Complementary and Integrative Health Intervention Use in Binge Eating Disorder: A Narrative Review

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Abstract

Binge eating disorder (BED) is an autonomous DSM-5 eating disorder and mental health diagnosis characterized by discrete, rapid consumption of objectively large amounts of food associated with loss of control and distress. It has high lifetime prevalence rates, low treatment rates, and high rates of treatment dissatisfaction, early discontinuation of care, and recurrence. Complementary and integrative health (CIH) interventions (non-mainstream practices used with conventional approaches for whole-person treatment) hold potential to overcome many treatment barriers and improve BED treatment outcomes. Some CIH interventions have empirical support for use in eating disorders. However, little is known about the current state of CIH use in BED. Here, we summarize the current literature base on several of the more commonly used and recognized CIH interventions in the context of BED, including meditation, mindfulness, yoga, acupuncture, nutritional supplements, and pre/pro/postbiotics. We also summarize several challenges and limitations to CIH research in the context of BED and discuss the need for further research funding. Overall, CIH interventions can complement current BED treatments to improve clinical outcomes, particularly coping with symptoms, managing anxiety/stress/mood, and tolerating treatment (thus reducing treatment dropout). Empirical testing is warranted with a particular need for randomized controlled trials and guidelines on implementation and use.

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# Introduction

Binge eating disorder (BED) is an autonomous DSM-5 eating disorder and mental health diagnosis that affects nearly 3 million adults in the U.S. alone (1). It is characterized by discrete (2-hour) episodes of rapid consumption of objectively large amounts of food (without compensation), associated with loss of control, distress, guilt, and shame that occur at least once per week for at least three months (2). The biopsychosocial disorder is associated with high lifetime prevalence rates (4.5–31% (1, 3)) and a complicated health sequelae that include anxiety, depression, impaired cognitive function and emotion regulation, obesity, cardiovascular disease, diabetes, low self-esteem, and often stigmatization and isolation (1, 4-12). Moreover, it significantly impairs quality of life (9).

Standard of care interventions for BED include psychological interventions (e.g., cognitive behavioral therapy (CBT), CBT-self-help, interpersonal therapy, and psychodynamic therapies), medications (e.g., antidepressants, anticonvulsants, and anti-obesity/weight loss medications), nutritional counseling, and behavioral weight control (which combines nutritional and psychological counseling to promote healthy behavior change) (13, 14). These standard BED interventions generally have low treatment success rates (38.3–43.6% (1, 8)), high recurrence rates (49–64% (1, 15)), high treatment dissatisfaction (16), and early discontinuation of care (16). For example, CBT has a <50% success rate in fully alleviating BED symptoms (17, 18). Pharmacotherapy for BED is less effective than CBT and does not enhance the success of CBT in alleviating BED symptoms (17, 18).

Moreover, the issue of weight, obesity, and physiological health factors remains a point of contention in the field (7), as BED has a 40-70% incidence of lifetime obesity (1, 5, 6) and at the same time, overvaluation of body weight/shape/size are viewed as being central to the disorder (1, 7, 19). Nevertheless, it stands to note that behavioral weight control (13) is the only empirically-supported guideline intervention (14) to produce changes in body weight and composition (15) that reduce risks for many negative physical and mental health comorbidities associated with BED (5, 6, 11, 20, 21). However, like all other empirically supported interventions for BED, behavioral weight control is associated with low remission rates (36% at 12-month follow-up)(15) that are not improved by pharmacotherapies (14, 22). For this and other reasons, currently available pharmacotherapies are often not recommended for treating BED (17) and novel treatment approaches are needed (23).

In addition to the low treatment success rates (1, 8, 15, 16), many individuals with BED face socioeconomic barriers that prevent them from ever receiving a formal evaluation or diagnosis and ever accessing formal treatment (23). For example, studies find that 93.4– 96.8% of individuals who meet DSM criteria for BED never receive a formal diagnosis (24, 25), 67.3% do not perceived the need for formal treatment (24), and 56.4–86.8% never receive or pursue standard treatment (1, 24), due in part to a variety of possible treatment barriers. The treatment barriers facing individuals with BED are summarized in Bray et al., 2024 (23) and include:

1. Treatment costs (24, 26-36).
2. Inadequate insurance coverage (24, 31, 32, 36).
3. Stigmatization from healthcare providers (4, 24, 26, 32, 33, 35-42).
4. Insufficient provider screenings, in general (24-26, 32, 34, 41-43) and in minorities (4, 24, 26, 36, 42, 44).
5. Sociodemographic disparities in healthcare utilization and treatment (e.g., healthcare avoidance often driven by sociodemographic norms about healthcare use, marginalization (e.g., racism and stigmatization) from healthcare providers, and disparities in treatment quality based on race, ethnicity, or other sociodemographic factors) (4, 36, 40, 42, 44-50).
6. Denial (4, 24, 32), self- stigmatization (34-36, 39, 42), and shame (4, 24, 26, 32, 34-36, 39, 43, 51) about having an eating disorder, mental health diagnosis, or medical diagnosis.
7. Misconceptions about who can have an eating disorder/BED (4, 24, 34, 36, 39, 44), often related to old misconceptions that ascribe eating disorders exclusively to thin, affluent, white, cis-gendered females (the “SWAG: skinny, white, affluent, girl” stereotype (52))(4) .
8. Recognizing, screening for, and prioritizing physical issues often associated with BED (e.g., weight, gastrointestinal issues) vs. underlying mental health issues and eating disorder psychopathology [e.g., emotion dysregulation, trauma history, negative affect, negative urgency (7, 53), also likely related to denial (4, 24, 26, 32, 39, 51)](4, 7, 26, 33, 37, 41, 42, 54), related to prioritization of weight and physical health over mental health within patients (33), healthcare providers (26, 41) and society at large (36).
9. Insufficient resources to find/coordinate care, including:
10. Insufficient patient and provider education on BED treatment options (26, 32, 34, 41, 43).
11. Insufficient resources to coordinate communicate between multiple providers in a multidisciplinary team (26, 36).
12. Time required to seek-, coordinate-, and engage in treatment (36, 39, 55-59).
13. Transportation to- and from treatment (32, 34, 36, 55-59).
14. Eating disorder provider scarcity and wait lists (4, 34, 41, 60).
15. Geographic access to treatment resources (4, 34, 36, 41, 61).
16. Poor education on BED diagnosis (e.g., that it is in fact an autonomous DSM-5 mental health diagnosis) (4, 26, 34, 36, 39, 41, 43).

