Article:
Kambanis, P.E. orcid.org/0000-0002-1950-3332, Graver, H. orcid.org/0000-0003-4293-6926, Palmer, L.P. orcid.org/0000-0003-3608-5395 et al. (14 more authors) (2025) Patterns of symptom change in behaviors and cognitions during 10-session cognitive behavioral therapy (CBT-T) for non-underweight eating disorders. International Journal of Eating Disorders. ISSN 0276-3478

https://doi.org/10.1002/eat.24429

Patterns of symptom change in behaviors and cognitions during 10-session cognitive behavioral therapy (CBT-T) for non-underweight eating disorders

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Word count of main text (including references, tables, and figures): 2100/2000

Word count of abstract: 200/200

Tables: 1

Figures: 1

Declarations

Ethics Approval and Consent to Participate: The study was conducted according to the Declaration of Helsinki and study protocol was approved by the Mass General Brigham Institutional Review Board. Written informed consent or waiver of informed consent as approved by the IRB was obtained for all participants.

Conflicts of Interest: Drs. Thomas, Becker, and Eddy receive royalties from Cambridge University Press for their books on avoidant/restrictive food intake disorder. Drs. Thomas and Burton-Murray receive royalties from Oxford University press for their book on rumination disorder. Dr. Burton-Murray receives royalties from Cambridge University Press for her forthcoming book on irritable bowel syndrome. Dr Waller receives royalties from Routledge for the CBT-T manual. Drs. Thomas, Eddy, and Kambanis receive consulting fees from Equip Health. Dr. Breithaupt serves as a consultant for Otsuka Pharamecuticals and HealthiVibe.

Funding: Funding from K24MH135189 (Thomas); K23MH125143 (Becker); K23DK131334 (Burton-Murray). The content is solely the responsibility of the authors and does not necessarily represent the official views of the funding agencies.

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Consent for Publication: The authors consent for this manuscript to be published. There are no other parties involved in the decision to publish.

Acknowledgments: Not Applicable.

Availability of Data and Materials: The data that support the findings of this study are available from the corresponding author upon request

Abstract

Objective: Little is known about the timing of behavioral versus cognitive change in 10-session cognitive-behavioral therapy for non-underweight eating disorders (CBT-T). We aimed to: (a) evaluate the magnitude of behavioral and cognitive symptom reduction across treatment; and (b) investigate the relation between early behavioral changes and subsequent cognitive changes. We hypothesized: (a) large and significant reductions in behavioral and cognitive symptoms from pre- to mid-treatment and from pre- to post-treatment and (b) that early behavioral change would predict subsequent cognitive change over the course of treatment. **Method:** Patients (N = 63) were offered CBT-T and completed the Eating Disorder-15 on a weekly basis. We used intent-to-treat analyses implementing the last observation carried forward or backward approach. **Results:** We observed large and significant reductions in most behavioral and all cognitive symptoms pre- to mid-treatment and pre- to post-treatment. Early changes in behavioral symptoms did not significantly predict subsequent cognitive changes. **Discussion:** Behavioral improvements occurred rapidly and were sustained throughout treatment, whereas cognitive changes followed a more gradual trajectory. The absence of a significant predictive relationship between early behavioral change and subsequent cognitive change suggests that these domains may improve independently. Future research should investigate the mechanisms linking behavioral and cognitive changes.

Keywords: eating disorders, non-underweight eating disorders, bulimia nervosa, binge-eating disorder, other specified feeding/eating disorder, cognitive-behavioral therapy, cognitive-behavioral therapy for eating disorders, behaviors, cognitions

Key points:

- We observed large and significant reductions in most behavioral and all cognitive symptoms pre- to mid-treatment and pre- to post-treatment during ten session cognitive-behavioral therapy for eating disorders (CBT-T).
- Early changes in behavioral symptoms did not predict subsequent cognitive changes.
- Behavioral improvements occurred rapidly and were sustained throughout treatment, whereas cognitive changes followed a more gradual trajectory.

