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A Comparison of the Efficacy of Online HAPIFED versus Online Cognitive Behavioural Therapy for Binge Eating Disorder: A Randomized Controlled Trial

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Abstract: The efficacy of two different online treatment programs for people with binge eating disorder (BED) was compared. One hundred and nineteen adults with BED were randomized to treatments based on the Healthy Approach to Weight Management and Food in Eating Disorders (HAPIFED) or cognitive behavioural therapy (CBT). The treatments were delivered via videoconferencing in 10 groups with approximately 12 participants in each group. Each group included 13 treatment sessions and two follow-up sessions. Participants' self-reported eating disorder behaviours/psychopathology, general mental health, and weight were assessed at pre-treatment, the end of treatment, a 3-month follow-up, and a 6-month follow-up. The participants in both treatments similarly reduced objective and subjective binge eating episodes from pre-treatment to the end of treatment. There were no significant differences in weight loss for the participants in either treatment. The participants in both treatments had reduced levels of loss of control over eating, eating disorder psychopathology, depression, psychological stress, and difficulties in emotion regulation from pre-treatment to the end of treatment. Treatments based on the HAPIFED or CBT delivered via videoconferencing can reduce binge eating and improve mental health in people with BED.

Keywords: binge eating disorder; eating disorders; treatment; therapy; online; overweight; obesity

Citation: da Luz, F.Q.; Mohsin, M.; Teixeira, P.C.; dos Santos, E.; Gaeta, T.; Ferrari, S.; Martin, K.; Dias, A.; Jana, T.A.; Marinho, L.S.; et al. A Comparison of the Efficacy of Online HAPIFED versus Online Cognitive Behavioural Therapy for Binge Eating Disorder: A Randomized Controlled Trial. *Obesities* **2024**, *4*, 145–159. https://doi.org/10.3390/obesities4020014

Academic Editor: Carmine Finelli

Received: 18 March 2024
Revised: 18 May 2024
Accepted: 7 June 2024
Published: 13 June 2024

1. Introduction

Binge eating disorder (BED) is commonly associated with numerous health complications [1–8]. People with BED often have a high body mass index (BMI) [2,3,9] and medical and psychiatric comorbidities (e.g., diabetes, metabolic syndrome, gastrointestinal problems, sleep abnormalities, mood disorders, and anxiety disorders) [1–8,10,11]. For instance, people with BED have a 69.9% and 59% lifetime prevalence of mood disorders and anxiety disorders, respectively [12]. Despite these health complications, treatments for BED are not widely implemented. People with recurrent binge eating episodes rarely access therapies for an eating problem and mostly are treated for weight loss or general

mental health problems [13]. Moreover, even general mental health treatments for people with eating disorders are rarely implemented. Data from a nationally representative survey of the United States household population showed that only 29% of people with BED had received treatment for emotional difficulties in the 12 months prior to the survey [14]. Another study in the United States showed that only 20% of college students with eating disorders had received mental health treatment the previous year [15].

Many barriers can impede people with eating disorders from obtaining specialized treatment. Some of these barriers are direct and indirect treatment costs (e.g., price of sessions, transportation), low BED health literacy, stigma, health insurance constraints on the coverage of costs, cultural or ethnic influences, mental health literacy, or living outside of metropolitan areas [16,17]. A potential solution to overcome one of the barriers mentioned above—namely, difficulty accessing specialized treatment—is the implementation of online treatments [18]. Online guided self-help treatments became more popular in recent years. However, research on the efficacy of online treatments for people with eating disorders is inconclusive. For instance, three previous studies have shown that online guided self-help treatments that used cognitive behavioural therapy (CBT) reduced binge eating and eating disorder psychopathology in people with BED [19–21]. In contrast, another study found that face-to-face CBT led to faster and greater reductions in binge eating and eating disorder psychopathology in comparison to online guided self-help [22].

Two systematic reviews investigated the efficacy of online treatments for eating disorders [23,24]. One systematic review with a meta-analysis assessed interventions that were primarily delivered via a computer, mobile phone, or tablet and concluded that the value of online therapy for binge eating was uncertain [23]. Nonetheless, that review did not include studies with interventions that were delivered entirely by a therapist via videoconferencing [23]. Another systematic review with a meta-analysis found that online therapies for people with eating disorders are commonly limited in their interactive and personalized design features [24]. This review concluded that there is a need for online therapies to be more interactive and to deliver interventions that are specific to the user's own characteristics [24]. However, that review excluded studies that investigated the use of technological devices such as online chat, video calls, or email communication to deliver therapist-led interventions [24]. Overall, these systematic reviews did not support the efficacy of online therapies for binge eating when they only entailed a limited amount of interaction with a therapist.

Treatments delivered via videoconferencing can be well accepted by people with eating disorders [25,26]. A study with five people with eating disorders who had low access to mental health services found that the participants reported high levels of satisfaction with CBT delivered by psychologists via a mobile video application [25]. Additionally, another study with 11 people with symptoms of BED showed positive perceptions of therapy delivered via videoconferencing due to its convenience [26]. Other studies also reported improvements in eating disorder symptoms, a reduction in weight, and greater levels of physical activity in people with BED when they were treated via videoconferencing [27,28]. A pilot study showed reductions in loss of control over eating and eating disorder psychopathology in people with BED after the completion of four sessions of online therapy [28]. Finally, a case series with people with BED showed that those who completed a multidisciplinary treatment delivered via videoconferencing reduced their weight and improved their eating and exercise habits [27]. Considered together, these studies support the potential of treatments delivered by healthcare professionals via videoconferencing to reduce binge eating and eating disorder psychopathology in people with BED. However, due to methodological limitations (e.g., small sample sizes and a lack of control groups), no causal conclusions have been drawn.