Complementary and integrative health **(CIH)** interventions hold potential to overcome many treatment barriers (23) and improve BED management and care (62-65). The United States’ National Centers for CIH **(NCCIH)** define CIH interventions as “a group of diverse medical and health care systems, practices, and products that are not presently considered to be part of conventional medicine" (66). These are commonly used as a complement or integrative component of standard therapy and can be classified broadly as:

1. Physical (e.g., massage)(66).
2. Psychological (e.g., mindfulness and spiritual practices, meditation, psychotherapy)(66).
3. Nutritional (e.g., special diets, dietary supplements, herbs, and pre/pro/postbiotics)(66).
4. Combinations of modalities 1 – 3 above (e.g., mind-body interventions, yoga, acupuncture, and mindful eating)(66).

Additionally, most CIH interventions share a central value of addressing and providing “whole person health,” which the NCCIH defines as “[referring] to helping individuals, families, communities, and populations improve and restore their health in multiple interconnected domains – biological, behavioral, social, environmental – rather than just treating disease,” and “expanding the understanding of the connections between these various aspects of health, including connections between organs and body systems (66, 67).

Empirical support for benefits of CIH use in the context of eating disorders broadly and BED specifically are growing. For example, studies support potential roles for mindfulness meditation and self-compassion practices (62, 65, 68-75), yoga (62, 63, 65, 75-85), acupuncture (62, 63, 86), supplements (62, 87), herbs (62) and pre/probiotics (88), in the context of eating disorders broadly (62-65, 68-82, 86-92) and BED specifically (62-65, 68, 71, 72, 74-76, 79, 86, 89, 92-94). Literature also exists that supports the use of hypnosis (62) and Traditional Chinese Medicine (64). Here, we summarize the current literature on several of the more commonly used and recognized CIH interventions in the context of BED (95), including mindfulness, acupuncture, yoga, nutritional supplements, and pre/pro/postbiotics. Table 1 summarizes the existing empirical support for various CIH interventions, organized by the outcomes they are shown to target. We also summarize several challenges and limitations to CIH research in the context of BED and discuss the need for further research funding.

# Neurobiology Associated with Binge Eating Disorder

Many CIH interventions reviewed here produce neurobiological alterations that can correct, oppose, heal, or support regulation of those known to occur in BED. This suggests these interventions hold potential to correct neurobiological dysregulations and alterations associated with BED and thus help alleviate BED symptoms. The neurobiological alterations observed in BED are complex and largely outside of this review’s scope. They are suitably described elsewhere (96), and findings relevant to the purposes of this review will be briefly summarized here and in [Figures 1](#_Figure_1) and [2](#_Figure__2) as well as in **Supplementary Figures S1–S16** in the Supplementary Materials.

At a neurobiological level, feeding and eating behaviors are thought to involve complex interactions between physiological and neural systems associated with hunger/satiety mechanisms, ingestive (homeostatic/appetitive and consummatory) mechanisms, and hedonic/reward/reinforcement-based mechanisms (96-99) (Figure S1). Implicated neural circuitry includes the **mesostriatal and nigrostriatal dopamine systems,** the **corticolimbic system**,and the **frontoparietal executive control system/network** (96, 97, 99-107). These systems are illustrated in [Figures 1](#_Figure_1) and [2](#_Figure__2) and in the **Supplementary Figures S1–S16** (96, 97, 99-107, 131-137)(108-111)(112-118) (96, 119-124).(96, 97, 99-107, 125-130).

At the neurochemical level, the **opioid** and **dopamine** systems within these circuits are recognized as primarily responsible for mediating three predominant aspects of reward and reinforcement-based eating: “liking,” associated with hedonic impact/reward value; “wanting,” associated with motivation/incentive salience; and “learning” implicit in cue association and reward predictions[[1]](#footnote-1) (97, 100, 103, 104, 152). These systems are thought to be inherent to all reinforcing processes, including those that drive overconsumption, BED, obesity, substance-related and addictive disorders (SRADs, formerly substance use disorders, SUDs), and “food and eating addictions,” (22, 94, 97, 100-107, 154-156). Additional neurotransmitters, neuropeptides, and neurohormones associated with these processes include dopamine, opioids, serotonin, orexigenic and anorexigenic peptides/hormones, glutatmate, endocannabinoids, and glucocorticoids (96, 157-159), as well as inhibitory gamma-aminobutyricacid (GABAergic) systems, leptin, insulin, ghrelin, glucagon-like peptide 1 (GLP-1), melanin-concentrating hormone, (MCH) oxytocin, and corticotrophin-releasing factor/hormone (CRF/CRH) (97). Notably, these systems largely overlap with those involved in substance-related and addictive disorders (SRADs, formerly termed substance use disorders, SUDs) as addressed in section 2.1 below.

It is crucial to acknowledge that this is a rapidly evolving field, and a comprehensive understanding of these mechanisms and their implications for treatment requires further research. This overview of the intricate neurobiological interactions and similarities between BED and SUDs, particularly in relation to dysregulated nucleus accumbens/ventral striatal responses to rewards, is of paramount importance.

BED is often characterized by elevated sensitivity to food salience/reward and increased impulsivity[[2]](#footnote-2) and compulsivity[[3]](#footnote-3) (96, 160-162)(22, 96, 155, 164-168) (**Figure 2**). These alterations result in food/eating-related impulsions and compulsions overriding homeostatic and cognitive regulation systems (151, 170, 171). For example, neuroimaging studies find reduced activity in the vmPFC, inferior frontal gyrus, and insula in individuals with BED during neurocognitive testing (172). This can diminish the capacity to curb or self-regulate binge eating behaviors (151, 172). BED is also associated with a shift from impulsivity to compulsivity that is thought to involve neuroplastic changes in the mesolimbic dopamine system and prefrontal systems that can accelerate habit formation from goal-directed behaviors (114, 116-118). The glucocorticoid stress system is also thought to be implicit in these dysregulated changes (99, 157-159).