Patterns of symptom change in behaviors and cognitions during 10-session cognitive behavioral therapy (CBT-T) for non-underweight eating disorders

Cognitive-behavioral therapy for eating disorders (CBT-ED; Fairburn, 2008; Waller et al., 2007) has the strongest evidence base for treating adult eating disorders (EDs; Atwood & Friedman, 2020; Linardon et al., 2017); however, access to care remains limited due to its resource-intensive nature. Treatment typically requires ≥20 sessions, with some protocols extending up to 60 sessions (Stefini et al., 2017). Emerging evidence supports a briefer, 10-session version known as CBT-T ("T" for ten sessions; Waller et al., 2019), which retains core elements of CBT-ED for non-underweight EDs while significantly reducing session count. CBT-T achieves comparable outcomes to 20-session CBT-ED, with similar symptom reduction/remission rates (Allen et al., 2024; Birtwell et al., 2021; Moore et al., 2021a, 2021b; Moore & Waller, 2023; Pellizzer et al., 2019; Waller et al., 2018; Tatham et al., 2020; Wade et al., 2021; Rose et al., 2021). A systematic review and meta-analysis reported that 65% of CBT-T completers achieved positive outcomes (i.e., post-treatment ED symptom scores within one standard deviation of non-clinical norms) in half the time of CBT-ED (Keegan et al., 2022).

One of CBT-T's key strengths is its emphasis on large early change, a robust predictor of ED treatment outcomes (Chang et al., 2021; Linardon et al., 2017; Vall & Wade, 2015). This contrasts with many community therapies (e.g., psychodynamic/supportive therapies), which often prioritize cognitive before behavioral change. While CBT-ED also encourages early change, it does not emphasize the "largest tolerable change" that CBT-T promotes. CBT-ED's maintenance model posits that cognitions maintain behaviors, whereas CBT-T asserts that behaviors drive and maintain cognitions, making behavioral change the most effective route to modifying maladaptive cognitions. CBT-T leverages the principle of early behavioral change by

frontloading treatment with four sessions to catalyze rapid behavioral shifts, with subsequent sessions contingent upon early progress (Waller et al., 2019). This approach aligns with CBT-T's theoretical framework, which proposes that behavioral changes drive cognitive improvements (Waller et al., 2018).

Despite growing evidence for CBT-T, no studies have directly tested whether behavioral changes precede cognitive improvements or examined how these changes unfold over time. We aimed to: (a) evaluate symptom reduction across treatment; and (b) investigate the relation between early behavioral change and subsequent cognitive change. We hypothesized: (a) significant reductions in behavioral and cognitive symptoms from pre- to mid-treatment and pre- to post-treatment; and (b) that, consistent with the principles of CBT-T, early behavioral change would predict subsequent cognitive change.

Method

Participants

We recruited 63 adults (87% female; 91% white; 86% non-Hispanic/Latinx) seeking treatment for non-underweight EDs (body mass index [BMI] > 18.5 kg/m^2) at an outpatient ED clinic. Twenty-nine patients consented to CBT-T in a treatment study, while 34 received CBT-T as part of routine clinical care and were included via chart review. Demographic/clinical characteristics, attrition, and outcomes did not differ between the two groups (Supplementary Table 1). Our study design follows the ORBIT model for developing behavioral treatments (Czajkowski et al., 2015), which guides intervention refinement and preliminary evaluation before large-scale efficacy/effectiveness trials. The study was approved by the Mass General Brigham Institutional Review Board, which also granted consent waivers for chart review.

Patients were included if they met *DSM-5* (American Psychiatric Association [APA],

2013, 2022) criteria for a non-underweight ED, were ≥ 18 years old, capable of consent, able to complete self-reports, and had a primary care physician for medical monitoring. Three 17-year-olds were included as exceptions after declining family-based treatment and being deemed clinically appropriate for CBT-T due to non-underweight status. Exclusion criteria included active suicidality, untreated/unstable bipolar disorder/psychosis, intellectual disability, insufficient English proficiency, or requiring a higher level of care.

