, predicts binge-eating behavior and the psychological distress associated with stigmatizing experiences may be an important mediating factor of the development of ED symptoms (Ashmore, Friedman, Reichmann, & Musante, 2008). Weight-stigmatization increases body image dissatisfaction, which leads to disordered eating behavior, psychopathology, and unhealthy dieting (Haines & Neumark-Sztainer, 2006). In addition to these sociocultural factors, obesity and EDs have many biological links. BED-specific familial factors may independently increase the risk of obesity, especially severe obesity (Hudson, et al., 2006). Vulnerabilities such as a family history of depression and perfectionism are also associated with the risk of developing BED and BN in those with a high weight status (Fairburn, et al., 1998). These vulnerabilities are not only risk factors preceding ED development, but also having comorbid overweight and ED is associated with the *further* development of psychopathologies, such as depression, low-esteem, and anxiety (Ermis et al., 2004; Byrne, LeMay-Russel, Tanofsky-Kraff, 2019). Like the relationship between weight-status and ED symptomology, other psychopathology can be both an influencing factor in the development and maintenance of an ED and overweight/obesity (Eremis et al., 2004; Gianini, White, & Masheb, 2013; Goldschmidt, Wall, Loth, Le Grange, & Neumark-Sztainer, 2012).

Considering the intertwined nature of overweight/obesity and binge-type EDs, it is evident that these two conditions *relate* and *exacerbate* each other. Regardless of the original presenting condition, they frequently develop to be comorbid presentations.

Presentation of Binge-Type Eating Disorders in Overweight or Obese Individuals

The presentation of binge-eating episodes or clinical BED was found in a quarter of adults with obesity (He, Cai, & Fan, 2017; Kalarchian et al., 2007). Prevalence of BED is especially high in populations seeking treatment for their ED (Kalarchian et al., 2007; Masheb, White, & Grilo, 2013), suggesting that individuals with binge-type EDs and high weight status also have a higher degree of severe clinical impairment that drives them to treatment. For the large proportion of individuals experiencing binge-type ED pathology and comorbid overweight/obesity, their symptoms range from disordered eating behavior to distressing cognitions about their weight and shape, which have a negative impact on their mood and anxiety (Desai, Miller, Staples, & Bravender, 2008; Hsu et al., 2002; Kennedy et al., 2017; Tanofsky-Kraff, et al., 2005; Wilfley, Wilson, & Agras, 2003). Studies reveal that these individuals have additional symptoms of lower self-esteem, preoccupation with food, trouble with emotion regulation, as well as a presence of mood and anxiety disorders in addition to typical symptoms of binge-type EDs (Burrows & Cooper, 2002; Desai, Miller, Staples, & Bravender 2008; Gianini, White, & Masheb, 2012; Glasofer et al., 2007; Tanofsky-Kraff et al., 2004). When comparing the behavior of those who have overweight/obesity and binge eating with those who have overweight/obesity and no binge eating, those who binge eat had more eating disturbances (restriction, loss of control, more reports of hunger) than the non-binge eaters (Macias & Leal, 2003). Interestingly, there are also distinctions between those with BED and overweight/obesity compared to those with BED and normal weight that demonstrate how having a higher weight status exacerbates the severity of BED

symptoms (Glasofer et al., 2007; Goldschmidt et al., 2011; Desai, Miller, Staples, & Bravender, 2008). For those with clinical BED and normal weight status, they are less likely to use unhealthy weight control behaviors, and they experience less impairment and less severe symptoms compared to those with comorbid BED and obesity (Glasofer et al., 2007; Goldschmidt et al., 2011; Desai, Miller, Staples, & Bravender, 2008). These distinctions suggest that those with comorbid binge-type EDs and overweight/obesity are experiencing a greater ED severity and suggest that this population could benefit from additional intervention beyond the current protocol implemented in the treatment of BED.

Evidence-Based Treatment for Binge-Type Eating Disorders and Obesity

There are currently multiple evidence-based interventions that are effective for treating binge-type EDs, as well as overweight/obesity, which could be effective components of a combined treatment for comorbid overweight/obesity and binge-type EDs (Fairburn, 2008; Hilbert et al., 2019; Vocks et al., 2010). Traditional psychotherapy treatments such as cognitive behavioral therapy (CBT) (Fairburn, 2008; Hilbert et al., 2019; Iacovino, Gredysa, Altman, & Wilfley, 2012; Vocks et al., 2010; Wagner, Nagl, Dölemeyer, Steinig, & Kersting, 2016) and interpersonal psychotherapy (IPT) (Wilfley et al., 2002; Wilson, Wilfley, Agras, & Bryson, 2010; Zwaan, 2001) have been effective in the treatment of BED and BN. CBT-based interventions emphasize self-monitoring, managing triggers with alternative coping mechanisms, and restructuring automatic negative thoughts to target the behaviors and psychopathology of binge-type EDs (Fairburn, 2008). IPT focuses on how interpersonal relationships may be influencing ED thoughts and behaviors and addresses the interpersonal problem area(s) to reduce the symptoms (Wilfley, et al., 2002). Studies have found both CBT and IPT highly effective in treating binge-type EDs, whether administered in the traditional one-on-one therapy session format, in a group, or through guided-self-help

(Iacovino, Gredysa, Altman, & Wilfley, 2012; Wilfley, et al., 2002; Wilson, et al., 2010). These modalities have even been translated into internet-based interventions that have shown to be moderately effective (Cohen's $d = 0.4$) in yielding a large reduction in binge eating and eating disorder symptomology (Fitzsimmons-Craft et al., 2020; Jones et al., 2008; Wagner et al., 2016). As such, CBT, IPT, or CBT-based guided self-help are recommended as the first-line treatments for binge-type EDs (Vocks et al., 2010). Given the scalability for internet-facilitated online intervention, the National Institute for Health and Care Excellence (NICE) in the United Kingdom has recommended online, guided self-help CBT interventions as first line interventions for EDs (NICE, 2017). Thus, the use of online, guided interventions has strong support in the treatment of binge-type EDs.

Despite these interventions' effectiveness in treating ED symptoms and some short-term weight loss, these results appear to be limited to treating the eating psychopathology and not long-term weight status (Grilo, Masheb, Wilson, & White, 2011). When compared to behavioral weight-loss (BWL) interventions alone, psychotherapy interventions for BED tend to outperform BWL in reducing the eating pathology that was contributing to weight; however, weight loss was not sustained long term for either intervention, though psychotherapy was found to be helpful in weight maintenance long term in some studies (Butryn et al., 2012; Hilbert et al., 2019; Grilo, & Masheb, 2005; Grilo, Masheb, Wilson, & White, 2011; Munsch, Meyer, & Biedart, 2012; Wilson, Wilfley, Agras, & Bryson, 2010). In a comparison of CBT to BWL in individuals who have BED, weight loss was minimal and differed little across treatments, suggesting that BED participants struggled to lose weight without having their binge eating symptoms managed (Grilo et al., 2011). A recent stepped care study found that BWL was as effective as CBT in long term weight loss, suggesting that long term weight loss can be achieved by these types of interventions (Grilo et al.,

2020). Other findings suggest that CBT administered via guided self-help demonstrates efficacy for binge eating but is not sufficient for effective and sustained weight loss (Grilo & Masheb, 2005; Grilo et al., 2020; Jones et al., 2008; Wagner et al., 2016). Although ED treatment in the absence of obesity treatment does not result in large weight reduction, amelioration of binge eating does result in small weight loss and decreased weight regain over time (Piya et al., 2021; Yanofski, 2003). These findings are consistent with other studies, all suggesting that a moderate or high dose of BWL treatment may be required to produce clinically significant weight loss after reductions in binge eating severity and behavioral changes (Ariel & Perri, 2017).