A randomized controlled trial (RCT) comparing the efficacy of treatments for BED delivered via videoconferencing was conducted. The treatments were based on the Healthy Approach to Weight Management and Food in Eating Disorders (HAPIFED) [29] or CBT for eating disorders [30]. HAPIFED is a multidisciplinary treatment that encourages

healthy weight management in addition to addressing eating disorders [31,32]. In contrast, the aim of CBT for eating disorders is solely to treat eating disorder behaviours and psychopathology [30]. HAPIFED is a new treatment program, and research on its efficacy is limited to one previous RCT [31,33]. That RCT compared the efficacy of long-term (30 sessions) and in-person HAPIFED versus CBT in reducing eating disorder behaviours and weight in people with recurrent binge eating and a high BMI [31,32]. That trial found that HAPIFED was associated with a higher rate of remission for binge eating at a 12-month follow-up in comparison to that of CBT; however, both treatments induced similar reductions in eating disorder psychopathology and weight [31,32]. The findings of that trial contrast with the hypothesis that HAPIFED induces a similar reduction in binge eating and greater weight loss in comparison to CBT [31,33]. Thus, additional studies comparing the efficacy of HAPIFED versus CBT are necessary.

Long-term and in-person treatments such as those delivered in the aforementioned RCT [31,33] can be time-consuming and costly; nonetheless, the efficacy of shorter and online treatments for BED is unknown. Thus, the primary aim of this RCT was to examine the efficacy of relatively short treatments based on the HAPIFED or CBT delivered via videoconferencing in reducing binge eating and body weight in people with BED and a high comorbid BMI. Similar reductions in binge eating in people who received either of the treatments were expected. However, this study's hypothesis was that online HAPIFED would induce a greater reduction in body weight in comparison to that of online CBT. This was our hypothesis as the number of weight management interventions was greater in online HAPIFED in comparison to that in the previous RCT, which examined the efficacy of face-to-face HAPIFED [31,33]. Our secondary aim was to examine whether the online treatments could reduce eating disorder psychopathology and loss of control over eating as well as improve general mental health in people with BED.

2. Materials and Methods

This study is reported in line with the Consolidated Standards of Reporting Trials (CONSORT) statement [34].

2.1. Participants and Study Design

Inclusion criteria for participants in the RCT were as follows: (1) BED according to the DSM 5 criteria [35]; (2) age $\geq$ 18 years; (3) access to a computer with internet; (4) access to a private room during sessions; (5) being literate; (6) access to a scale and stadiometer to measure weight and height; (7) time available to complete the program; and (8) BMI $\geq$ 27 and <45 kg/m^2. It is noteworthy that participants with a BMI between 25 and 27 kg/m^2 were excluded as they can be at a lower risk of weight-related health complications in comparison to people with a BMI > 27 kg/m^2. Moreover, people with a BMI $\geq$ 45 kg/m^2 were excluded as they commonly require bariatric surgery to manage their body weight [36]. Additional exclusion criteria were as follows: (1) simultaneous participation in another treatment for weight management or binge eating; (2) bariatric surgery in the previous 24 months; (3) clinical conditions that interfere with weight control (e.g., Prader-Willi syndrome, Cushing syndrome); (4) schizophrenia, bipolar disorder, or a high suicide risk; and (5) pregnancy. It was assumed that the maximum standard deviation would not exceed 15 for the variable objective binge eating episodes, and a 95% confidence interval along with a 4% margin of error were applied. A sample size of 54 was considered sufficient to reject the null hypothesis at the 0.05 probability level.

Recruitment was conducted via the University of São Paulo's social media from August 2020 to June 2022. Potentially eligible participants were invited for an online semi-structured interview to assess whether they were eligible. Participants were required to measure and state their body weight and height to interviewers. Additional details of recruitment process have been reported previously [37].

Participants were stratified according to BMI (<35 kg/m^2 or $\geq$35 kg/m^2) and sex and were randomized to treatment arms. Allocation ratio was 1:1. Participants were

randomized using the automatic randomization function of a secure web application for building and managing online surveys and databases, namely REDCap [38]. The REDCap application was used to randomize each participant to a treatment arm after confirmation that they were eligible to join a treatment group that would start in the following 1–2 weeks. Twenty-four participants were recruited to receive treatment in an online HAPIFED group or an online CBT group per semester. This procedure was repeated five times to achieve a sample size of 120 participants. Participants were not informed about which treatment they were allocated to or about characteristics of the comparison treatment. The statistician who analysed treatment results was blind to participants' treatment allocation.

2.2. Trial Registration

The RCT was registered in the Brazilian Registry of Clinical Trials (universal trial number U1111-1289-0818) [39].

2.3. Interventions

This RCT included 5 online HAPIFED groups and 5 online CBT groups. Each group started with approximately 12 participants. All groups included 13 weekly treatment sessions and 3- and 6-month follow-up sessions. All sessions lasted for approximately 2 h and were conducted via videoconferencing.