Procedure

Data were collected from November 2019 to August 2024. A patient flow diagram is included in the Supplement. All patients underwent a standard clinic evaluation, conducted/supervised by CMF, KTE, JJT, or KRB, with diagnoses conferred via routine clinical interview according using *DSM-5* (APA, 2013, 2022) criteria. Eligible patients were offered CBT-T. The 29 trial participants received treatment at no cost; the 34 clinic participants followed standard billing procedures. Patients received CBT-T (Waller et al., 2019), a structured, 10-session treatment targeting current symptoms, delivered weekly for 50-60 minutes. An initial four-session contract was extended only if patients engaged in therapy tasks and made foundational behavioral changes; otherwise, treatment was terminated early (Waller et al., 2019). We informed participants of this criterion for continued engagement in the consent process. We provided those who were terminated per protocol for lack of engagement/progress by Session 4 with referrals to alternative treatment options. Clinicians were trained by one of the treatment developers (GW) and received ongoing supervision.

Measures

Patients self-reported demographics. Weight was measured by clinicians for in-person evaluations (n = 10) or by patients using home scales during virtual evaluations (n = 53) — a

shift driven by Covid-19. Patients completed the Eating Disorder-15 (ED-15; Tatham et al., 2015), a brief weekly self-report measure of eating attitudes/behaviors. The ED-15 consists of 10 attitudinal items (0-6 scale) and five behavioral items assessing objective binge eating, self-induced vomiting, laxative use, restriction, and excessive exercise (times/week). Attitudinal subscales include Weight/Shape Concerns and Eating Concerns, with an overall Global Score calculated as the mean of all 10 items. Due to low reports of self-induced vomiting (n = 11) and laxative use (n = 8), these behaviors were combined into an overall purging frequency (n = 19).

Statistical Analyses

For patients who completed treatment in <10 sessions (n = 14), missing data at Session 10 was solely due to early completion rather than true missingness; therefore, their final session score was carried forward. Similarly, for those who completed treatment in >10 sessions (n = 4), their last recorded session score was used as their final session value. This approach ensures all participants who completed treatment had a final session value. We conducted analyses in Mplus (Muthén & Muthén, 1998-2017). We handled the remaining missing data (i.e., for those who did not fill out the ED-15 at a given session, or who dropped out or were terminated per protocol) using full information maximum likelihood, which allows for parameter estimation based on all available data points.

Aim 1

To test our hypothesis that behavioral and cognitive symptoms would significantly reduce between pre- to mid-treatment (Session 1 to Session 4) and from pre- to post-treatment (Session 1 to Final Session), we conducted a series of fixed-effects multilevel models. The models accounted for repeated measures nested within individuals, with session comparisons examined using dummy-coded variables.

Aim 2

To test our hypothesis that early behavioral improvements drive subsequent cognitive changes, we conducted a linear regression analysis using early behavioral change (Session 1 minus Session 4) as the predictor and subsequent cognitive change (Session 4 minus Final Session) as the outcome. We created a composite behavioral score by summing all ED-15 behavioral items (objective binge eating, purging, restriction, and excessive exercise) to capture overall behavioral frequency (e.g., if a patient binged and vomited three times each in a week, their total behavioral frequency would be six). We utilized the ED-15 Global Score as our measure of cognitions.

Results

Mean age of the overall sample was 34.1 $\pm$ 14.4 years (range = 17 – 80) and mean BMI was 29.8 $\pm$ 8.9 kg/m^2 (range = 19.7 – 71.1). Using *DSM-5* criteria, 16 met criteria for BN, 27 for BED, and 20 for OSFED (n = 12 atypical anorexia nervosa, n = 6 binge-eating disorder of low frequency/limited duration, n = 1 night eating syndrome, n = 1 purging disorder).

Attrition

Of 63 patients who initiated CBT-T, 43 (68%) completed treatment and the remainder were either self-initiated dropouts (n = 11; 18%) or terminated per protocol for lack of engagement/progress by session 4 (n = 9, 14%). There were no significant demographic/clinical differences between treatment completers and non-completers (Supplementary Table 2). Completers attended an average of 9.6 $\pm$ 1.8 sessions (range = 5-15). Fourteen patients finished early after meeting treatment goals, and four patients required up to five extra sessions due to comorbidities/severity.