Research on the treatment of obesity has supported the use of BWL interventions. BWL treatments focus on making healthful changes to diet and lifestyle that are implemented with sustainable goals that aim to maintain the changes even beyond the intervention (Butryn et al., 2011; Butryn, Webb, & Wadden, 2012). BWL interventions suggest that weight loss treatment can be effective and done in a healthful manner as opposed to the restrictive methods of disorder eating (Haynos et al., 2015). BWL treatments have incorporated psychological interventions such as CBT to enhance the effectiveness of the intervention (Grilo & Masheb, 2005; Grilo, Masheb, Wilson, & White, 2011; Wilfley et al., 2007). Samples of adults seeking treatment for obesity have shown high attrition rates of participants who also suffer from binge eating, as well as a higher incidence of regained weight post-treatment (Blomquist et al., 2008; Zwann, 2001; Sherwood, Jeffery, & Wing, 1999). After receiving treatment, patients with obesity and comorbid BED have reported marked weight gain during the post-treatment year (Blomquist et al., 2008). These findings suggest that current evidence-based weight loss methods are not sustainable long term for those with binge eating, suggesting that implementing weight loss methods alone are not sufficient for those with comorbid overweight/obesity and binge eating (Balantekin et al., 2017; Grilo & Masheb, 2005;

Grilo, Masheb, Wilson, & White, 2011; Grilo et al., 2020; Macias & Leal, 2003; Neumark-Sztainer et al., 2007; Sherwood, Jeffery, Wing, 1999). Other studies have shown promise in BWL with the use of smartphone technology. A 12-week, smartphone based, weight-loss intervention had significant weight loss in a randomized control trial (Martin, Miller, Thomas, Champagne, Han, & Church, 2015), suggesting that BWL is an effective weight-loss treatment in-person as well as through mobile-based interventions. Meta-analyses have also demonstrated the effectiveness of digital weight-loss interventions, especially when coupled with coaching (Berry, Sala, Abber, Forman, 2021; Islam et al., 2020; Neveet al., 2011).

To date, most interventions for binge-type EDs and overweight/obesity have been studied separately. However, there have been some investigations into combined treatment with mixed results (Brownley et al., 2016; Braet, Tanghe, Decaluwé, Moens, & Rosseel, 2004; Hayes et al., 2018; Grilo, Masheb, Wilson, & White, 2011; Jones et al., 2008; Masheb, Grilo, & Rolls, 2012; Munsch, Meyer, & Biedart, 2012). Results suggest that CBT combined with the energy density diet (a type of BWL) was significantly more effective than CBT combined with the general nutritional information and calorie control (Masheb, Grilo, & Rolls, 2012). Energy density methods emphasize consuming foods low in energy (calories) and high in bulk (fiber and water; ex. vegetables, fruits, lean meats, and whole grains) while decreasing consumption of high-energy dense foods (ex. oils, high-fat meats, and full-fat dairy). The combination of diet change with CBT to address the ED symptoms was more effective at reducing energy-dense foods and increasing fruit and vegetable consumption compared to CBT paired with general nutrition as a control, suggesting that low-energy-density dietary counseling has promise as an effective method for enhancing CBT for obese individuals with BED (Masheb, Grilo, & Rolls, 2012; Rolls, Drewnowski, & Ledikwe, 2005).

The long-term effects of these combined interventions have revealed mixed results. Findings support use of combination of both these treatments together, particularly when treatment is concurrent (Munsch, Meyer, & Biedert, 2012; Grilo, Masheb, Wilson, & White, 2011). Research suggests CBT was superior to BWL for producing reductions in binge eating through 12-month follow-up, while BWL produced statistically greater, though modest, weight loss during treatment (Grilos, Masheb, Wilson, & White, 2011). A meta-analysis found that when compared to psychotherapies alone, ED treatment combined with weight-loss interventions revealed no additive effect on longitudinal weight-loss outcomes (Hilbert et al., 2019). However, this meta-analysis study had very few combined studies to analyze, thus making statistical comparison difficult. Other studies comparing the use of CBT and BWL for BED found comparable results after treatment and 6-months post-treatment (Munsch, Meyer, & Biedert, 2012). Another recently published study of a combined BWL and ED intervention compared to CBT-only in groups of individuals with binge-type EDs found that metabolic and body measurement outcomes between groups were not significantly different from each other at 6-months (Hay et al., 2022). These few studies demonstrate a need for more research on combined interventions to investigate their use as an effective method for treating the comorbid presentation of binge-type EDs and overweight/obesity.

Significance of the Current Study

Binge-type EDs and obesity-related health concerns are two serious medical issues, though study of their treatment has largely remained separate. However, the intersection of EDs and overweight/obesity reveals a large, and mostly underserved, population. Given the high comorbidity of binge-type EDs and overweight/obesity, as well as the serious physical and mental health symptoms that can occur from experiencing these comorbidities, treatment could benefit

from addressing these concerns together (da Luz et al., 2018). Proposals have called for the combination of evidence-based interventions that support the use of treatment for binge-type EDs and comorbid overweight/obesity (Cardel et al., 2022; Golden, Schneider, & Wood, 2016; Irving & Neumark-Sztainer, 2002; Neumark-Sztainer, 2005; Yanovski, 2003; D'Adamo, Fenning, Grammer, Jebeile, Fitzsimmons-Craft, & Wilfley, in press).

Past studies focused specifically on weight loss in individuals with BED after treatment of BED symptoms via psychotherapy, or compared weight loss interventions to psychotherapy interventions (Hilbert et al., 2019; Munsch, Meyer, & Biedert, 2012; Yanovski & Sebring, 1994; Wifley et al., 2002; Grilo & Mashem, 2005). Outcomes of these studies have been mixed, with some suggesting that combination treatment could further improve the outcomes for individuals with BED (Hilbert et al., 2019; Munsch, Meyer, & Biedert, 2012; Yanovski & Sebring, 1994; Wifley et al., 2002; Grilo & Mashem, 2005). Given that these studies have focused on individuals with BED, those with other EDs, particularly BN, remain unstudied in terms of combined binge-type ED treatment and weight loss.

Online programs geared towards ED treatment have found improvements in ED psychopathology (Fitzsimmons-Craft et al., 2020; Stice, Shaw, & Marti, 2006). Additionally, online BWL programs have found promising results, though more comparison studies are needed (Islam et al., 2020; Neve et al., 2011). Given the high prevalence of individuals with comorbid EDs and overweight/obesity, there exists a gap in research on interventions to help these individuals who also want to manage their weight status appropriately as well as reduce their ED psychopathology. Thus, an online intervention for ED psychopathology and weight loss in individuals with clinical and sub-clinical binge-type EDs was the next step. The goal of this study was to implement a digital program to reduce ED pathology and binge eating, while also reducing

weight, for young adults with binge-type EDs and comorbid overweight/obesity. Intervention for this population is especially imperative as young adults with binge-type EDs are particularly susceptible to continued weight gain (Masheb, White, & Grilo, 2013). This project built upon the promising prior findings that support the use of combined CBT with energy-density BWL for treatment of binge-type ED symptoms and weight management. Furthermore, it utilized an online format as supported by a previous ED treatments study (Fitzsimmons-Craft et al., 2020). This study implemented an online, guided self-help ED intervention that concurrently offered CBT-based tools to improve ED symptoms, while also teaching the energy-density food principles of BWL (Rolls, Drewnowski, & Ledikwe, 2005) for individuals with clinical/sub-clinical binge-type EDs with comorbid overweight/obesity (combined intervention) and examined effectiveness compared to a control condition that offered an online intervention that only addressed ED symptoms (ED-only intervention). By comparing to an ED-only intervention, this project hoped to assess if there were added beneficial effects of *combining* weight-loss and binge-type ED intervention content compared to the already empirically-supported online intervention for EDs.

Aims and Hypothesis

Primary Aim

Aim 1: Test the use of online, guided self-help program in the reduction of ED psychopathology and weight loss for young adults with clinical or sub-clinical binge-type EDs who have comorbid overweight/obesity and compare if the effects of the combined intervention are *different* than the ED only intervention.

1a) Assess ED psychopathology and binge eating at baseline, mid-intervention, and post-intervention time-points to test if change of ED symptoms is different in the combined intervention compared to the ED-only intervention.

1b) Assess weight at baseline, mid-intervention, and post-intervention time-points to test if weight change is different in the combined intervention compared to the ED-only intervention.

Secondary Aim

Aim 2: Assess if retention and engagement in combined intervention is different than the ED-only intervention.

2a) Identify if addition of weight-loss content impacts retention for online program as measured by program completion between participants in each group.

2b) Identify if addition of weight-loss content impacts individual session engagement for online program as measured by percentage of completed session free-responses between participants in each group.

Hypotheses

Aim 1: It was predicted that use of a combined ED and weight-loss online, guided self-help intervention would lead to improved outcomes compared to the ED-only intervention.

1a) It was predicted that use of a combined ED and weight-loss online, guided self-help intervention would lead to greater reduction in ED symptoms and binge eating than the ED-only intervention.

1b) It was predicted that use of a combined ED and weight-loss online, guided self-help intervention would lead to greater weight loss than the ED-only intervention.

Aim 2: It was predicted that retention and engagement in combined intervention would be greater than control group.