Many of the neurobiological, psychopathological, physiological, behavioral, and genetic similarities between SUDs and BED have been identified [22, 97, 100, 107, 152]. For example, certain types of foods, food cue exposure, stressors, emotional reactivity, and changes in weight or eating patterns can induce compulsive patterns of binge-like consumption akin to those seen in BEDs and SUDs [22, 97, 197, 198]. Neuroimaging studies reinforce overlapping mechanisms in BEDs and SUDs neurobiological underpinnings [22, 154, 202, 204].

The transition from impulsive, reward-driven behaviors to compulsive, habit-driven behaviors has been associated with the development of both SUDs and BED [96, 100, 101, 178]. This transition is thought to involve neuroplastic changes in the mesolimbic dopamine system (especially in the NAc) and in the prefrontal systems [96, 103, 179]. Dopamine neurotransmission in the caudate is relevant to the neurobiology of BED.

Given the striking similarities between BEDs and SUDs, the potential for interventions effective for SUDs to be applicable in alleviating BED symptoms is a compelling avenue for further exploration. This possibility, while promising, has not yet been fully demonstrated, underscoring the crucial need for additional research in this area

# Empirical Support for Complementary and Integrative Health Use in Binge Eating Disorder

## Meditation

An operational definition of meditation is somewhat ambiguous in the primary research literature, with many sources describing meditation practices rather than defining the field. Generally speaking though, meditation as it is practiced in Western medicine and research can be loosely operationally defined as a “set of diverse and specific methods [for] distinct attentional [or mental] training[s],” that aim to “bring one’s mental activity under improved insight into one’s own mental activity” (Cahn and Polich (211) as cited in Brandmeyer, Delorme (212)) and “improve an individual’s core psychological capacities, such as attentional and emotional self-regulation,” (213). The “set of diverse and specific methods” of meditation (212) generally include:

* **Mindfulness meditation** (a meditation technique that involves intentional non-judgemental attention to experiences in the present moment and includes Vipassana meditation, Zen Buddhist meditation, and mindfulness-based interventions (MBIs), including mindfulness-based stress reduction (MBSR) practices, mindfulness-based cognitive therapy (MBCT), and mindfulness-based relapse prevention (MBRP)), addressed further in section 2.2) (211, 213-221).
* **Mantra meditation** (a meditation technique that aims to relax the mind and help it focus through the use of mantras, sacred utterances or [numinous](https://en.wikipedia.org/wiki/Numinous) sounds believed by practitioners to have religious, magical or spiritual powers and includes Transcendental Meditation® (TM®), Relaxation Response (RR; further addressed in section 2.1.1.1), and Clinically Standardized Meditation (CSM)) (219-221) (220, 222-224).
* **Spiritual Meditation** (a highly variable form of meditation most often used to connect to- and form a deeper understanding of a higher power/higher self/divinity/deity/the Universe that often includes religious components such as prayer) (220, 221).
* **Yoga** (a traditional Ayurvedic practice that has a large variation in its modalities but typically involves physical poses (*asanas*), movement (*vinyasa*), focused breathing (*pranayama*), mindfulness (*dharana)*, and meditation (*dhyana, upasana*) in efforts to unify the body and the mind (often through the breath, *pranayama*) and prepare the body for meditation (*dhyana, upasana*), described in section 2.3) (213, 219, 220, 225-227).
* **Tai Chi** (A “moving mediation” practice that involves the use of active concentration of the mind to guide the body in the slow, gentle, light, continuous flow through a series of set postures or forms while focusing on present-moment awareness to promote posture, flexibility, relaxation, well-being, mental concentration, and mind-body coordination)(213, 219, 220).
* **Qi Gong** (also referred to as Chi Gong, an “energy healing” practice that shares with Tai Chi the use of proper body positioning, efficient movement, deep breathing, visualizations, and a quiet focused mind but differs from Tai Chi in that movements are not sped up, the visualizations differ, and in its focus on energy healing, which can be done internally (called nei qi) or externally by a Qi Gong practitioner who emits energy (“qi”) for the purpose of healing another person (called wai qi))(213, 219, 220).

All of these forms of meditation – and others – generally share four common elements (228, 229):

* **A quiet environment** with as few distractions as possible.
* **A focus of attention** (such as a mantra, object, or the sensation of the breath on which to focus the mind.
* **A passive, nonjudgemental attitude** (e.g., letting distractions come and go naturally without judgement).
* **A comfortable position/posture** (that may or may not be specific) (e.g., sitting, laying down, walking, or in other yogic positions).

### Empirical Support for Meditation in the Context of Binge Eating Disorder

Most empirical support for the use of meditation in the context of BED focuses on the use of mindfulness/mindfulness-based interventions (MBIs) (62, 65, 68-75, 92, 230-235), self-compassion practices (68, 72) (as addressed in section 2.2) and yoga (84, 85, 95, 236) (as addressed in section 2.3). Outside of these specific forms of meditation, a 2002 dissertation (237) on the efficacy of a peer-lead, mutual-help, community-based 12-step program for binge eating (e.g., Overeaters Anonymous) in fostering abstinence in BED found that 58% of OA participants engaged in prayer or meditation daily as part of the 11th step tradition (134/231, 58%) and 25% (58/231) engaged in prayer or meditation 2–5 times/wk (237). The dissertation also found that increased use of prayer and meditation correlated positively with increased abstinence ratio (0.2, p ≤ 0.01), decreased frequency of relapse (0.25, p ≤ 0.01), and greater adherence to a food plan (0.18, p ≤ 0.01)(237). In such programs, little instructions are given as to the form of meditation used, thus, the type of meditation used may vary from spiritual, concentrative/mantra, and mindfulness-oriented. Together, these findings provide a low level of empirical support for the use of meditation in supporting abstinence from binge eating and adherence to a meal plan (a central tenant of conventional treatments for BED, such as CBT (233)), and in helping to prevent relapse. These findings warrant replication and formal peer-reviewed publication.

Mindfulnes meditation has a variety of empirical support in the context of BED, which is discussed in section \*\*\*. Further discussion on empirical support for mindfulness and mantra meditation approaches with potential relevelce to BED can be found in the supplementary material (S\*\*\*).