2.3.1. Online HAPIFED

The treatment protocol for the online sessions of HAPIFED was developed based on the HAPIFED manual [29]. All sessions included interventions delivered by psychologists, dietitians, and/or exercise physiologists that aimed to reduce participants' eating disorder behaviours and improve their poor weight management (e.g., strict dieting, binge eating, lack of planning/organization, sedentarism). Healthcare professionals that delivered interventions in online HAPIFED had experience with the treatment of people with eating disorders in private practice and academic settings. Topics addressed in each session are shown in Table A1 (Appendix A). A mobile application (app) was developed to assist with the treatment of online HAPIFED participants. Participants were instructed to use the app as a self-monitoring tool to record foods and drinks they ingested, information about their eating behaviours (their ingestion of fruit and vegetables, hunger and satiety levels, loss of control over eating, emotional states), and physical activity.

2.3.2. Online CBT

The treatment protocol for the online CBT was developed based on CBT enhanced for eating disorders (CBT-E) [30]. Online CBT was delivered by psychologists who completed the web-centred CBT-E training [40] and had previous experience with the treatment of eating disorders in private practice and academic settings. Two psychologists—working as a therapist and co-therapist—delivered the sessions. Topics addressed in each session are shown in Table A2 (Appendix A). Participants who received online CBT were instructed to use a self-monitoring form to record the times of their meals and snacks, the foods and drinks they consumed, the places where they ate or drank, whether or not they experienced loss of control over eating, and comments about the context of their binge eating episodes.

2.4. Assessments

2.4.1. Demographic Characteristics

Information about participants' age, sex, race, weight, height, occupation, marital status, and income was collected via a self-report online questionnaire.

2.4.2. Eating Disorder Examination Questionnaire (EDE-Q)

The EDE-Q is a 28-item self-report questionnaire that is used to assess the quantity of objective binge eating episodes and subjective binge eating episodes as well as the severity of eating disorder psychopathology in the past 28 days [30]. The EDE-Q generates a global

score by averaging the subscales' scores (i.e., dietary restraint, weight concerns, shape concerns, and eating concerns), with higher scores, indicating a greater degree of eating disorder psychopathology. Overall, the EDE-Q is a reliable and valid measure of eating disorder behaviours and psychopathology [41]. An unpublished Brazilian Portuguese version of the EDE-Q that was adapted from the European Portuguese EDE-Q was used in the current study [33,42]. Cronbach's alpha for the item pool of the EDE-Q global score was 0.70 at pre-treatment and 0.88 at 6-month follow-up.

2.4.3. Loss of Control over Eating Scale (LOCES)

The LOCES is a 24-item self-report scale that is used to assess a key symptom of BED, namely, the loss of control over eating [43]. The items of the LOCES are rated on a 5-point Likert scale that ranges from 1 ("never") to 5 ("always"), which is averaged to generate a total score. Higher scores on the LOCES suggest greater severity of loss of control over eating in the past 28 days. The LOCES shows convergent and discriminant validity, as well as good internal consistency and test–retest reliability [43]. A Brazilian Portuguese version of the LOCES was used in this study [44]. Cronbach's alpha for the item pool of the LOCES total score was 0.91 at pre-treatment and 0.96 at 6-month follow-up.

2.4.4. Difficulties in Emotion Regulation Scale (DERS)

The DERS is a 36-item self-report scale that is used to assess difficulties in emotion regulation [45]. Each item of the DERS is rated on a Likert scale from 1 ("almost never") to 5 ("almost always"). Higher scores on the DERS suggest increased difficulties with emotion regulation. Only DERS total scores were analysed in this study. The DERS shows good discriminative ability, good internal consistency, and good construct validity [46]. A Brazilian Portuguese version of the DERS was used in this study [47]. Cronbach's alpha for the DERS total item pool was 0.86 at pre-treatment and 0.88 at 6-month follow-up.

2.4.5. Depression Anxiety and Stress Scale (DASS-21)

The DASS-21 is a self-report scale that is used to assess the severity of symptoms of depression, anxiety, and psychological stress in both non-clinical and clinical samples [48]. The DASS-21 contains 21 items that are rated on a Likert scale from 0 ("did not apply to me at all") to 3 ("applied to me very much or most of the time"). Higher scores in each subscale of the DASS-21 suggest more severe symptoms of depression, anxiety, or psychological stress. The DASS-21 shows a high level of reliability and an appropriate level of construct validity [49]. The Brazilian Portuguese version of the DASS-21 was used in this study [50]. Cronbach's alphas were 0.89 and 0.92 for the depression subscale; 0.77 and 0.90 for the anxiety subscale; and 0.81 and 0.92 for the psychological stress subscale at pre-treatment and 6-month follow-up, respectively.

2.5. Statistical Analyses

Participants' pre-treatment demographic characteristics by treatment arm were examined. Continuous variables were reported as means and standard deviation (SD), and categorical variables were reported as percentages. Mean scores with 95% confidence intervals (CIs) for outcome measures by treatment arm were reported for participants who completed assessments at each timepoint. Analysis of variance for repeated measures (ANOVA) was conducted for multiple group comparison test between pre-treatment results and the results at end of treatment, 3-month follow-up, and 6-month follow-up. The levels of significance (all p-values < 0.05) from the multiple group comparison test were adjusted to reduce the risk of type 1 error, which may occur in multiple comparison tests for multiple endpoints. Effect sizes (Cohen's d) [51] were computed for each outcome as an indication of the magnitude of change from pre-treatment to end of treatment, 3-month follow-up, and 6-month follow-up based on the two-way comparisons. Established thresholds for interpreting the effect sizes were applied as follows: Cohen's d of 0.2 de-noted a small effect, Cohen's d of 0.5 denoted medium effect, and Cohen's d of 0.8 or above denoted a large

effect. Linear mixed models were applied to examine the interaction effects for assessment timepoints and treatment arms as the outcome measures were continuous and repeated. This method allows for flexibility in modelling covariance structures involving longitudinal and repeated data that have within-subject, time-dependent correlations. SPSS 28 [52] was used to conduct the statistical analyses.