2a) It was predicted that use of a combined ED and weight-loss online, guided self-help intervention would lead to improved retention compared to the ED-only intervention.

2b) It was predicted that use of a combined ED and weight-loss online, guided self-help intervention would lead to improved session engagement compared to the ED-only intervention.

Method

Overview of Design

The study was approved by the Institutional Review Board (IRB) at the home institution where the study was conducted. The IRB had concerns about the information being collected via the online format. As such, data about gender, age, and racial identity were not collected to ensure the IRB's comfort, as well as increase the participants' comfort with the amount of information requested. To be eligible for enrollment, all participants confirmed they were between the ages of 18- and 39-years-old. Participants were screened via online survey (Appendix A), which was distributed to young adults through email announcements from universities' Student Health Centers, campus organizations, workplace recruitment listservs, social media, and other electronic methods. Participants (N = 60) were randomly assigned to the combined intervention (n=30) or the control intervention (n=30), began receiving sessions via email within one week of their initial baseline and received a new session each week for eight weeks. Regardless of participants' condition, all participants were asked to complete a survey at baseline, mid-intervention (after

session four) and post-intervention (after session eight) to assess their Eating Disorder Examination Questionnaire (EDE-Q; Appendix B) scores and weight change.

The interventions were created from an established evidence-based ED intervention (Fitzsimmons-Craft et al., 2020) and modified for both study arms. For the current study, the original program was updated to have less text and more engagement (questions asking participants to apply the material to their life; e.g., “What are your goals?”), and was also updated to apply to young adults instead of college students. References were made to work- and family-life instead of school- and dorm-life. Additionally, the programs were modified to be more inclusive of all demographics, with examples including male, female, and non-binary individuals, and images included more people of diverse racial and ethnic backgrounds. The program was also formatted to be uploaded into the Qualtrics hosting website (Qualtrics.com). These changes were made to the original program and were part of both arms of the intervention. The control group (ED-only intervention) hailed close to the original program, and the combined intervention included BWL strategies and food density material to target weight loss. Sample pages of the program hosted on Qualtrics are included in Appendix C.

Individuals in both groups participated in the weekly CBT-based self-help sessions (Appendix C). The sessions were distributed each week via email, and contained new material related to the session theme. Those in the combined intervention group received weekly session content pertaining to ED and weight-loss interventions (Appendix D; Raynor, Van Walleghen, Bachman, Looney, Phelan, & Wing, 2011; Rolls, Drewnowski, & Ledikwe, 2005). Those in the control group received sessions with only ED intervention content. The control group’s sessions included added filler content regarding regular eating and meal planning (such as a sample meal schedule and example of a meal plan) in place of the weight-loss content to ensure that sessions

were the same length for both conditions so as to control for factors that might decrease engagement. Within program sessions, data on the participants' engagement and progress was recorded. This included a weekly record of self-reported weight change and symptoms. Each session was designed to take no longer than 20 minutes to complete. Additional reminders and guidance to complete the program material were offered via email each week by the coach (author GM). Coach messages were sent to program participants every week. If participants forgot to complete their session, the coach reminded the participants about their next session. If participants completed the session, the coach provided feedback on their progress and helped trouble shoot any difficulties they were having with applying the material. If the participants messaged the coach back, then two messages were sent in a week, though most weeks consisted of one coach message. Examples of coach messages with GM and participant responses are included in Appendix E.

Recruitment

Participants were recruited via online survey that was distributed through email, in partnership with Student Health Services, groups on college campuses, local employment listservs, social media, and other electronic mediums. Previous studies suggest that college campuses have elevated rates of ED screens, 17.1%, compared to community samples (Eisenberg, Nicklett, Roeder, & Kirz, 2013). Additionally, in a study with a sample of 690 college women screening positive for a DSM-5 ED at 28 US universities, 58% had overweight/obesity (Kass et al., 2016), suggesting that recruiting on college campuses would result in a large eligible participant population. Thus, college students were targeted, in addition to young adults. On college campuses, emails were sent out to student groups (such as student athletes, Greek life, etc.), and were also promoted by professors and staff related to the study's content (e.g. the campus nutritionist). To recruit young adults into the study, social media and workplace listservs were used.

Work places (such as hospital systems) circulated information about the study in periodical announcements. Additionally, professionals in the EDs field were asked to share study information on their personal social media (such as Twitter) in order to encourage other professionals in the field to share the study link. Past studies that have recruited via online screen have found electronic invitation (specifically email) to be most successful in recruiting participants (Fitzsimmons-Craft et al., 2019). The study was advertised as a behavioral weight-management intervention combined with positive body image material in order to reach individuals who identified as wanting to lose weight, but also wanting help with their eating behaviors and weight and shape concerns.

Participants

Participants were 60 young adults (aged 18-39) with clinical or sub-clinical binge-type EDs who have comorbid overweight/obesity (BMI > 25). Study eligibility was determined by those who meet the criteria of 6 or more binge episodes in the past 3 months (consumption of objectively large amount of food in one sitting, combined with sense of lost control while eating that causes marked distress; Kass et al., 2019). Importantly, only participants who endorsed that they *wanted to lose weight* on the questionnaire were offered enrollment in the study. Once enrolled, participants were randomized, with those in the treatment group receiving the combined ED and weight loss program, and those in the control group receiving an intervention with ED-only content. A consort diagram of participants can be found in Figure 1.

Past studies have found BED prevalence rates to be higher than BN or AN, as well as affecting proportionate rates of men and women (Kalarchian et al. 2007; Hudson, Hiripi, Pope, & Kessler, 2007). As such, both men and women were eligible to participate in the study. Any participants who screened positive for possible AN (BMI <18.5) were excluded. Those who screened for possible AN were referred to the NEDA Resources Page.

Measurements

A modified version of the Stanford-Washington University Eating Disorder (SWED; Fitzsimmons-Craft et al., 2020) Screen was used to screen participants for EDs (Appendix A). Specifically, questions related to ED symptoms, weight and shape concerns, and height and weight were asked, as well as an added question regarding interest in weight-loss. The EDE-Q was used to measure ED pathology and symptoms (Appendix B). The EDE-Q (version 6.0; Fairburn, 2008) is a 28-item questionnaire that assesses ED psychopathology over the past 28 days, and includes Weight Concern, Shape Concern, Eating Concern, and Restraint subscales, as well as a Global score. The EDE-Q also measures self-reported frequency of ED behaviors (i.e., binge eating, vomiting, laxative use, compulsive exercise). Additionally, self-reported height and weight was used to calculate BMI at screening (to determine eligibility criteria of overweight BMI > 25). Self-reported height and weight was also assessed following enrollment in the study in the baseline, mid-intervention, and post-intervention assessments. Due to the COVID-19 pandemic, all measures were collected through online surveys as in-person measurements were not possible due to social distancing restrictions limiting in-person meetings.

Power

To achieve a power of 0.8 and an error probability of 0.05 using linear regression modeling (required for primary outcome variables of EDE-Q scores and weight loss assessed in Primary Aim 1), approximately 30 participants per group (i.e., combined ED and weight-loss intervention and ED-only control intervention) were needed to detect a moderate effect size of 0.4, accounting for a possible 10% attrition rate (estimated from previously reported data and comparable studies; Fitzsimmons-Craft et al., 2020; Jones et al., 2008).

Analysis of Measured Outcomes

1) Aim 1: Analyzed average EDE-Q scores, binge episodes, and weight change at baseline, mid-intervention and post-intervention between program and control groups and compared mean differences within groups with a no-intercept general linear mixed model. Binge episodes were analyzed using a negative binomial model.

1a) Analyzed average EDE-Q scores and binge episodes at baseline, mid-intervention, and post-intervention with no-intercept general linear mixed model (EDE-Q scores) and negative binomial model (binge episodes) analyses to compare time points between both groups.

1b) Analyzed average weight change at baseline, mid-intervention, and post-intervention time-points with a no-intercept general linear model mixed analysis to compare time points between both groups.

2) Aim 2: Analyzed session completion and session engagement between the combined intervention and control intervention.

2a) Compared program completion (completed all 8 sessions) between combined intervention and control intervention with a Chi-Squared analysis.

2b) Compared session engagement (percentage of free-responses completed within sessions) between combined intervention and control intervention with a Paired Sample t-test.