### Possible Underlying Mechanisms

Beyond the lack of high-level empirical support for the safety, feasibility, and efficacy of meditation in the context of BED treatment, another limitation in its use is the alleged lack of empirical support for its underlying mechanisms. In the context of BED, there are two very plausible mechanisms of action for meditation practices that are untested in the context of binge eating but have empirical support generally. These include the effects of meditation on relaxation and stress responsiveness, both biophysiologically and neurobiologically, as addressed below.

#### The Biophysiological and Epigenetic Relaxation Response in Meditation, Mindfulness, and Yoga

The biophysiological “relaxation response” is a term and phenomenon coined and investigated by Harvard cardiologist Herbert Benson in the late 1960s through current day (219, 229, 278-284). It refers to the self-induced reduction in sympathetic nervous system activity that opposes the parasympathetic “fight-or-flight” response and can be induced by meditation, including mantra meditation and TM®, mindfulness meditation, prayer, zen meditation and yoga, as well as by autogenic training, progressive relaxation, and hypnosis with suggested deep relaxation (219, 229).

Benson and colleagues began studying the relaxation response after noting the effects of stress on various disease-specific populations, including cardiovascular disease as well as in neurodegenerative diseases and mental health disorders, including Alzheimer’s disease, multiple sclerosis, anxiety, depression, posttraumatic stress disorder, and schizophrenia (282, 284-286). Benson and colleagues thus developed a technique for inducing the relaxation response, which includes the following components (219, 229):

Try to find **10 – 20 minutes in your daily routine**.

**Assume a comfortable position**.

Try to arrange your life so that you will have **no distractions**.

**Commit to a specific length of practice** and time yourself by glancing periodically at a clock or watch but do not set an alarm.

Within these parameters, one suggested approach to elicit the relaxation response is as follows (219, 229):

1. **Select a word or mantra** to use during the practice that is firmly rooted in your belief system. Examples may include *one, peace, love, om,* or religious phrases or passages such as *shalom, salaam,* or *The Lord is my shepherd.*
2. **Assume a comfortable position** (usually sitting, though other positions may be used).
3. **Close your eyes.**
4. **Relax your muscles.** You may wish to begin by relaxing your feet and progress upward to the facial muscles.
5. **Breathe slowly and naturally**, silently **repeating your selected mantra on each exhale**.
6. **Assume a passive attitude throughout.** Do not worry about how well you are doing. If other thoughts enter your mind, simply say “oh, well,” and gently return to your practice.
7. Once you have relaxed your body (step 4) you may open your eyes temporarily to check the time, but do not use an alarm.
8. When you are finished with your practice, sit quietly for a minute or so, first with your eyes closed, then with your eyes open. Wait 1 or 2 minutes before standing.

This technique can generally be learned in five minutes. It is instructed to practice this technique twice daily for 10 – 20 minutes per session, at least two hours after any meal so as not to impede the digestive process (219). This technique has been associated with decreased oxygen consumption, respiratory rate, heart rate, blood pressure, and muscle tension, as well as increased alpha wave production (219, 229), reduction in circulating levels of neuroendocrine mediators of stress, including cortisol, ACTH, copeptin, epinephrine, and norepinephrine, and prolactin (p < 0.001) (287)and increases in insulin, gonadotropic hormone (GH), testosterone, and DHEAs (p < 0.05) (287).

Additionally, one 15-min session of relaxation response practice has been found to evoke significant temporal gene expression changes, both in individuals with years of practice and in novices with 8 wks of practice (with greater significance associated with longer use)(282). Specifically, enhanced expression was observed in genes associated with energy metabolism, mitochondrial function, insulin secretion, and telomere maintenance (282), and reduced expression was observed in genes linked to inflammatory responses and stress-related pathways (282, 287-289). Daily practice of the relaxation response has also been found to induce favorable reductions in the expression of inflammatory genes (287) and reductions in DNA methylation-based estimates of chronological age (287-289).

Together, these findings suggest that the relaxation response as one possible mechanism by which meditation could reduce psychosocial stress in individuals with BED, and thus reduce negative urgency and binge eating episodes, as well as potentially also improving physical repercussions associated with binge eating (e.g., inflammation, insulin resistance, inflammatory bowel disease, weight gain, and other cardiometabolic problems) (7, 19). However, this possibility remains to be tested.

#### Neurobiological Alterations

There are many neurobiological alternations associated with various forms of meditation (including mindfulness meditation, mantra meditation, and yoga Nidra), that hold potential benefit in the context of BED. Neural imaging studies demonstrate that mantra meditation, including TM®, is associated with significantly neuroplastic alterations in connectivity and brain wave emission that are associated with reduced perceptions of anxiety and stress, reduced cognitive anxiety symptoms, improvements in stress coping/resilience, and changes in interoceptive awareness (297)(298)(299)(300). For example, a 1-year longitudinal study in 14 participants with no previous meditation exposure found that initiating a TM® practice resulted in significant increases in frontal coherence both at rest and during cognitive functioning that correlated with reduced state and trait anxiety and increased emotional stability, inner/outer orientation, and moral reasoning[[4]](#footnote-6) (301). These findings also suggest possible neurobiological mechanisms by which a TM® meditation practice could be useful in the context of BED, which has high comorbidity with anxiety (12, 19) and is characterized by high levels of stress and emotional dysregulation thought to induce and maintain binge eating (7, 19). Additionally, a highly-cited positron emission tomography (PET) study found that yoga nidra meditation decreased binding of a radioactive tracer (11C-raclopride) that competes with endogenous dopamine binding at D2 dopamine receptors in the ventral striatum by 7.9%, suggesting yoga nidra meditation results in a ~65% increase in dopamine release in the ventral striatum (295, 296). In light of the ventral striatal dopamine deficiency/dysregulation associated with BED (CITATION), these findings hold strong support for the possibility of yoga nidra to offer improvement in BED symptomatology and underlying neurobiology. However, this possibility remains to be tested.

There is also a large body of empirical support for the use of meditation and mindfulness-based interventions (MBIs) in the context of the substance-related and addictive disorders (SRADs) (219, 267, 291, 292) (238)(228, 269). For example, multiple studies demonstrate that various forms of mediation, including TM®, result in rapid elevations in neurotransmitters and neurohormones that are implicated in BED and SRADs alike, including GABA, dopamine, beta-endorphins, serotonin, acetylcholine, melatonin, arginine vasopressin (AVP), and glutamate, as well as rapid reductions in cortisol, epinephrine, norepinephrine, and adrenocorticotropic hormone (ACTH) (296). These findings support a potential benefit of meditation and MBIs in the context of BED, given the shared neurobiological underpinnings that overlap in BED and SRADs (as addressed in \*\*\*).