3. Results

One hundred and nineteen participants were included in the RCT. The participants' demographic characteristics and number of participants assessed at each timepoint are shown in Table 1 and Figure 1, respectively.

Table 1. Participants' characteristics at pre-treatment by treatment arm.

Participants' Characteristics	Online HAPIFED Groups	Online CBT Groups	Online HAPIFED Groups vs. Online CBT Groups: *p*-Values
	Number (%)	Number (%)	
All participants	61 (100.0)	58 (100.0)	
Gender			
Male	5 (8.2)	6 (10.3)	
Female	56 (91.8)	52 (89.7)	$p = 0.686$
Age group			
<30	15 (24.6)	11 (19.0)	
30–39	23 (37.7)	31 (53.4)	
40 and above	23 (8.2)	16 (27.6)	$p = 0.225$
Mean Age (SD)	36.5 (9.8)	35.4 (7.5)	$p = 0.245$
Race			
White	44 (72.1)	45 (77.6)	
Black or other	17 (27.9)	13 (22.4)	$p = 0.493$
Occupation			
Employed full/part time	40 (65.6)	38 (65.5)	
Unemployed/Other	21 (34.4)	20 (34.5)	$p = 0.995$
Marital status			
Married/Living with partner	38 (62.3)	39 (67.2)	
Single/Never married/Other	23 (37.7)	19 (32.8)	$p = 0.573$
Income			
Less than BRL 3.135	34 (55.7)	35 (60.3)	
Above BRL 3.135	27 (44.3)	23 (39.7)	$p = 0.611$

HAPIFED, Healthy Approach to Weight Management and Food in Eating Disorders; CBT, Cognitive behavioural therapy; BRL, Brazilian real; *p*-values, levels of significance.

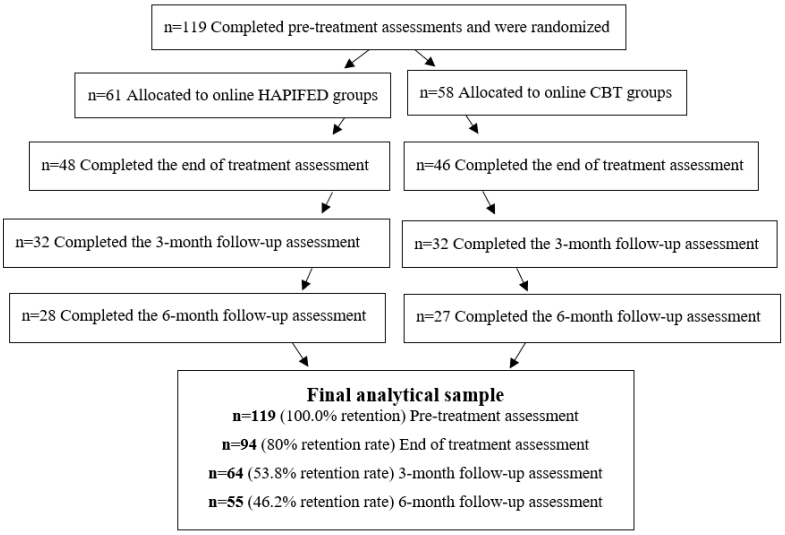

Figure 1. Participants' flowchart from pre-treatment to 6-month follow-up assessments.

At the end of the treatment, shape concerns were higher ($p = 0.014$) in participants who received online CBT compared to those who received online HAPIFED (Table 2). At the 3-month follow-up, the level of dietary restraint was higher ($p = 0.003$) in participants who received online CBT compared to those who received online HAPIFED (Table 2). At the 6-month follow-up, there were no significant differences in the mean scores of any of the outcome measures for participants who received either treatment.

Table 2. Mean scores with 95% confidence interval of outcome measures for online HAPIFED and online CBT at each timepoint.