A no-intercept general linear mixed model produces separate expected means for participants at each time-point. The primary advantages to this approach are that missing data are accommodated more efficiently than a standard repeated measures ANOVA and comparisons of means are easily estimated. Using this model, a matrix of coefficients was developed to compare the model across time and between both conditions. A negative binomial model was used for binge

episodes because of the skewed distribution common for count variables. Analyses of groups compared change in EDE-Q scores and weight change from baseline, mid-intervention (session 4), and post-intervention (session 8). Specifically, the analyses compared change in EDE-Q scores and change in BMI over time and performed time versus group analyses to compare results between the combined intervention and ED-only control groups. For investigation of the secondary aim, the number of participants who completed the program were compared between the two groups using a Chi-Squared analysis. Session engagement between groups was also compared using a paired samples Student's t-test of the percentage of session free-responses completed within each group.

Results

Analyses were conducted in R (Core Team, 2021) using the lme4 package (Bates, Maechler, Bolker, & Walker, 2015). Secondary aim analyses were run in SPSS version 26. A total of 60 participants enrolled in the study, and 30 participants were randomized to each condition. Though 10 participants formally withdraw from the study, intent to treat analyses were run with estimated means to account for all 60 participants. All genders were eligible to participate, and participants selected whether they were between the ages of 18-39 to confirm their young adult status. The mean BMI of the sample at baseline was 34.4 (SD = 7.4). The mean EDE-Q Global score for all participants at baseline was 3.7 (0.9) (clinical cut-off = 4), and the average number of binges reported over the last 28 days was 11.1 (9.3). Regarding diagnostic features of the sample, most of the participants were full criteria for either BN (47%) or BED (23%) diagnoses. Those that met BN criteria had 4 or more binge episodes and 4 or more compensatory behaviors (vomiting, laxatives use, excessive exercise) in the last 28 days. Those that met for BED had 4 or more binge episodes in the last 28 days and no reported compensatory behaviors. The remaining

sample met criteria for sub-clinical BN (10%) or sub-clinical BED (20%). Those that had subthreshold BN criteria endorsed less than 4 binges in the last 28 days and less than 4 cumulative compensatory behaviors. Those that had subthreshold BED criteria had less than 4 binges in the last 28 days and no compensatory behaviors. Severity of weight status was also calculated, with 31.7% having overweight, 30% having class 1 obesity, 20% having class 2 obesity, and 18.3% having class 3 obesity. Table 1 summarizes the sample demographics.

Table 1. Demographics and Sample

Measure Demographics	At Baseline Mean (SD)
BMI	34.4 (7.4)
EDE-Q Global	3.7 (0.9)
Binges (in last 28 days)	11.1 (9.3)
Diagnostic Demographics	Percent
BN (n = 28)	47%
Sub-clinical BN (n = 6)	10%
BED (n = 14)	23%
Sub-clinical BED (12)	20%
Weight Status Demographics	Percent
Overweight (BMI 25 to < 30 [n = 19])	31.7%
Obesity Class 1 (BMI 30 to < 35 [n = 18])	30%
Obesity Class 2 (BMI 35 to < 40 [n = 12])	20%
Obesity Class 3 (BMI 40 or higher [n = 11])	18.3%

* Criteria defined using EDE-Q data which collects symptoms over the last 28 days
Abbreviations: BMI, Body Mass Index; EDE-Q, Eating Disorder Examination-Questionnaire

Main outcomes are reported in Table 2. An intent to treat, no-intercept model analysis revealed no significant interaction between groups and time (all $ps > .05$), suggesting that there were no significant changes in main outcomes due to study condition. However, there were significant differences for EDE-Q and binge episodes across time-points for participants in each condition. Table 2 summarizes means across time-points between the combined and ED-only conditions. Average baseline BMI in the combined intervention was 35.4, and 33.3 in the ED-only

Table 2. Main Outcomes

Condition (n = 60) Combined (n = 30) ED-Only (n = 30)		Measures at Time Points		
		Baseline	Mid-Intervention	Post-Intervention
		Est. M (SE)	Est. M (SE)	Est. M (SE)
Weight (BMI)	Combined Intervention	35.4 (1.4)	35.1 (1.4)	35.2 (1.4)
	ED-Only Intervention	33.3 (1.4)	33.1 (1.4)	33.1 (1.4)
EDE-Q Global	Combined Intervention	3.7 (0.2)	3.1 (0.2)	2.4 (0.2)
	ED-Only Intervention	3.7 (0.2)	2.8 (0.2)	2.3 (0.2)
Binge Episodes (over last 28 days)	Combined Intervention	10.2 (1.5)	5.9 (1.6)	5.3 (1.6)
	ED-Only Intervention	12.1 (1.5)	6.5 (1.7)	4.4 (1.7)

Abbreviations: BMI, Body Mass Index; EDE-Q, Eating Disorder Examination-Questionnaire

intervention. Regarding ED symptoms, the mean EDE-Q Global score at baseline was 3.7 for both groups and average binge episodes for the combined intervention was 10.2 at baseline and 12.1 for the ED-only intervention. At post-intervention average baseline BMI in the combined intervention was 35.2, and 33.1 in the ED-only intervention. No-intercept general linear mixed model results revealed no significant difference between BMI at any time point, nor were groups significantly different from each other ($ps > .05$). At post-intervention, EDE-Q Global score for the combined intervention group was 2.4, and 2.3 for the ED-only intervention.

Table 3 depicts follow up comparisons. Follow-up comparisons assessed EDE-Q Global scores across time and revealed there was a significant difference for both groups between baseline and post-intervention ($ps < .001$). Interestingly, the combined intervention revealed significant change in EDE-Q Global at all three time points ($ps < .05$), whereas the ED-only intervention had significant change from baseline to mid-study ($p < .001$). As such, those in the combined intervention reported continued reduction in ED pathology throughout their time in the program

and those in the ED-only intervention had significant change at the beginning of their time in the program. Overall, the final changes in EDE-Q Global were not significantly different between the two groups and both the combined intervention and ED-only intervention equally improved eating disorder symptomology (though at different rates). At post-intervention, binge episodes (over the last 28 days) for the combined intervention group was 3.6, and 3.1 for the ED-only intervention. Negative binomial model results revealed there was a significant difference for both groups between baseline and post-intervention ($p < .001$); however, there was no significant difference between the groups. Both the combined intervention and ED-only intervention equally reduced binge eating episodes. Follow-up comparisons compared groups across time and revealed binge-eating episodes were significantly different between baseline and mid-study ($ps < .01$), and baseline and post-study ($ps < .001$). Binge eating episodes were not significantly different between

Table 3. Follow-up Comparisons

Time by Condition: Follow-Up Comparisons								
Condition (n = 60) Combined (n = 30) ED-Only (n = 30)		Baseline vs. Mid-Intervention			Mid- vs. Post-Intervention		Baseline vs Post-Intervention	
		Est. Change (SE)	<i>p</i>		Est. Change (SE)	<i>p</i>	Est. Change (SE)	<i>p</i>
Weight (BMI)	Combined Intervention	0.3 (0.8)	$p > .05$		-0.1 (-0.2)	$p > .05$	0.2 (0.6)	$p > .05$
	ED-Only Intervention	0.2 (0.4)	$p > .05$		0.0 (0.4)	$p > .05$	0.2 (0.4)	$p > .05$
EDE-Q Global	Combined Intervention	0.6 (0.2)	$p = .006^*$		0.6 (0.9)	$p = .01^*$	1.1 (0.2)	$p < .001^*$
	ED-Only Intervention	0.9 (0.2)	$p < .001^*$		0.4 (0.3)	$p > .05$	1.4 (0.2)	$p < .001^*$
Binge Episodes (over last 28 days)	Combined Intervention	4.3 (1.2)	$p = .002^*$		0.6 (1.3)	$p > .05$	4.9 (1.2)	$p = .001^*$
	ED-Only Intervention	5.6 (1.4)	$p < .001^*$		2.1 (1.5)	$p > .05$	7.1 (1.3)	$p < .001^*$

Abbreviations: BMI, Body Mass Index; EDE-Q, Eating Disorder Examination-Questionnaire

* Indicates Holm corrected statistical significance (within group comparisons) at $p < .05$ level

mid- and post-intervention assessments, thus, the greatest reduction in binge episodes occurred at the beginning of the program for both groups.