Together, these and other findings suggest several neurobiological mechanisms by which various forms of meditation can reduce stress responsiveness, lower state and trait anxiety, and improve emotional stability, moral reasoning, and inner/outer orientation (e.g., by increasing frontal coherence) in a way that could benefit the high anxiety states and stress and emotional dysregulation thought to indue and maintain binge eating (12, 19)(7, 19).

### Limitations and Strengths

Limitation: lack of rigorous trials in the context of RCT and meta-analyses (213, 219, 250, 304-306).

Also, remote delivery in the context of rigorous trials has not been tested (with few exceptions (71, 74)); thus, most evidence in the literature comes from in-person protocols(213, 250, 304-306). This latter limitation is frequently cited as a limitation of all meditation studies (regardless of whether delivery is remote or in-person)(213, 250, 304-306).

Mindfulness-based interventions have the advantage that they can be delivered remotely (71, 74) and training in mindfulness can also be accessed for free or low cost through website platforms, mobile applications, and books/workbooks/audiobooks/ebooks (216, 307, 308). These strengths have the potential to minimize or overcome the barriers of treatment costs, insurance coverage, provider scarcity, and geographic proximity.

On the other hand, a huge and widely understood limitation of the standardized mindfulness-based intervention (MBI) protocols is precisely that they are not feasible/acceptable (due to lengthy time commitments) or scalable (due to the scarcity of skilled instructors, especially in smaller non-urban areas)(309, 310). Also, remote delivery in the context of rigorous trials has not been tested (with few exceptions (71, 74)). Thus, most evidence in the literature comes from in-person protocols. These limitations highlight the clinical difficulty in establishing the evidence base for some of these more widely accessible options, as dosing often is not measured and the quality of intervention often varies (309, 310).

Additionally, a recent study of 14 BED experts also identified that there can be a potential barrier to client uptake (95). However, findings also suggest meditation and mindfulness can be effective, regardless of one’s feelings towards these practices. Sharing this information with clients (e.g., that they don’t have to like mindfulness or meditation for the intervention(s) to be effective) may help minimize the particular uptake barrier of discomfort.

*“I talk a lot [with my patients] about the data around* ***mindfulness****. I tell them how much I hate mindfulness and meditation, but how much it helps. …The fMRI data [is] astonishing –the most recent data [suggests that] even a small meditation practice changes threat sensitivity. I mean, I don't even know what to say except Marsha Linehan was right! You put it in* ***DBT*** *early on, and most of our patients hate it [but] …we used to think you had to get to a calm state [for meditation or mindfulness to be effective]; it turns out if you hate it the entire time, and you're thinking about your target [hate] list and you refocus your thoughts, that's like weightlifting for your brain. So obviously, I have a lot of enthusiasm about it.” (P72 as quoted in Bray et al., 2023*(95)*).*

## Mindfulness

Mindfulness is a process operationally defined by two central components: self-regulation of attention (e.g., attention to present-moment experiences) and orientation to experience (e.g., practicing a non-emotive, unattached view of acceptance, openness, and curiosity towards all experiences, including the wandering of the mind) (216, 307, 311). Mindfulness practices are originally found in Buddhist traditions developed to overcome personal suffering (307) but have more recently been used clinically to reduce cognitive vulnerability to stress and emotional distress (229, 311, 312). Mindfulness-based interventions (MBIs) generally use mindfulness practices to develop the ability to self-regulate one’s thoughts and attention, remain grounded in the present moment, and practice a state of non-emotive, nonjudgemental and unattachment towards thoughts, sensations, feelings, or urges related to the past, present, and future (75).

Aspects of mindfulness and self-compassion strategies are incorporated into second-wave CBT[[5]](#footnote-7) (313-317) (the standard eating disorder and BED treatment) (233) and third-wave behavior therapies2 (e.g., dialectic behavior therapy (DBT), MBIs, including mindfulness-based stress reduction (MBSR), acceptance and commitment therapy (ACT), and compassion mind training/compassion-focused therapy (CFT)) (73, 313-317) with improved treatment responses that are well-supported in the literature (234, 235).

Various studies also support mindfulness- as well as combined mindfulness and self-compassion practices (62, 65, 68-75). For example, a 2020 systematic review and meta-analysis of mindfulness and eating disorder psychopathology identified 74 independent samples in 70 papers, including three samples consisting solely of individuals with current or past BED (70). The review also identified four samples of individuals with current or past mixed eating disorders and two samples of individuals with current or past anorexia nervosa, with longitudinal effect sizes observed over a 180-day follow-up period in all studies (70). The meta-analysis found inverse associations between mindfulness and eating disorder psychopathology (r = -.25, p < .001), both concurrently (r = -.25, p < .001) and prospectively (rs = -.22 to -.24, ps < .001), with strongest associations observed in binge eating, emotional/external eating, body dissatisfaction, acting with awareness, and nonjudging facets. However, the association between mindfulness and eating disorder psychopathology was not statistically significant for individuals with BED psychopathology (r = −.16, 95% CI [−.34, .04], p = .11).

More recently, Grohmann and Laws’ 2021 comprehensive systematic review and meta-analysis of two decades of mindfulness-based interventions (MBIs) for binge eating identified 21 samples in 20 papers, including 11 RCTs meta-analyzed to reveal that MBIs significantly reduced binge eating severity score (g=-0.39, 95% CI: -0.68, -0.11; n= 335 MBIs, 283 controls) at the end of the trial; however, the reductions were not maintained at follow-up in the five studies that reported follow-up outcomes (g=-0.06, 95% CI, -0.31, 0.20, k = 5)(235). MBIs also significantly reduced depression and improved emotion regulation and mindfulness ability (235). Overall, the authors concluded that further research is needed on the efficacy of mindfulness-based interventions in BED and future studies should focus on including minority populations (235).