Outcome Measures	**Pre-Treatment**	**End of Treatment**	**3-Month Follow-up**	**6-Month Follow-up**	**Pre-Treatment Versus**	
	Online HAPIFED (n = 61)	**Online HAPIFED (n = 48)**	**Online HAPIFED (n = 32)**	**Online HAPIFED (n = 28)**	**End of Treatment**	**6-Month Follow-up**
	Mean (95%CI)	**Mean (95%CI)**	**Mean (95%CI)**	**Mean (95%CI)**	***p*-Values**	***p*-Values**
OBE episodes	12.8 (10.1–15.5)	6.2 (2.9–9.5)	5.3 (0.9–9.6)	4.1 (0.3–8.6)	0.001	0.001
SBE episodes	10.4 (8.7–12.1)	5.4 (3.5–7.2)	4.7 (2.4–7.0)	4.3 (1.9–6.7)	0.001	0.001
Dietary restraint	2.0 (1.6–2.3)	1.1 (0.8–1.5)	0.8 (0.4–1.2)	1.0 (0.5–1.4)	0.001	0.001
Eating concerns	3.4 (3.0–3.8)	1.6 (1.2–2.0)	1.4 (1.0–1.9)	1.3 (0.9–1.8)	0.001	0.001
Shape concerns	4.8 (4.5–5.2)	3.1 (2.7–3.4)	3.1 (2.6–3.5)	3.0 (2.5–3.4)	0.001	0.001
Weight concerns	4.2 (3.9–4.5)	2.8 (2.5–3.2)	2.7 (2.3–3.1)	2.8 (2.4–3.2)	0.001	0.001
EDEQ global	3.6 (3.3–3.9)	2.2 (1.8–2.5)	2.0 (1.6–2.4)	2.0 (1.6–2.4)	0.001	0.001
LOCES total	81.3 (76.8–85.9)	52.6 (47.5–57.6)	50.6 (44.5–56.6)	50.9 (44.5–57.3)	0.001	0.001
Depression	14.5 (12.0–17.0)	10.0 (7.3–12.8)	8.9 (5.8–12.0)	9.9 (6.6–13.2)	0.001	0.018
Anxiety	9.4 (7.4–11.4)	6.9 (4.7–9.1)	7.9 (5.3–10.5)	7.3 (4.6–10.0)	0.074	0.076
Stress	19.2 (16.9–21.5)	14.3 (11.8–16.9)	14.9 (11.9–17.8)	16.6 (13.4–19.8)	0.004	0.445
DERS total	97.3(91.2–103.4)	86.5 (79.8–93.1)	84.3 (76.8–91.8)	81.9 (74.0–89.8)	0.001	0.004
Outcome Measures	Online CBT (n = 58)	Online CBT (n = 46)	Online CBT (n = 32)	Online CBT (n = 27)	End of treatment	6-month follow-up
	Mean (95%CI)	Mean (95%CI)	Mean (95%CI)	Mean (95%CI)	*p*-values	*p*-values
OBE episodes	13.4 (10.9–15.8)	5.5 (2.0–9.1)	5.3 (0.8–9.9)	7.3 (2.3–12.4)	0.005	0.052
SBE episodes	10.7 (9.0–12.4)	5.1 (3.1–7.0)	4.8 (2.5–7.1)	6.2 (3.7–8.6)	0.001	0.110
Dietary restraint	2.2 (1.8–2.5)	1.6 (1.2–1.9)	1.7 (1.2–2.1)	1.4 (0.9–1.8)	0.007	0.001
Eating concerns	3.6 (3.3–4.0)	2.0 (1.6–2.5)	2.0 (1.6–2.5)	2.0 (1.5–2.5)	0.001	0.001
Shape concerns	5.0 (4.7–5.4)	3.7 (3.4–4.1)	3.5 (3.1–3.9)	3.6 (3.1–4.0)	0.001	0.001
Weight concerns	4.4 (4.0–4.7)	3.2 (2.8–3.5)	3.0 (2.5–3.4)	3.1 (2.7–3.6)	0.001	0.001
EDEQ global	3.8 (3.5–4.1)	2.6 (2.3–2.9)	2.5 (2.2–2.9)	2.5 (2.1–2.9)	0.001	0.001
LOCES total	82.5 (77.9–87.1)	54.2 (48.9–59.4)	56.1 (50.0–62.1)	57.3 (50.7–64.0)	0.001	0.001
Depression	16.9 (14.3–19.4)	12.9 (10.1–15.7)	12.1 (9.0–15.3)	13.9 (10.5–17.3)	0.004	0.097
Anxiety	11.3 (9.2–13.4)	7.1 (4.8–9.3)	8.2 (5.6–10.8)	8.8 (6.0–11.6)	0.002	0.203
Stress	22.6 (20.2–24.9)	16.4 (13.8–18.9)	15.4 (12.4–18.4)	17.7 (14.4–21.0)	0.001	0.023
DERS total	103.5 (97.3–109.7)	84.6 (77.8–91.4)	88.8 (81.3–96.3)	87.8 (79.9–95.8)	0.001	0.002

OBE, Objective binge eating; SBE, Subjective binge eating; EDEQ, Eating Disorders Examination Questionnaire; LOCES, Loss of Control over Eating Scale; DERS, Difficulties in Emotion Regulation Scale; CI, Confidence interval; *p*-values, Levels of significance. *p*-values for two-way comparisons are calculated based on paired sample *t*-test.

Participants who received online HAPIFED had reduced mean scores for all outcome measures (Ps < 0.05) from pre-treatment to the end of treatment (except for anxiety) and from pre-treatment to the 6-month follow-up (except for anxiety and psychological stress) (Table 2). The mean scores for all outcome measures were reduced (Ps < 0.05) in participants who received online CBT from pre-treatment to the end of treatment (Table 2). However, participants who received online CBT did not significantly reduce mean scores of objective or subjective binge eating, depression, or anxiety from pre-treatment to the 6-month follow-up.

Our mixed model findings showed that—adjusting for time effects over the assessment timepoints—dietary restraint, eating concerns, shape concerns, and EDE-Q global scores differed by treatment arm (Table 3). Results from the mixed models also showed that all of the outcome measures significantly differed across the assessment timepoints within each treatment arm. None of the outcome measures showed significant interactions for the treatment arms according to the assessment timepoints.