Secondary outcomes are reported in Table 4. Of those that enrolled in the study, 46.7% of the sample completed all 8 sessions of the program (28 total, 15 in the combined condition and 13 in the ED-only condition). There was also a 16.7% formal dropout rate (participants that requested withdrawal from the study). The primary reported reason for drop out was not having enough time for the study anymore. Figure 1 details participant numbers throughout the study. Program engagement was categorized into program completion (those that completed at all 8 sessions) and session engagement (percentage of each individual session completed [21 opportunities to respond on average]). The combined intervention had an average session completion rate of 5.2, and the ED-only participants had an average of 5 sessions completed. Figure 2 depicts the distribution of participants' session completion rate. Regarding session completion, there were no significant differences between the combined intervention and ED-only intervention ($X^2 = 0.27$; $p = 0.61$). Session engagement was calculated by averaging the percentage of the session responses participants completed within each session. Student's t-test revealed no significant difference

Table 4. Engagement

Program Completion Engagement

n = 28	Completed all sessions	X^2	p
Combined Intervention (n = 15)	50%	0.27	0.61
ED-Only Intervention (n = 13)	43.3%		

Average Session Engagement

n = 28	(% of each individual session completed)	t	p
Combined Intervention (n = 15)	88%	0.88	0.54
ED-Only Intervention (n = 13)	87%		

between the average percentage of session completion between participants in each group ($t = 0.88$; $p = .54$). As such, program engagement did not significantly differ between the two groups.

Discussion

This study implemented a program to reduce ED symptoms associated with binge-type EDs, such as bingeing and weight and shape concerns, while also aiming to reduce weight for young adults with binge-type EDs and comorbid overweight/obesity. It was hypothesized that a combined ED and BWL intervention would help individuals with binge-type EDs and overweight/obesity reduce ED behaviors and lose weight compared to an ED-only intervention, while also leading to increased program participation due to the combined program addressing the comorbid overweight/obesity. Findings revealed that outcomes from the combined intervention group and the ED-only intervention group did not significantly differ from each other. While both groups achieved a significant reduction in EDE-Q Global scores and binge episodes from baseline to post-intervention, one group did not reduce outcomes more than the other.

In this study, the combined intervention reduced mean EDE-Q Global scores by 1.3 points, and the ED-only intervention reduced scores by 1.4 points. When looking at binge eating episodes specifically, the combined intervention reduced mean number of episodes over the last 28 days by 4.9 episodes on average, and the ED-only intervention reduced by an average of 7.7 episodes. These outcomes are not significantly different between each group, suggesting that the programs worked equally well at reducing these symptoms of binge-type EDs in young adults with comorbid overweight/obesity. Notably, neither program had significant changes in weight. As such, the hypothesis that the combined intervention would lead to more weight loss compared to the ED-only intervention was not supported. Similarly, engagement did not significantly differ between

the two groups. Between the combined intervention and ED-only intervention, participants completed comparable numbers of sessions, as well as comparable percentages of each sessions' free-responses. Thus, the hypothesis that combining ED and weight-loss content would increase participation compared to the ED-only intervention was also not supported.

Study Strengths, Limitations, and Additional Future Directions

The current study had notable strengths and limitations. A strength is that the significant outcomes replicate (and even extend) findings from the original online, guided self-help intervention (Fitzsimmons-Craft et al., 2020). In the original study, the EDE-Q Global reduced by 0.92 from baseline to post-intervention (Cohen's $d = -0.8$), and binge episodes reduced by 4.66 (Cohen's $d = -0.8$) from baseline to post-intervention. The current study had an EDE-Q Global Cohen's d effect of -1.4, and binge episode reduction with a Cohen's d effect size of -0.9. This replication may even be considered more of a strength in the context of the COVID-19 pandemic, given the increased rates of psychiatric symptoms (Kim et al., 2022). A study of college-aged adults found that symptoms of binge-type EDs increased after the start of the pandemic. Given that binge-type ED symptoms were negatively affected by the pandemic, the current study's reduction in ED symptoms even further supports the effectiveness of the intervention during an unprecedented time.

The study also had higher engagement results compared to other online interventions. The average number of sessions completed within the program was 5.1 (64%). In comparison, the original study had a completion rate of 39% (Fitzsimmons-Craft et al, 2020). Additional studies of digital ED interventions have found that users tend to complete less than half of program sessions (Fitzsimmons-Craft et al., 2020; Fitzsimmons-Craft et al, 2022; Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012). Program completion rates of 40-60% have also been found in weight-

loss mobile interventions (Brindal, Freyne, Saunders, Berkovsky, Smith, & Noakes, 2012). As such, the current study's engagement is in-line, or even higher, than other digital interventions. Studies have also found that more personalized feedback increases days in the program. The current study's program completion rate of 46.7% highlights the strength of the weekly coaching offered in both programs. Another strength of the virtual intervention was that it was programmed in a low-cost, user-friendly web-server, Qualtrics. Thus, the intervention was effective in reducing ED symptoms without smartphone-based applications, and could stand as a model for future research testing mental health interventions without the need for costly application programming. However, the "low-tech" nature of the intervention likely led to limitations in the study as well.

Limitations of the current study include the program's reduced capacity for participants to easily self-monitor their meals and behaviors. Interventions testing the efficacy of mobile-based, weight-loss programs have noted the positive impact of self-monitoring and other behavior tracking tools (Martin, Miller, Thomas, Champagne, Han, & Church, 2015). A study found that use of self-monitoring on a weight-loss application enhanced weight loss, as did other personalized features to help participants overcome barriers to weight loss. The current study's intervention taught self-monitoring skills and encouraged them through coaching, but due to the hosting website not having an easy function to serve as a "diary," adherence could not be tracked and self-monitoring was likely limited. As such, further emphasis on self-monitoring and behavior tracking may improve weight loss in future studies.

Another limitation due to the online format was the use of self-reported height and weight. Bluetooth scales could have facilitated more frequent weigh-ins and would have increased the accuracy of reported weight. Though, the significant change in ED pathology, but not in weight, likely indicates that participants were indeed reporting accurately and not trying to portray positive

change. Bluetooth scales could have also facilitated daily weighing, which has been found to improve weight-loss outcomes (Brindal, Freyne, Saunders, Berkovsky, Smith, & Noakes, 2012; Nezami, Valle, Nulty, Espeland, Wing, & Tate, 2021). Participants who weighed themselves daily during a BWL intervention had greater weight loss than those who skipped days (Nezami, Valle, Nulty, Espeland, Wing, & Tate, 2021). However, these findings are from work conducted with individuals who have overweight/obesity without ED pathology. The current study did not include daily weighing due to its discouraged use in ED interventions. A point of concern in the field of ED treatment is the emphasis on weight loss for those who have eating psychopathology (Butryn & Wadden, 2005; Wadden et al., 2004). Evidence suggests that obesity prevention and treatment, if conducted correctly, do not predispose adults to EDs, and can lead to significant improvements in psychological status (in ED symptoms and self-esteem, etc.) (Butryn & Wadden, 2005; Golden, Schneider, & Wood, 2016; Jebeile et al., 2019; Eichen et al., 2019). Additional studies suggest daily weighing in BWL interventions is not harmful to clinical pathology in those with and without disordered eating symptoms (Steinberg, Tate, Bennett, Samuel-Hodge, & Ward, 2014; LaRose, Fava, Steeves, Hecht, Wing, & Raynor, 2014). Importantly, these interventions included support around the use of weighing as a tool in weight-loss, and included approaches to looking at weight objectively. These methods in fact lead to improved weight outcomes. Given that the current study's combined intervention still had positive outcomes on ED pathology, it is possible that adding daily weight measurement with Bluetooth scales could have improved weight-loss outcomes without negative effect on ED pathology. Future research is needed to establish if daily weight measurements could aid in weight-loss without increasing ED pathology.

Lastly, the online format reduced the IRB's comfort with personal information gathered in the online survey, and thus some demographic information was not collected. This reduces the

generalizability of the study's findings across ages of participants, genders, socio-economic status, and other such demographic classifications.

Future directions could explore enhancing specific components of weight-loss interventions that could be combined with the effective ED-only intervention to treat those with binge-type EDs and comorbid overweight\obesity. For example, including emphasis on meal regularity could improve weight-loss efficacy and lead to significant weight change. Meal regularity describes consistency of meal times, as well as consistency of calories at each meal (Eom, Lee, Cho, & Moon, 2021). Those who ate the same amount for breakfast, lunch, and dinner, and had those meals at the same time every day, lost more weight than those who did not. The current study emphasized eating three meals and two snacks a day, but did not emphasize the number of calories in each, nor the time of day meals were consumed.