Aim 1

Results are presented in Table 1 and Figure 1. Regarding behaviors, partially supporting our hypothesis, we observed large and significant reductions in objective binge eating and restriction from Session 1 to Session 4. From Session 1 to the Final Session, objective binge eating, restriction, and excessive exercise showed similarly large and significant reductions, with no further changes observed between Session 4 and the Final Session. By contrast, purging decreased numerically but non-significantly throughout treatment.

Regarding cognitions, ED-15 Eating Concern, Shape/Weight Concern, and Global Score (which served as our measure of cognitions) decreased significantly from Session 1 to Session 4 and Session 1 to the Final Session, with further significant symptom reduction occurring from Session 4 to the Final Session. All effect sizes were very large.

Aim 2

Contrary to our hypothesis, early changes in behavioral symptoms were not a significant predictor of subsequent cognitive change across the course of treatment (B = .03 [SE = .03], z = .91, p =.363, β = .21).

Discussion

This study is the first to evaluate the timing of behavioral and cognitive changes in CBT-T, addressing a critical gap in understanding symptom changes and highlighting the importance of early behavioral change. We aimed to: (a) assess the extent of symptom reduction throughout treatment; and (b) examine the relation between early behavioral changes and subsequent cognitive outcomes. Partially consistent with our hypothesis, most behavioral and all cognitive symptoms significantly decreased from pre- to mid-treatment and pre- to post-treatment. However, contrary to our hypothesis, early behavioral changes did not significantly predict subsequent cognitive changes.

Behavioral and cognitive symptoms followed distinct trajectories. Behavioral symptoms showed large *early* reductions that were maintained throughout treatment, supporting CBT-T's emphasis on rapid behavioral change. An exception was purging (which decreased numerically but not significantly), likely due to its low base rate in our sample. By contrast, cognitive symptoms improved gradually, with significant changes from Sessions 1 to 4 and further reductions between Sessions 4 and the Final Session. Cognitive improvements may require a longer intervention period, likely reflecting the impact of later treatment phases focused on cognitive restructuring and body image work. Early behavioral progress did not predict later cognitive change; although behavioral interventions are a critical first step, additional strategies may be needed to sustain cognitive change. Behavioral and cognitive changes may occur independently or may be influenced by other factors (e.g., cognitive flexibility, motivation to change). Alternatively, our small sample size may have limited statistical power.

This study fits within ORBIT Phase Ib (Czajkowski et al., 2015), refining CBT-T by examining symptom change sequencing and identifying key targets for optimization. While findings align with CBT-T's focus on early behavioral change, they suggest cognitive change might not be solely dependent on behavioral improvements. Elements from broader models like CBT-ED (e.g., more integrated cognitive restructuring) might enhance outcomes. Findings highlight CBT-T's practicality and scalability, as it was successfully implemented by both clinicians and trainees. Notably, 14 patients improved in < 10 sessions, which is particularly striking given that the full treatment was already brief at 10 sessions. This underscores the treatment's adaptability and efficiency. However, findings should be interpreted with limitations in mind. No Stage III clinical trials have yet been conducted to confirm CBT-T's efficacy in large, multisite samples. Future research should prioritize rigorous trials to refine CBT-T's

implementation on a broader scale.

Larger, more diverse samples are needed for greater generalizability. This study was not pre-registered. Self-reported weight may be subject to bias, which could affect the accuracy of BMI calculations. We did not conduct a formal structured diagnostic interview for psychiatric comorbidities as part of this study. Variability in session counts may raise concern about fidelity to the 10-session framework; however, all clinicians were trained by the treatment developer and received ongoing supervision. Extended treatment durations primarily reflected comorbid complexity rather than protocol deviations. The structured initial four-session contract may have limitations in feasibility/scalability across different healthcare settings, particularly those with limited resources for patients requiring alternative treatments. Limitations notwithstanding, this study strengthens evidence for CBT-T in reducing ED symptoms within a brief treatment framework. Notably, this is one of the first studies to evaluate behavioral and cognitive change sequencing in CBT-T, demonstrating that behavioral improvements occurred rapidly and were sustained, while cognitive changes followed a more gradual trajectory. The lack of a predictive relationship between early behavioral change and subsequent cognitive change suggests these domains may improve independently rather than sequentially. Future research should investigate mechanisms linking behavioral and cognitive changes to further optimize CBT-T and enhance its clinical effects for individuals with EDs. Longitudinal studies examining the maintenance of cognitive/behavioral changes would provide valuable insight into the durability of symptom improvement and factors associated with sustained recovery.