Table 3. Results of mixed model analyses by treatment arm and assessment timepoint, as well as interaction of treatment arms and assessment timepoints.

Outcome Measures	Effect					
	Treatment Arms (Online HAPIFED Groups, Online CBT Groups)		Assessment Timepoints (Pre-Treatment, End of Treatment, 3-Month Follow-up, and 6-Month Follow-up)		Treatment Arm and Assessment Timepoints	
	F-Value	*p*-Value	F-Value	*p*-Value	F-Value	*p*-Value
Objective binge eating episodes	0.9	0.337	14.5	<0.001	0.6	0.628
Subjective binge eating episodes	0.3	0.611	22.0	<0.001	0.4	0.736
Dietary restraint	5.6	0.020	13.9	<0.001	1.2	0.302
Eating concerns	4.5	0.036	74.7	<0.001	0.7	0.533
Shape concerns	5.4	0.022	64.0	<0.001	1.1	0.357
Weight concerns	1.8	0.184	50.6	<0.001	0.1	0.938
EDE-Q global score	5.8	0.017	72.7	<0.001	0.8	0.477
LOCES total score	1.8	0.180	91.5	<0.001	0.6	0.623
Depression	3.6	0.059	11.0	<0.001	0.2	0.904
Anxiety	0.5	0.460	6.3	<0.001	0.5	0.689
Stress	1.6	0.212	13.9	<0.001	0.6	0.610
DERS total score	0.8	0.366	23.0	<0.001	1.5	0.221

EDEQ, Eating Disorders Examination Questionnaire; LOCES, Loss of Control over Eating Scale; DERS, Difficulties in Emotion Regulation Scale; F-value, the value of F-test statistic that determines whether a random term significantly affect the response; *p*-value, levels of significance.

Large effect sizes (Cohen's $d \geq 0.80$) for eating concerns, shape concerns, weight concerns, EDE-Q global scores, and LOCES total scores were found at the end of treatment, as well as the 3- and 6-month follow-ups for participants in both treatments (Table 4). Additionally, large effect sizes for objective binge eating at the 6-month follow-up and dietary restraint at the 3- and 6-month follow-ups were found in participants treated with online HAPIFED.

Table 4. Mean scores with 95% confidence interval of outcome measures for online HAPIFED and online CBT at each timepoint.

Outcome Measures	Effect Sizes (Cohen's *d*): Online HAPIFED Groups			Effect Sizes (Cohen's *d*): Online CBT Groups		
	Pre-Treatment Compared to			Pre-Treatment Compared to		
	End of Treatment	3-Month Follow-up	6-Month Follow-up	End of Treatment	3-Month Follow-up	6-Month Follow-up
	Cohen's *d*	Cohen's *d*	Cohen's *d*	Cohen's *d*	Cohen's *d*	Cohen's *d*
Objective binge eating episodes	0.59	0.73	0.85	0.50	0.52	0.49
Subjective binge eating episodes	0.49	0.53	0.67	0.75	0.75	0.32
Dietary restraint	0.48	0.93	0.81	0.42	0.42	0.78
Eating concerns	1.24	1.37	1.56	1.16	1.03	0.92
Shape concerns	1.21	0.93	0.98	1.15	0.97	0.97
Weight concerns	0.96	0.83	0.81	1.04	1.07	0.87
EDE-Q global score	1.19	1.26	1.23	1.12	1.04	1.05
LOCES score	1.52	1.40	1.84	1.24	1.17	1.24
Depression	0.47	0.64	0.49	0.44	0.42	0.34
Anxiety	0.27	0.19	0.36	0.50	0.35	0.26
Stress	0.45	0.37	0.15	0.63	0.53	0.48
DERS score	0.49	0.45	0.63	0.79	0.58	0.68
Boddy mass index	0.28	0.32	0.33	0.34	0.41	0.42
Body weight	0.28	0.32	0.33	0.28	0.40	0.53

Notes: Cohen's *d* value indicates small effect at 0.20; medium effect at 0.50; and large effect at 0.80. Negative sign indicates that the mean scores increased at 3-month and 6-month follow-ups, respectively, compared to end of treatment. Eating Disorders Examination Questionnaire; LOCES, Loss of Control over Eating Scale; DERS, Difficulties in Emotion Regulation Scale.

Body Weight

Participants who received online HAPIFED or online CBT showed mean weight reductions of 6.8% and 3.9%, respectively, from pre-treatment to the 6-month follow-up (Table 5). No significant difference in weight loss was found in participants who received online HAPIFED versus online CBT at the 6-month follow-up.

Table 5. Change in participants' body weight from pre-treatment to 6-month follow-up.

	Mean Body Weight (kg)		**Calculated Manually from Overall Mean**		**Calculated from Individual Level Weight Pairwise**	
	Pre-Treatment	**6-Month Follow-up**	**Difference (kg)**	**% Weight Loss: Pre-Treatment to 6-Month Follow-up**	**Difference (kg)**	**% Weight Loss: Pre-Treatment to 6-Month Follow-up**
Online HAPIFED groups	96.1	89.5	6.6	6.8%	2.3	2.4
Online CBT groups	98.4	94.5	3.9	3.9%	3.8	3.8
	$p = 0.476$	$p = 0.256$				$p = 0.419$

HAPIFED, Healthy Approach to Weight Management and Food in Eating Disorders; CBT, Cognitive behavioural therapy; *p*-values, levels of significance.