Additionally, more consistent coaching on meal planning may have improved weight-loss outcomes. In a BWL intervention that included in-person coaching, meal planning had a significant impact on weight-loss (Hayes et al., 2021). Emphasis was placed on meal planning during the weekly interventionist meeting to ensure that participants were able to meet their calorie goals. The current study's combined intervention included meal planning as a strategy to encourage regular patterns of eating; however, participants mainly managed meal planning on their own. Though the coach offered guidance in the beginning and responded to participant questions, it is possible that not enough emphasis was placed on meal planning to see the weight-loss benefits that have been attributed to consistent meal planning in behavioral weight-loss interventions. An outside mobile application, such as MyFitnessPal, could be a free addition to the program to help increase meal planning and tracking. Future research may investigate if emphasis on these components could lead to weight loss in the combined program group.

The program could also be tailored to the diagnosis or weight-class of the participant. For example, those with a higher weight status could receive more intense coaching. Furthermore, a combined intervention may be more effective at reducing weight if coaching is delivered in-person or via telehealth. The U.S. Preventive Services Task Force (USPSTF, 2003) recommends high-intensity counseling (12 or more, in-person sessions) in BWL interventions for sustained weight-loss. The current study aimed to achieve weight loss through an entirely online format. It is possible that this sacrificed the empirically-supported benefits of intensive multicomponent behavioral interventions. Future studies should investigate the amount of face-to-face intervention needed for use in conjunction with a digital program in order to achieve significant weight loss.

Qualitative Findings

Participants reported an appreciation for the combined intervention's weight-loss material. Though not part of the study's aims, some qualitative findings from coach messages and in-session responses are informative of the participants' views on the program. One participant in the combined intervention remarked:

“I've identified in this program that my main concern with my body at this point in life is health, rather than just cosmetic concerns [and] I find that it is a more profound motivation and one that encourages me to keep trying even when I slip up.”

Another participant in the combined intervention shared similar feelings, stating:

“I have only lost a few pounds during this process, but I'm honestly not mad about it. I'm beginning to feel a lot better in my body and more confident... [I'm] honoring my body where it's at rather than where I've wished it was.”

Lastly, a participant expressed how the combined program content positively impacted their life during the program:

“I've changed the way I eat in a really kind, healthy, and manageable way. I haven't lost a lot of weight, but I was 0% restrictive and still lost 5 pounds in the last 2 months. If I

kept that up, I'd be stoked. I didn't have to miss out on any parties or hang outs with my friends, I got to eat at all my favorite restaurants while I was home, and drink champagne at my brother's wedding. So yeah, this has been a really positive experience for me.”

These comments reflect qualitative support for the acceptability of weight-loss and healthy lifestyle content while addressing EDs. Though the weight-loss findings in the combined intervention were not statistically significant, it appears that that the program still had a positive impact on the participants' lives.

The quantitative outcomes demonstrate that ED pathology improved despite the inclusion of weight-loss content. Across the field of ED research, there exists a concern that weight-loss interventions will increase ED psychopathology, especially considering how dieting is a risk factor for ED development (Butryn & Wadden, 2005; Wadden et al., 2004). However, a multitude of research findings suggests that evidence-based weight interventions do not increase ED psychopathology (Golden, Schneider, & Wood, 2016; Jabiele et al., 2019; Yanovski et al., 2000). The current study's results also replicate a recently published finding in a combined ED and BWL intervention that supports BWL content does not increase ED symptomology (Hay et al., 2022). Hay and colleagues (2022) conducted a study of a combined ED and BWL intervention compared to ED-only intervention in an in-person group session format for individuals with binge-type ED and overweight/obesity over 6 months. The results produced improvement in eating disorder symptomology, but did not have significant weight related outcomes. This is in line with the current study's findings that healthy BWL content does not increase ED symptomology and holds promise that more exploration could be done without increasing ED severity. Considering these findings, future research should explore if increasing intensity of weight-loss components (meal planning, meal tracking, face-to-face coaching, etc.) could potentially achieve weight-loss outcomes.

Conclusions

In summary, the current study found that a combined intervention with ED and weight-loss content led to a significant decrease in ED symptomology and binge-eating episodes, however it did not lead to significant weight change compared to an ED-only intervention, nor did it increase engagement, for participants with binge-type EDs and comorbid overweight/obesity. These results suggest that additional research is needed to address the gap in treatment for those with binge-type EDs and overweight/obesity. Considering the high prevalence of overweight/obesity in those with binge-type EDs, and the negative long-term outcomes of both conditions, addressing both the ED symptomology and weight status would foster positive outcomes in this population.

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Figure 1. Consort Diagram of Study design and Data Collection Components

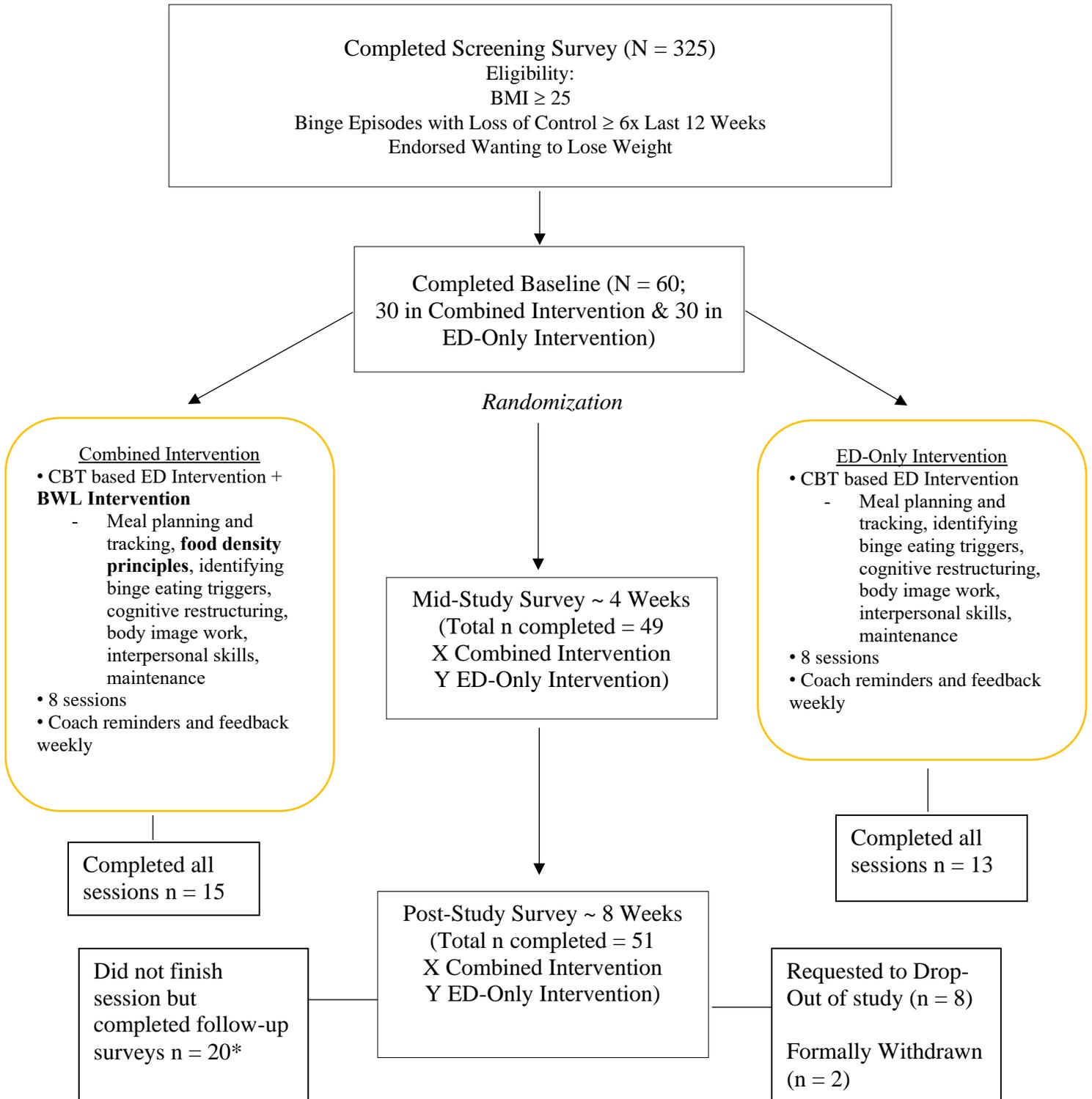
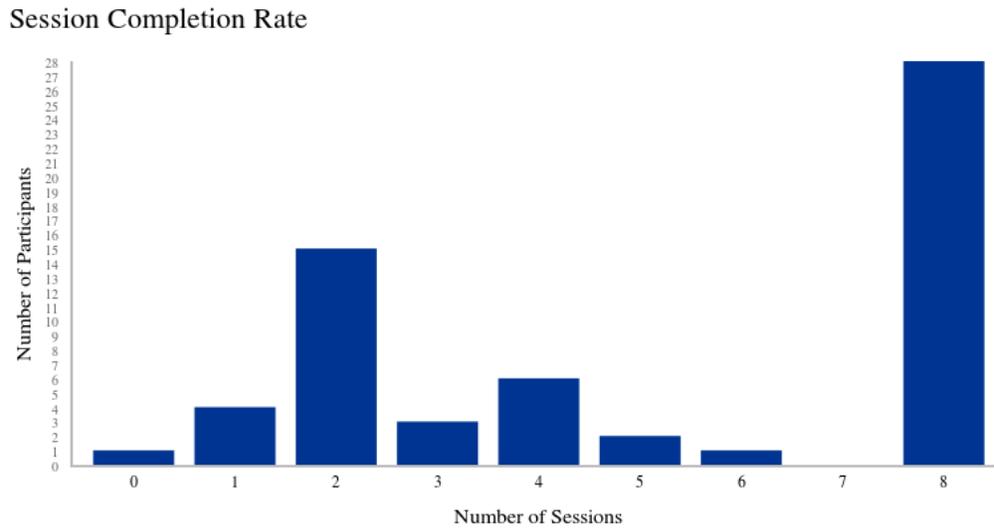