### Possible Underlying Mechanisms

A limitation in the use of mindfulness and meditation in empirically supported Western Medicine is the alleged lack of empirical support for its underlying mechanisms. In the context of BED, there are two very plausible mechanisms of action for mindfulness and meditation practices that are untested in the context of BED but have empirical support generally. These include the effects of mindfulness on relaxation and stress responsiveness, both biophysiologically and neurobiologically.

The biophysical relaxation response associated with mindfulness, meditation, prayer, autogenic training, and some forms of hypnosis

### Limitations and Strengths

Mindfulness-based interventions have the advantage that they can be delivered remotely (71, 74), and training in mindfulness can also be accessed for free or low cost through website platforms, mobile applications, and books/workbooks/audiobooks/ebooks (216, 307, 308, 318, 319). These strengths have the potential to minimize or overcome the barriers of treatment costs, insurance coverage, provider scarcity, and geographic proximity.

On the other hand, a huge and widely understood limitation of the standardized mindfulness-based intervention (MBI) protocols is precisely that they are not feasible/acceptable (due to lengthy time commitments) or scalable (due to the scarcity of skilled instructors, especially in smaller non-urban areas)(309, 310). Also, remote delivery in the context of rigorous trials has not been tested (with few exceptions (71, 74)); thus, most evidence in the literature comes from in-person protocols(213, 250, 304-306). This latter limitation is frequently cited for a limitation of all meditation studies (regardless of whether delivery is remote or in-person)(213, 250, 304-306). These limitations highlight the clinical difficulty in establishing the evidence base for some of these more widely accessible options, as dosing often is not measured and the quality of intervention often varies (309, 310).

Additionally, a recent study of 14 BED experts also identified that there can be a potential barrier in client uptake (95). However, findings also suggest meditation and mindfulness can be effective, regardless of one’s feelings towards these practices. Sharing this information with clients (e.g., that they don’t have to like mindfulness or meditation for the intervention(s) to be effective) may help minimize the particular uptake barrier of discomfort.

*“I talk a lot [with my patients] about the data around* ***mindfulness****. I tell them how much I hate mindfulness and meditation, but how much it helps. …The fMRI data [is] astonishing –the most recent data [suggests that] even a small meditation practice changes threat sensitivity. I mean, I don't even know what to say except Marsha Linehan was right! You put it in* ***DBT*** *early on, and most of our patients hate it [but] …we used to think you had to get to a calm state [for meditation or mindfulness to be effective]; it turns out if you hate it the entire time, and you're thinking about your target [hate] list and you refocus your thoughts, that's like weightlifting for your brain. So obviously, I have a lot of enthusiasm about it.” (P72 as quoted in Bray et al., 2023*(95)*). [This quote was already quoted above]*

## Yoga

Yoga is a traditional Ayurvedic practice that has a large variation in its modalities but typically involves physical poses (asanas), movement (vinyasa), focused breathing (pranayama), mindfulness (dharana), and meditation (dhyana, upasana) in efforts to unify the body and the mind (often through the breath, pranayama) and prepare the body for meditation (dhyana, upasana) (225-227). Existing literature on the use of yoga in adults with BED includes one systematic review (76) that includes one preliminary RCT in 90 adult women with BED and BMI >25 (45 yoga, 45 weight list control) (85), a retrospective mixed-methods study conducted 20 individuals who participated in the preliminary RCT just described (84, 85), and one prospective observational study on physical activity (including yoga) in 91 adults with BED (236). Overall, this literature finds that benefits of the use of yoga in the context of BED include:

* Improved subjective/self-reported binge eating (84) and overeating (236).
* Improved body image concerns (including body satisfaction and acceptance) (85, 236), which are thought to be an important driving factor in BED by catalyzing restriction and its subsequent binge eating (7, 23).
* Improved relationship with movement and self-care (84).
* Improved negative affect (84, 236), a core feature of BED (7, 12, 19).
* Improved global eating disorder psychopathology (50% reduction in binge eating scores) (85).
* Improvements in BMI, hip, and waist measurements (85) can place individuals at risk for other health problems.

Importantly, the mixed-methods RCT and qualitative narrative-based study (84, 85) tested a 12-week 60-minute yoga program that focused on movement, breath awareness, meditation, and mindful eating, with results including significantly reduced binge eating (50% reduction in binge eating scores) and reduced BMI, hip- and waist measurements)(85). These were maintained at the 3-month follow-up (85). Study participants were also asked to keep a journal, and qualitative analysis of journal entries identified two themes: 1) physical self-empowerment and 2) changes in food consumption (e.g., building a healthy reconnection to food, reductions in quantity and speed of food consumption, and improved food choices) (84). The authors interpreted these findings to “provide insights relevant to therapeutic processes that may occur within eating disorder interventions that draw on meditation-based approaches” (84).

A recent study of BED experts’ opinions and experiences with CIH use in the context of BED also identified that experts use yoga in the context of healing trauma related to exercise shaming (95). This application also reportedly helps to heal the relationship with the body and movement, which is perceived to be highly stigmatized, “intruded upon,” commanded, and traumatized (95). Experts also identified yoga as an intervention that can be used to promote patient-driven, “inside-out” “whole person” healing (as described for acupuncture in section 2.2 above).

In summary, research demonstrates the benefits of yoga when used as a complement or integrated into standard care for BED.

### Limitations and Strengths

The practice of yoga encompasses a large variety of forms, ranging from more meditative styles like yoga nidra (320) to more intensive styles like hot yoga and more commercial blends of hot yoga and group fitness (e.g., hot yoga sculpt)(67). The variety that exists in the field can present both a limitation and a strength. On the one hand, the variety provides something for everyone; on the other hand, a recent study of BED experts identified one expert opinion that more intensive styles can be anti-therapeutic for some patients by endorsing eating disorder symptoms (see italicized statement from P5 below) (95). While yoga does have the advantage that it can be delivered virtually/remotely (321-332), and there are many free yoga tutorials available online (e.g., https://yoga.dasa.ncsu.edu), it has the disadvantage that individuals who don’t know about ways to access yoga virtually may avoid going into a studio in order to avoid the stigmatization often faced by individuals in larger bodies (23). Yoga, in particular, may also have a barrier to entry for those who have no exposure to it, that is, it may require a larger risk to attend a first-time class with no previous yoga experience.