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Table 1

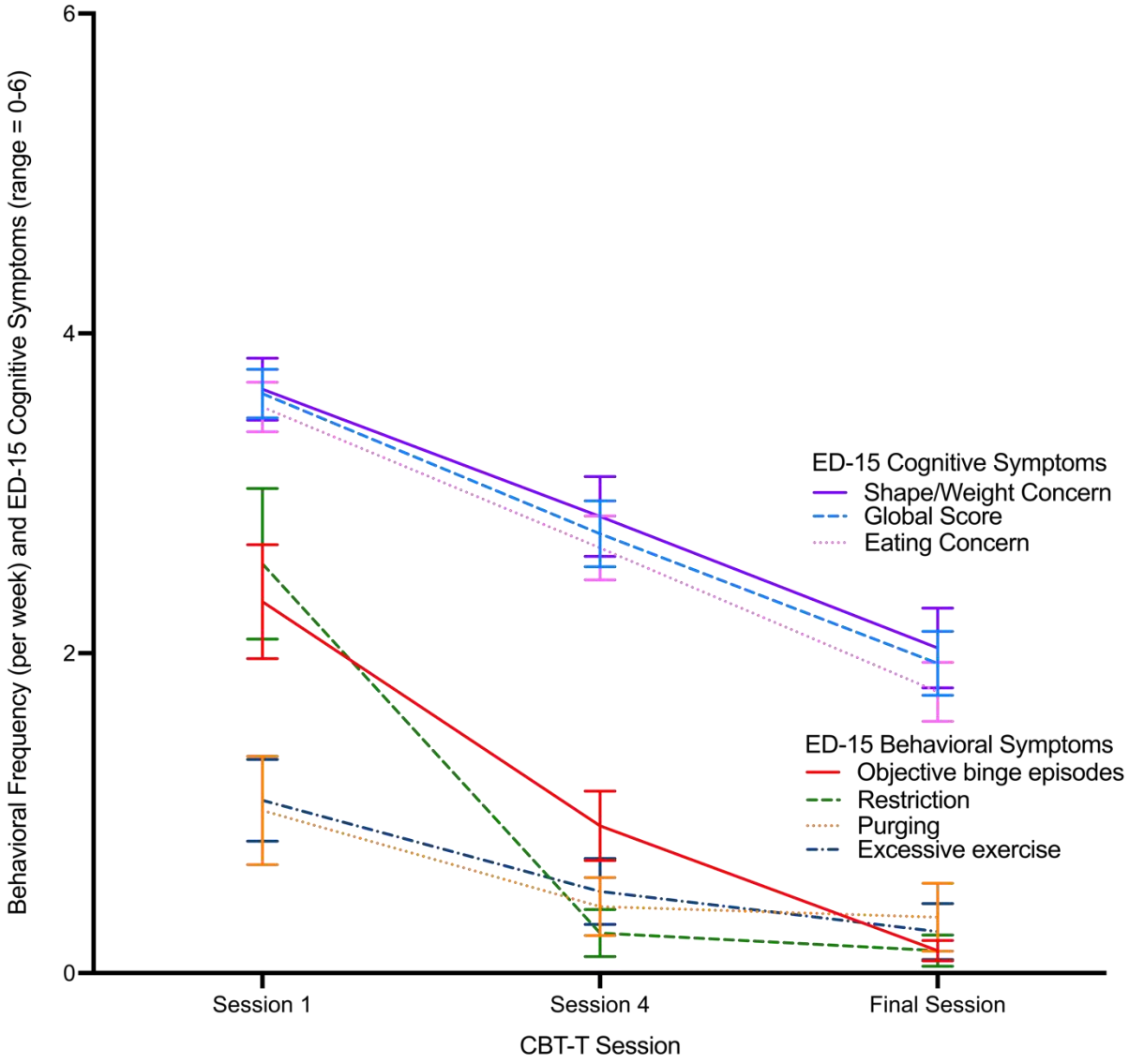
Aim 1 – Changes in Eating Disorder Behavioral and Cognitive Symptoms Across Treatment