Figure 2. *Session Completion Rate*



Appendix A. Eligibility Screening Tool

SWED

1. **In the past 3 months**, how many times have you had a sense of having lost control while eating (e.g., feeling driven or compelled to eat; not being able to stop eating once you've started; not being able to keep yourself from eating large amounts of certain kinds of food in the first place; giving up on even trying to control your eating because you know that, no matter what, you're going to eat more than you want)? _____
2. **In the past 3 months**, how many times have you had a sense of loss of control AND you also ate what most people would regard as an unusually large amount of food at one time, defined as definitely more than most people would eat under similar circumstances (e.g., eating two full meals or three main courses at one time; eating an unusually large amount of one food or combination of foods)? _____
3. **In the past 3 months**, how many times have you done any of the following as a means to control your weight or shape:
 - a. Made yourself throw-up? _____
 - b. Used diuretics or laxatives? _____
 - c. Exercised excessively (e.g., pushed yourself very hard; had to stick to a specific exercise schedule no matter what; felt compelled to exercise)? _____
 - d. Fasted (intentionally not eaten anything at all for at least 8 waking hours)? _____
4. What was your lowest weight in the past year, including today in pounds (lbs)? _____
5. What is your current height?
 - a. Feet: _____
 - b. Inches: _____
6. What is your current weight in pounds (lbs)? _____
7. **In the past year**, what is the most weight you have lost?
 - a. 0-5 lbs
 - b. 6-10 lbs
 - c. 11-20 lbs
 - d. 21-30 lbs
 - e. 31-40 lbs
 - f. 41-50 lbs
 - g. 51-60 lbs
 - h. >60 lbs
8. Would you like to lose weight?
 - a. No
 - b. Yes, (if so, how many pounds? _____)
9. Over the **past four weeks**, to what extent have concerns about your weight/shape or your eating behaviors or rituals interfered with your school work?
 - a. Never
 - b. Rarely
 - c. Sometimes
 - d. Often
 - e. Always
10. Over the **past four weeks**, to what extent have concerns about your weight/shape or your eating behaviors or rituals interfered with relationships or social life?
 - a. Never
 - b. Rarely
 - c. Sometimes
 - d. Often

- e. Always
11. Over the **past four weeks**, to what extent have concerns about your weight/shape or your eating behaviors or rituals made you feel badly about yourself?
- a. Never
 - b. Rarely
 - c. Sometimes
 - d. Often
 - e. Always
12. In the past two weeks, have you had at least four drinks if you are female or five drinks if you are male, on one occasion?
- a. No
 - b. Yes
13. During a typical week, how many alcoholic beverages do you consume? _____
14. On average, during the past two weeks have you felt depressed or hopeless?
- a. Not at all
 - b. A little
 - c. Moderately
 - d. Quite a bit
 - e. Extremely
15. On average, during the past two weeks have you felt anxious or tense?
- a. Not at all
 - b. A little
 - c. Moderately
 - d. Quite a bit
 - e. Extremely
16. On average, during the past two weeks, has it been difficult for you to fall asleep or stay asleep at night?
- a. Not at all
 - b. A little
 - c. Moderately
 - d. Quite a bit
 - e. Extremely
17. Are you interested in participating in a study that could offer you an online program that could help you achieve more balanced healthy eating behaviors to achieve weight loss and weight maintenance.
- a. Yes
 - b. No
 - c. If yes.... Please provide the email address at which you would like us to contact you for this study if you're eligible. _____

Appendix B. *Eating Disorder Examination Questionnaire (EDE-Q) – Assessment at Baseline, Mid-Intervention & Post-Intervention Follow-ups*

EATING QUESTIONNAIRE

Instructions: The following questions are concerned with the past four weeks (28 days) only. Please read each question carefully. Please answer all the questions. Thank you.

Questions 1 to 12: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days) only.

On how many of the past 28 days	No days	1-5 days	6-12 days	13-15 days	16-22 days	23-27 days	Every day
---------------------------------------	------------	-------------	--------------	---------------	---------------	---------------	--------------

- 1 Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)?
- 2 Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight?
- 3 Have you tried to exclude from your diet any foods that you like in order to influence your shape or weight (whether or not you have succeeded)?
- 4 Have you tried to follow definite rules regarding your eating (for example, a calorie limit) in order to influence your shape or weight (whether or not you have succeeded)?
- 5 Have you had a definite desire to have an empty stomach with the aim of influencing your shape or weight?
- 6 Have you had a definite desire to have a totally flat stomach?
- 7 Has thinking about food, eating or calories made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?
- 8 Has thinking about shape or weight made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?
- 9 Have you had a definite fear of losing control over eating?
- 10 Have you had a definite fear that you might gain weight?
- 11 Have you felt fat?
- 12 Have you had a strong desire to lose weight?

Questions 13-18: Please fill in the appropriate number in the boxes on the right. Remember that the questions only refer to the past four weeks (28 days).

Over the past four weeks (28 days)...

- 13 Over the past 28 days, how many times have you eaten what other people would regard as an unusually large amount of food (given the circumstances)?
- 14 On how many of these times did you have a sense of having lost control over your eating (at the time that you were eating)?
- 15 Over the past 28 days, on how many DAYS have such episodes of overeating occurred (i.e., you have eaten an unusually large amount of food and have had a sense of loss of control at the time)?

16 Over the past 28 days, how many times have you made yourself sick (vomit) as a means of controlling your shape or weight?

17 Over the past 28 days, how many times have you taken laxatives as a means of controlling your shape or weight?

18 Over the past 28 days, how many times have you exercised in a “driven” or “compulsive” way as a means of controlling your weight, shape or amount of fat, or to burn off calories?

Questions 19 to 21: Please circle the appropriate number. Please note that for these questions the term “binge eating” means eating what others would regard as an unusually large amount of food for the circumstances, accompanied by a sense of having lost control over eating.

No days	1-5 days	6-12 days	13-15 days	16-22 days	23-27 days	Every day
0	1	2	3	4	5	6

19 Over the past 28 days, on how many days have you eaten in secret (ie, furtively)? Do not count episodes of binge eating

20 On what proportion of the times that you have eaten have you felt guilty (felt that you've done wrong) because of its effect on your shape or weight? Do not count episodes of binge eating

21 Over the past 28 days, how concerned have you been about other people seeing you eat? Do not count episodes of binge eating

Questions 22 to 28: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days).

Over the past 28 days	Not at all	Slightly	Moderate -ly	Markedly
22 Has your weight influenced how you think about (judge) yourself as a person?				
23 Has your shape influenced how you think about (judge) yourself as a person?				
24 How much would it have upset you if you had been asked to weigh yourself once a week (no more, or less, often) for the next four weeks?				
25 How dissatisfied have you been with your weight?				
26 How dissatisfied have you been with your shape?				
27 How uncomfortable have you felt seeing your body (for example, seeing your shape in the mirror, in a shop window reflection, while undressing or taking a bath or shower)?				
28 How uncomfortable have you felt about others seeing your shape or figure (for example, in communal changing rooms, when swimming, or wearing tight clothes)?				

What is your weight at present? (Please give your best estimate.)