*“I think Yoga …* ***has to be done correctly****. …I think a really critical piece is helping people do it in a way that is supportive and that either* ***helps, or at least works with or works around body image issues*** *and that that can be tricky. I think it can really help but …I think some people have that kind of aversive reaction to it somewhat. …There are people, I believe, who are doing* ***highly physically-strenuous yoga and that's not what we provide in our treatment setting****. …that tends to feel to our people like …higher intensity, and also …can get to be more in the realm of eating disorder symptoms, like exercise symptoms.” (P5 as quoted in Bray et al., 2023*(95)*).*

## Acupuncture

Acupuncture is an evidence-based tool (333) that originates from Traditional Chinese Medicine in which needles are inserted into the body to stimulate sensory nerves in the skin, muscles, and organs (67, 334-337). Evidence suggests acupuncture may enhance the effects of current standard treatment in eating disorders and BED, including reductions in BMI, binge eating frequency, anxiety, and improvements in emotion regulation (338-346). There is evidence that acupuncture is efficacious in reducing anxiety and promoting self-care in the treatment of anorexia (63, 64, 86, 347-350) and bulimia nervosa (63, 86). When administered as an adjunct therapy to diet and psychological counseling in individuals with anorexia and bulimia nervosa, acupuncture produced significant improvements in state anxiety (86) (thought to contribute to binge eating (351-353)) and physical-cognitive quality of life (86). Acupuncture has also been found feasible and beneficial in supporting behavioral weight control efforts in individuals with overweight and obesity (343), in part through its ability to reduce anxiety (343). In individuals with obesity, acupuncture has also been shown to reduce BMI, caloric intake, sense of hunger, and feeding quantity (346). A recent study of BED experts’ opinions and experiences with CIH use in the context of BED also identified that experts use acupuncture as a way to promote patient-driven “inside-out” healing (e.g., that comes from the patient’s innate desire to heal based on the patient’s lived experience(s)(95).

Although a Traditional Chinese Medicine pattern severity index has been developed for understanding eating disorders, including BED (64), no studies have formally tested the safety, feasibility, or clinical outcomes of acupuncture use in the context of adult BED.

Some of the mechanisms by which acupuncture can support feeding, weight, mental health, and behavior changes in populations of individuals with other eating disorders (e.g., anorexia nervosa and bulimia nervosa), obesity, and dysregulated eating patterns (preclinical and clinical) have been explored. These include:

* Providing non-stigmatized practitioner feedback and advice (354, 355).
* Improvements in quality of life (86).
* Reductions in anxiety (86, 344).
* Reductions in depression (86, 344).
* Reductions in perfectionism (86).
* Up-regulation of anorexigenic factors (e.g., proopiomelanocortin (POMC) (338), the transient receptor potential cation channel subfamily V member 1 (TRPV1)(338), neuronal nitric oxide synthase (nNOS) (338), leptin (341, 356), cholecystokinin (CCK) (340), fructooligosaccharides (Fos) (340), alpha-melanocyte-stimulating hormone (α-MSH) (357), and cocaine- and amphetamine- regulated transcript (CART) (357)).
* Reductions in orexigenic factors ghrelin (342) and neuropeptide Y (NPY) (339, 342, 356).

A strong acupuncture protocol – although not yet tested – would be wise to incorporate four areas of evidence-based literature on acupuncture:

1. Findings from evidence-based research on Traditional Chinese Medicine patterns associated with BED (64).
2. A variety of studies implicating the effects of acupuncture points/protocols on weight and eating/feeding behaviors (and underlying mechanisms and biomedical impacts)(63, 86, 338-350, 354, 356, 358-363).
3. The effects of acupuncture and moxibustion on stress-related disorders (and underlying mechanisms)(344).
4. The effects of the NADA and protocol in promoting abstinence and recovery from substance- related and addictive disorders and attenuating associated withdrawal symptoms (354, 362, 364-378).

Some key findings to incorporate into a potential acupuncture protocol for BED use are described here. Fogarty et al. (2012) developed a pattern severity index for understanding eating disorders (64), including BED. The pattern severity index was based on the number of symptoms/signs expressed by the individual divided by the total number of symptoms/signs associated with the specific Traditional Chinese Medicine pattern, based on findings in patients with BED (n=13), eating disorder not otherwise specified (EDNOS, n=26), bulimia nervosa (n=36), anorexia nervosa (n=67) and healthy controls (n=54). Primary patterns associated with BED that statistically differed from those observed in healthy controls included (p<0.05):

* Stomach *Yin Xu*.
* Liver *Qi* depression.
* Heart *Qi* Deficiency.
* Stomach heat.
* Heart *Yin* deficiency.
* Spleen *Qi* deficiency.
* Liver *Qi* stagnation.
* Stomach heat.
* Food damage.
* Food accumulation.
* Stomach-spleen disharmony.
* Kidney *Yang* deficiency.

These patterns would be wise to attend to when considering the use of acupuncture in individuals with BED.

Kondo & Kawamoto’s 2014 review on Japanese Sawada-style acupuncture and moxibustion for stress-related disorders highlights the ability of acupuncture and moxibustion to produce alterations in the autonomic nervous system, immune, endocrine, and metabolic systems, and stress responses (344). For example:

* The acupuncture sites ST 36, L11, BL12, and BL13 can alter sympathetic/parasympathetic tone, which becomes disrupted in stress, anxiety, and depressive disorders.
* Sites BL18, BL20, CV12, K16, LI11, ST36, and TE4 have an anti-inflammatory effect.
* Sites BL10, BL18, CV6, CV12, GB20, GV12, K16, LI11, ST36 have anxiolytic effects.
* Sites BL18, CV12, ST36, GB20, GB21, LR14, ST36 have antidepressant effects.
* BL23 promotes adrenal steroid hormone secretion and increases in norepinephrine and dopamine levels.
* ST 36 decreases stress-induced anxiety, serum cortisol levels, and tyrosine hydroxylase-immunoreactive expression in restrained rats and reduces beck depression inventory (BDI) scores in chronic fatigue syndrome and obsessive-compulsive disorder (OCD).
* ST25 prevents chronic stress-induced increases in sympathetic neuropeptide Y (NPY) and reduces chronic visceral hypersensitivity in irritable bowel syndrome through alterations in colon tissue serotonin metabolism.