4. Discussion

Our between-group analyses showed similar reductions in binge eating episodes and body weight in people who received either online HAPIFED or online CBT. However, our within-group analyses showed that (1) only online HAPIFED had large effect sizes on objective binge eating episodes at the 6-month follow-up; and (2) only the participants who received online HAPIFED reduced their number of objective and subjective binge eating episodes at the 6-month follow-up. Additionally, only the participants who received online HAPIFED showed a mean percentage weight loss (6.8%) that reached the level that is commonly considered beneficial for people with a high BMI [53]. Lastly, both treatments induced reductions in eating disorder psychopathology, loss of control over eating, and difficulties with emotion regulation at the 6-month follow-up. Thus, both treatments potentially improved participants' emotion regulation skills and contributed to reductions in dysfunctional attempts to regulate emotions via binge eating. Overall, the findings of this study complement the previous RCT that examined the efficacy of the HAPIFED program [31,32] by showing that HAPIFED can be delivered via videoconferencing to assist people with BED in reducing eating disorder behaviours and psychopathology. Moreover, consistent with the findings of that previous RCT [31], the within-group analyses of the current study suggest that multidisciplinary interventions of HAPIFED (i.e., psychotherapy, nutritional orientation, and physical activity orientation) can potentially be more effective in maintaining reductions in binge eating after treatment completion in comparison to CBT. This study also showed that CBT delivered via videoconferencing (in a group therapy format) can reduce eating disorder behaviours and psychopathology in people with BED.

There is a growing scientific literature supporting the use of online interventions to treat people with eating disorders characterised by recurrent binge eating. Previous studies in this field have shown the efficacy of online self-help CBT interventions in reducing binge eating and improving mental health in people with binge/purge eating disorders or BED [54,55]. For instance, a recent RCT found that a 12-week online self-help CBT program that used exercises addressing risk factors for and the mechanisms of BED reduced binge eating, eating disorder psychopathology, emotion dysregulation, depression, and anxiety in people with BED [55,56]. The findings of the current RCT contribute to the literature in this field by showing that online treatments based on CBT or HAPIFED delivered in a group therapy format via videoconferencing are also an effective treatment option to assist people with BED. Moreover, research on online treatments for people with eating disorders is continually evolving. For example, an ongoing RCT is investigating the efficacy, cost-effectiveness, and cost-utility of a low-intensity and low-cost online guided self-help CBT-E compared to treatment-as-usual CBT-E delivered via videoconferencing [57].

This study has several strengths and limitations. Our findings are limited in that numerous participants reported not being able to attend sessions due to being infected with COVID-19. This may have contributed to the relatively high dropout rates particularly for the follow-up assessments. Nonetheless, it is noteworthy that high attrition rates are common in online weight management interventions [58]. Another limitation of this RCT is that all of the data were collected via self-report measures and may be affected by social desirability bias. This study is also limited in that the effects of participants' physical activity levels on their mental health were not examined in isolation. Lastly, this RCT did not include control groups with participants who did not receive any interventions or a "placebo" intervention that controlled for the non-specific effects of therapy. Alongside these limitations, this study has several strengths, such as randomization of participants, allocation concealment, and blinding of participants and the statistician who analysed the RCT results.

The findings of this RCT enable us to make recommendations for future research. First, this field would benefit from RCTs comparing online treatment programs, such as online HAPIFED versus face-to-face therapies for people with BED. This is particularly important as face-to-face weight management interventions can be more effective in the long term in comparison to online interventions [58]. Secondly, this field would also benefit from RCTs comparing online treatment programs versus non-treated groups of people with BED to determine the efficacy of online treatments in comparison to the effect of time alone. Thirdly, RCTs comparing the efficacy of online treatments for people with BED in a group therapy format versus individual therapy format are also important. Group therapy may have advantages (e.g., it may be more cost-effective) in comparison to individual therapy for BED [59]. Lastly, future RCTs including participants with other prevalent eating disorders (e.g., bulimia nervosa and other specified feeding or eating disorders) are required to investigate the efficacy of online treatments in assisting people with a variety of unhealthy eating behaviours and body image concerns. It is noteworthy that a previous study found that a treatment combining online guided self-help and behavioural weight loss interventions reduced binge eating and eating disorder psychopathology in young adults with bulimia nervosa or BED and a high comorbid body weight [21]. However, that treatment did not induce significant weight loss [21]. Thus, it is important that future studies examine the efficacy and safety of different types of weight management interventions for people with eating disorders and a high comorbid body weight.

5. Conclusions

In conclusion, relatively short treatment programs based on HAPIFED or CBT—delivered via videoconferencing—were commensurate in reducing eating disorder behaviours and psychopathology in adults with BED. Moreover, online HAPIFED and online CBT similarly induced modest reductions in participants' body weight. Finally, both treatments induced a secondary benefit of improving emotion regulation and reducing symptoms of depression, anxiety, or psychological stress in people with BED. Thus, the delivery of treatments based on HAPIFED or CBT via videoconferencing can be an effective option to increase treatment access to people with BED and a high comorbid BMI.