What is your height? (Please give your best estimate.)

If female: Over the past three-to-four months have you missed any menstrual periods?
.....

If so, how many? Have you been taking the “pill”?

THANK YOU

Appendix C. Example of Material in Both Intervention and Control Programs

12:29



THE CYCLE OF BINGEING AND UNHEALTHY EATING

Feeling bad about your body, wanting to lose weight, and/or engaging in disordered eating habits such as overeating, vomiting, using diet pills or over-exercising are all behaviors related in a vicious cycle.



Here are some examples...

***Meghan:**
Meghan is invited to a party on Friday

12:29

Today's Meals:

Breakfast: _____

Snack 1: _____

Lunch: _____

Snack 2: _____

Dinner: _____

Snack 3 (Dessert!): _____

- **Your plan should adapt to the rhythm and flow of your life:** don't be too rigid about the mealtimes; adjust them to the reality of your life.
- **Eat based on when you have planned to rather than by your hunger cues.** We know this sounds counterintuitive, and we do want you to use your cues to make your plan, but often people with a history of binge eating can experience fluctuation in their cues when changing their eating

12:29

ACE

Awareness

What is your critical thought?



Challenge

What is the evidence for and against the thought?



Even-handed

What is a balanced point of view?



ACE Activity

When you have identified self-defeating thoughts, it's important to challenge them as a next step.

Try using the ACE tool (**Awareness, Challenge, Evenly balanced**):

A. Awareness:

- What is your critical thought?
 - "No one will talk to me"

Appendix C. Example of Material in Both Intervention and Control Programs Continued....

12:29

Here is one of my self-defeating thoughts (try to make it specific)!
Example: I'm a failure because I can never stick to my eating plan.

Here's how I can challenge it:
Example: Most of the time I usually do eat what I plan, I just have one meal or so that throws off my plan.

What evidence supports the thought?
Example: My homework ended up taking longer than expected, and I skipped my dinner plan. When I got home to make dinner,

12:29



Positive self-talk

Positive self-talk, on the other hand, is characterized by taking a flexible, accepting attitude towards yourself and others. It acknowledges small, concrete successes. Here are some examples:

- "Though I ate more than I planned on today, that's OK. I was feeling hungry and listened to my body"
- "I didn't get in a workout today. However, I was spending that time doing homework and meeting with friends, so that was time well spent."
- "I am intelligent, funny, and interesting."
- "I am worthy."

12:29

triggers are can help you prevent them from happening.

What are your Triggers?
Take a few minutes to think of two or three triggers that make you feel badly about yourself or your body in some way or that make you want to binge or overeat.

Trigger 1:

Trigger 2:

Trigger 3:

Great job!
We know that it sounds tedious at first, but once you get into the habit of identifying and tracking your triggers, you'll be much better prepared to tackle any unhealthy eating behaviors.

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Appendix D. Example of Combined Intervention ED and Weight Loss Content

12:29

The Importance of Balanced Eating

As a first step to help you feel better, the CoED program will help you develop balanced eating habits. In the next few sessions, we'll talk about more balanced eating, and go over some tools that will help you stop engaging in unbalanced eating behaviors.

An important part of balanced eating is eating regularly – which is roughly 3 meals a day with 2-3 snacks. Some people question whether eating more throughout the day might contribute to weight gain. When in fact, regular eating is important to long term weight maintenance in two ways: 1) eating balanced meals throughout the day prevents future weight gain through the prevention of binge eating (we talk about that next), and 2) regular eating helps sustain weight by creating healthy habits you can keep practicing long term.

12:29

Look below to see a comprehensive list of food's energy density:

**Adapted from The Ultimate Volumetrics Diet by Barbra Rolls, Ph.D

Very Low Density Foods	Low Density Foods	Med. Density Foods	High Density Foods
Soups	Soups	Vegetables & Legumes	Dairy
Chicken broth	Chili	Hummus	Full fat cheese
Vegetable broth	Split pea	French fries	Butter
Tomato soup (not cream based)	Vegetables & Legumes	Avocado	Sour cream
Chicken noodle soup	Tofu	Fruit	Bread & Crackers
Lentil soup	Sweet potatoes	Raisins	Pastries (cinnamon bun, croissant)
Vegetables	Green peas	Dairy	Butter
Celery	Beans (black, kidney, pinto, etc.)	Light cream cheese	Graham Crackers
Cucumber	Corn	Feta cheese	Wheat Crackers
Tomato	Potatoes	Mozzarella cheese (part skim milk)	Sour cream
Spinach	Fruit	Reduced fat swiss cheese	Meats
Zucchini	Grapes	Breads	Pork (spare ribs, braised)
Salad greens	Banana	Corn tortillas	Bacon
Asparagus	Dairy	Flour tortilla	Desserts, Snacks, & Candy
Broccoli	Low-fat plain yogurt	Whole wheat pita	Cream filled sandwich cookies
Mushrooms	1% fat cottage cheese	White bread	Cake
Green beans	Cereals & Grains	Whole grain bread	Caramel popcorn
Bell peppers	Bran flakes	Meats	Chocolate chip cookies
Carrots	Shredded wheat	Chicken breast (no skin)	Brownie
Winter squash	Rice	Eggs	Donuts
Fruits	Pasta	Sirloin steak	Potato chips
Watermelon	Meats	Salmon	Tortilla chips
Strawberries	Shrimp	Pork chop	Trail mix
Cantaloupe	Tuna	Ground beef	Chocolate candy
Peach	Tilapia	Mixed Dishes	Granola bar
Orange	Turkey breast (no skin)	Cheese pizza with thin crust	Nuts
Raspberries	Ham (extra lean)	Cheese burger	Peanut butter
Apple	Mixed Dishes	Sausage and egg biscuit	Almonds
Blueberries	Pasta with red sauce	Mac and Cheese	Peanuts
Pear	Chili con carne	Deli sandwich	Pecans
Dairy	Cereal with low fat or soy/nut milk	Grilled cheese	Condiments
Non-fat, unsweetened yogurt	Condiments	Condiments	Jam
Non-fat, plain Greek yogurt	Pasta sauce (tomato-based)	Reduced fat cream-based dressing	Cream dressing
Condiments	Mustard, ketchup	Full-fat Italian dressing	Mayonnaise
Salsa	Black olives	Light Mayonnaise	Margarine, olive oil, vegetable oil
Fat-free Italian dressing	Fat-free, cream-based dressing	Cream cheese	Mixed Dishes
			Fried rice
			Heavy sauté in oil

12:29

Eating for Success

Have you ever noticed that some foods make you feel fuller than others? Or, that some foods make you feel full for longer? A lot of that fullness comes from the energy density of the food, or how much energy (calories) a food provides per gram.

For example, foods that are low in energy density are low in calories, but high in weight and bulk (this weight can come from water and fiber): these include fruit, vegetables, rice, pasta, potatoes. Foods that are high in energy density (calories from fat) and low in weight or bulk are: oils, cheeses, nuts. Some fall in the middle range of density, like meat (depending on how lean it is), processed grains (bread, tortillas, pretzels) and avocados or spreads (hummus, dressing).

Appendix E. *Examples of Coach Communications*

Coach Messages

Hey [User]!

Super job with your session this week!!! You did really well with challenging the thought about speaking in front of your coworkers, great way to identify the negative thought and recognize that you may not know what the other person is going through when you compare, and also allowing for some positive thoughts about yourself! Really nicely done. :)

I was wondering if I could ask you to continue to practice that with regards to your thoughts about your hair, face and body? I saw you mentioned that those are features you frequently compare, so I thought it might be a helpful exercise to practice challenging negative thoughts.

Keep up the great work!
Grace

Hey [User]!

How's it going? Nice job with your session this week! What was it like challenging negative comments from others? It's common to internationalize, so practicing challenging thoughts from others just like we would challenge our own thoughts with the ACE method can improve our relationship with them and ourselves!

Let me know how it's going! I also sent out your 7th session, which is your second to last session in the program!

Keep up the good work!
Grace

User Responses

Hi Grace,

It's going great! I am so grateful I am able to participate in this program! It has really helped me with my binge eating and identifying and implementing ways to curb this behavior! It is great to know that I've found something that can work throughout my whole life and that if I have a slip-up, this way of thinking (moving on and not ruminating about the binge) and eating 5 times a day (trying to, but moving on if I don't) can just be carried on and there are no crazy steps I have to do to get back on track.

I only had to challenge a few negative comments from people with who I have close relationships, so it went really well! They listened to me and were very understanding. :)

Sincerely,
[User]