	Session 1			Session 4			Final Session			Session 1 v. Session 4				Session 1 v. Final Session				Session 4 v. Final Session			
Behaviors	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*B* (*SE*)	*z*	*p*	*β*	*B* (*SE*)	*z*	*p*	*β*	*B* (*SE*)	*z*	*p*	*β*
Composite behavior	62	7.0	7.3	53	2.1	3.3	43	0.9	2.6	-4.9 (1.0)	-5.1	< .001	-.40	-6.1 (1.0)	-6.0	< .001	-.47	-1.21 (1.05)	-1.2	.248	-.09
OBE	62	2.3	2.8	53	0.9	1.6	43	0.1	0.4	-1.40 (.37)	-3.8	< .001	-.30	-2.18 (.39)	-5.6	< .001	-.45	-0.79 (.41)	-1.9	.053	-.16
Purging	62	1.0	2.7	53	0.4	1.3	43	0.3	1.4	-0.60 (.37)	-1.6	.102	-.14	-0.67 (.39)	-1.7	.087	-.15	-0.07 (.40)	-0.2	.869	.15
Restriction	62	2.6	3.7	53	0.3	1.1	43	0.1	0.6	-2.32 (.45)	-5.1	< .001	-.41	-2.43 (.48)	-5.1	< .001	-.40	-0.11 (.50)	-0.2	.831	-.02
Excessive exercise	62	1.1	2.0	53	0.5	1.5	43	0.2	1.2	-0.57 (.31)	-1.9	.062	-.16	-0.83 (.32)	-2.5	.011	-.22	-0.25 (.34)	-0.8	.450	-.07
	Session 1			Session 4			Final Session			Session 1 v. Session 4				Session 1 v. Final Session				Session 4 v. Final Session			
Cognitions	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*B* (*SE*)	*z*	*p*	β	*B* (*SE*)	*z*	*p*	β	*B* (*SE*)	*z*	*p*	β
Shape/weight concern	52	3.7	1.4	46	2.9	1.7	38	2.0	1.5	-.80 (.31)	-2.6	.010	-.23	-1.62 (.33)	-5.0	< .001	-.44	-0.82 (.33)	-2.5	.014	.01
Eating concern	52	3.5	1.1	46	2.7	1.4	38	1.8	1.1	-0.88 (.24)	-3.6	< .001	-.30	-1.78 (.26)	-7.0	< .001	-.57	-0.90 (.26)	-3.4	< .01	-.29
Global score	59	3.6	1.2	50	2.7	1.5	42	1.9	1.3	-0.88 (.25)	-3.5	< .001	-.28	-1.67 (.26)	-6.5	< .001	-.52	-0.81 (.27)	-3.0	.003	-.25

Note. M – mean; SD – standard deviation. Behaviors are reported as weekly frequencies, while cognitions are measured on a scale from 0-6. Means and standard deviations are calculated using available data, without imputing missing values. Regression analyses address missing data using full information maximum likelihood (FIML).

Figure 1

Aim 1 – Changes in Eating Disorder Behavioral and Cognitive Symptoms Across Treatment



Note. Mean scores and standard errors of measurement for behaviors (frequency per week) and cognitive symptoms (range = 0-6) are displayed across treatment sessions (Session 1, 4, and Final Session). Cognitions and behaviors are presented on the same graph to illustrate changes over time. One participant was excluded from behavioral analyses, and up to nine participants were excluded from cognitive analyses due to missing ED-15 data.