Author Contributions: F.Q.d.L., P.H. and T.C. were responsible for designing the RCT protocol. F.Q.d.L. and E.d.S. delivered cognitive behavioural therapy. T.G. and S.F. delivered nutritional orientation. P.C.T., K.M. and A.D. delivered physical activity orientation. I.L., T.A.J., L.S.M., F.Q.d.L., E.d.S., S.F. and L.P. assessed participants. M.M. conducted the statistical analyses and drafted the study's Sections 2 and 3. F.Q.d.L. was responsible for writing the report. All authors provided feedback on the report and approved the final manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: Felipe Quinto da Luz was supported by a Young Investigator Grant and Fellowship from the São Paulo Research Foundation—FAPESP (2018/18028-2, 2019/14622-0). Isabella Lobo, Luisa Pascoareli, Leticia Marinho, and Edilaine dos Santos were supported by scholarships from FAPESP

(20/04181-3, 20/04220-9, 21/04479-5, 20/08814-0). Tatiana Jana was supported by a scholarship from the CAPES Foundation, Ministry of Education, Brazil.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Committee of the University of São Paulo's Faculty of Medicine Hospital (CAAE: 19551419.1.0000.0068) in Brazil.

Informed Consent Statement: Informed consent was obtained from all subjects involved in this study.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors upon request.

Conflicts of Interest: Phillipa Hay receives/has received sessional fees and lecture fees from the Australian Medical Council, Therapeutic Guidelines publication, and HETI New South Wales Institute of Psychiatry, as well as royalties/honoraria from Hogrefe and Huber, McGraw Hill Education, Blackwell Scientific Publications, Biomed Central, and PlosMedicine. She has received research grants from the NHMRC and ARC. She is Chair of the National Eating Disorders Collaboration Steering Committee in Australia (2012-), and was a member of the ICD-11 Working Group for Eating Disorders (2012–2019), and was Chair of the Clinical Practice Guidelines Project Working Group (Eating Disorders) of RANZCP (2012–2015). She has prepared a report under a contract for Shire (now Takeda) Pharmaceuticals in regard to binge eating disorder (July 2017) and has received consulting fees for education of doctors from Takeda Pharmaceuticals. All views in this paper are her own.

Appendix A

Table A1. Summary of the topics addressed in each session of online HAPIFED.

Session Number	Type of Intervention		
	Nutritional Orientation	**Physical Activity Orientation**	**Psychological Interventions**
1	-Introduction of healthcare professionals -Overview of the treatment program -How to use the HAPIFED App -Collaborative weighing -Participants' introductions and expectations for the treatment		
2	-Quality of foods -Structured eating -The binge eating cycle	----------	-Using the HAPIFED App -Personalizing the BED formulation
3	----------	-Understanding your relationship with physical activity	-Events, emotions, and eating -Proactive problem solving
4	-Identifying hunger and satiety cues	----------	-Events, emotions, and eating -Proactive problem solving
5	----------	-Myths about physical activity and exercise	-Events, emotions, and eating -Proactive problem solving -Addressing barriers to treatment progress
6	-Planning and organization around foods and eating	----------	-Addressing the urge to eat when not feeling physically hungry: "surfing the urge"
7	----------	-Weight loss versus fat loss	-Addressing the urge to eat when not feeling physically hungry: "surfing the urge"
8	-Mindful eating practice -Social aspects of eating	----------	-Understanding mindful eating
9	----------	-Reasons for physical activity/exercising	-Concerns about body shape and weight: focussing on the positive aspects of your body
10	-Brazilian healthy eating guidelines	----------	-Identifying my positive aspects

Table A1. *Cont.*

Session Number	Type of Intervention		
	Nutritional Orientation	**Physical Activity Orientation**	**Psychological Interventions**
11	----------	-Memory, emotions, and readiness to exercise	-Body image: developing other domains of self-evaluation
12	-Progress with treatment and future goals	----------	-Developing a long-term maintenance plan
13	-Preparation for the end of the treatment program -Relapse prevention -Discussion about individualized long-term maintenance plans		
14	-Booster session: identifying achievements and addressing difficulties		
15	-Booster session: identifying achievements and addressing difficulties		

Table A2. Summary of topics addressed in each session of the online CBT groups.

Session Number	Therapy Topics
1	-Introduction of therapists -Overview of the therapy program -Participants' introductions and expectations for the treatment -Personalization of the BED formulation
2	-Review of the personalization of the BED formulation -Instructions for self-monitoring -Collaborative weighing and addressing weight concerns
3	-Review of self-monitoring and collaborative weighing -Psychoeducation about BED -Regular eating
4	-Review of self-monitoring and regular eating -Addressing the urge to eat between meals and snacks
5	-Review of addressing the urge to eat between meals and snacks -Assessment of progress with the therapy and identification of barriers to change
6	-Review of the progress with the therapy and identification of barriers to change -Binge eating episode analysis and proactive problem solving
7	-Review of binge eating episode analysis and proactive problem solving -Addressing dietary restraint/restriction and binge eating
8	-Continuation of addressing dietary restraint/restriction and binge eating
9	-Review of dietary restraint/restriction and binge eating -Body image: developing other domains of self-evaluation
10	-Review of body image: developing other domains of self-evaluation -Body image: body checking, body avoidance, and comparison with others
11	-Review of body image: body checking, body avoidance, and comparison with others -Addressing body image: "feeling fat"
12	-Review of addressing body image: "feeling fat" -Dealing with setbacks and the "BED mindset"
13	-Review of dealing with setbacks and the "BED mindset" -Ending treatment well
14	-Booster session: identifying achievements and addressing difficulties
15	-Booster session: identifying achievements and addressing difficulties

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