These are possible sites that have known mechanisms which would be appropriate for an acupuncture protocol for BED.

Overall, acupuncture is a field with increasing empirical support for its use in the context of BED that warrants the development and testing of an acupuncture protocol for BED treatment.

### Limitations and Strengths

Treatment costs, insurance coverage, time burden, and research funding are all barriers that are applicable to clinical acupuncture use (95, 379). As BED experts noted in a recent mixed-methods study (95), an intake session with an acupuncturist generally costs between $100–250 in the U.S.(380)with follow-up sessions ranging from $60–120 (381). Additionally, traditional acupuncture often requires frequent and maintained use (e.g., two- to five times weekly for six to eight weeks) to be effective (67, 334, 335, 382). Although insurance policy coverage is increasing for acupuncture, the coverage available is limited and most insurance companies do not cover the frequency of sessions required for strong effects to be experienced (379, 383-385).

“*I know that … over the years, … there's been some acupuncture literature… though I think that literature in the eating disorder field isn't terribly deep, possibly in part because insurance coverage for those services is not widely accepted and that then, in many ways, dictates what gets studied and what gets implemented clinically.” (P60 as quoted in Bray et al., 2023*(95)*).*

### Evolution in the Field: Community Acupuncture, Auricular Acupressure (Ear Seeds), and the National Acupuncture Detoxification Association (NADA) Movement

#### Community Acupuncture

As a field, acupuncture has evolved to overcome or minimize many barriers to treatment access, especially in recent years. For example, community acupuncture allows multiple individuals to be seen by a floating practitioner at once, which can help alleviate the cost burden significantly (one group/community acupuncture setting costs between $20–50 per session (386)) without compromising results or patient experience (387-389).

#### Auricular Acupuncture (Ear Acupuncture) and Auricular Acupressure (Ear Seeds)

Auricular acupressure (ear seeds) use(s) small seeds to stimulate acupressure points in the ear that then stimulate other parts of the body (390). Empirical evidence supports the use of ear seeds in treating a variety of conditions that are often comorbid with BED, including anxiety (391-394), depression (395-397), trauma-related disorders (398), sleep (393), digestion, elevated blood glucose levels in Type 2 Diabetes (399), and overweight and obesity (395, 400-402), including body fat percentage (400), BMI (395, 400-402), waist and hip circumference (400, 401, 403), hip-waist ratio (403), and body weight (400-403), while also enhancing self-efficacy (402). Additionally, ear seeds can be made (for free) or purchased online for <$50 and can be self-administered[[6]](#footnote-8) and self-stimulated (400, 402), thus helping to minimize or overcome many current treatment barriers (e.g., costs, time, lack of diagnosis, and insurance coverage).

#### The National Acupuncture Detoxification Association (NADA) Protocol

Within the modality of ear seeds, the National Acupuncture Detoxification Association (NADA) has developed ear acupuncture-, bead-, and seed protocols for addictions, stress, and trauma that are effective in treating anxiety (367, 404), impulsivity (369), craving (365, 366, 368), and substance use (364-378, 405, 406). The NADA has also developed a large base of online instructions for self-administration3 and self-stimulation of ear seeds using the NADA protocol (acudetox.com). There is evidence that ear acupressure using the semi-standardized NADA protocol is efficacious in treating anorexia nervosa (350, 404, 407). For example, when administered as an adjunct therapy to an interdisciplinary inpatient treatment program for eating disturbances in 25 individuals with anorexia nervosa, the NADA protocol was qualitatively reported to relieve anxiety and somatic symptoms (404). Given its empirical support for a variety of conditions closely related to- or comorbid with BED and its ability to overcome multiple treatment barriers (e.g., costs, insurance, access, stigmatization, time), the NADA protocol offers a potentially easy and affordable option for helping individuals with BED cope with- and heal many underlying symptoms and associated consequences of the disorder. However, this possibility remains to be tested.

## Supplements, Vitamins, & Herbs

Empirical support for the use of supplements, vitamins, herbs, and pre/probiotics in the context of BED is scarce. Madden et al., 2014 provide a review of this category of CIH intervention in eating disorders broadly and highlight one herb – Rhodiola rosea and its active principle, Salidroside – that have been investigated for use in the context of binge eating (both individually and in combination with other herbs) in a preclinical rodent model (408, 409). R. rosea is found in high altitudes and latitudes and is used in traditional medicine in North Asia for its adaptogenic properties. More recent research has found that it can reduce cellular sensitivity to stress and abolish stress-induced serum cortisol increases and behaviors (408, 410). Cifani et al. (2010) found stress-induced increases in serum cortisol and stress-induced binge eating were blocked by the administration of R. rosea (200 mg/kg 1 hour prior to food access) in a rodent model of food restriction (21 days) and acute stress exposure (placing highly palatable food in the rat’s cage, within sight and smell but just out of reach) (408). The administration of Salidroside with either 100 mg/kg of R. rosea or 250 or 500 mg/kg of Hypericum perforatum was also found to significantly reduce (but not completely abolish) binge eating (408, 409). Although these findings suggest a potential for R. rosea to assist in the prevention of stress-induced binge eating, they have not been translated to relevant clinical (human) models.

More recently, a 2020 open-label pilot study investigated the efficacy of a Zinc-L-Carnosine Complex (Polaprezinc, Zeria Pharmaceutical Co, Ltd, Tokyo, Japan) as an add-on therapy for 22 patients with BED receiving antidepressants (411). All patients completed 16 weeks of supplementation (75 mg/d twice daily for 4 weeks, then increasing to 150 mg/d twice daily). A 75% reduction in the 4-week frequency of binge eating episodes was observed as well as a 23% remission rate (no episodes) at week 16 (P<0.001 for both). Significant reductions were also observed in Eating Disorder Examination-Questionaire (EDE-Q) scores and 16-item Quick Inventory of Depressive Symptomatology (QIDS-SR16) self-reported scores over the course of treatment (P < 0.001 for all measures).

To the authors’ knowledge, no other vitamins or herbal supplements have been empirically investigated or supported in the context of BED.

## Pre-, Pro-, and Postbiotics

Literature is also emerging about the role of gut microbial dysbiosis in the context of BED and the potential benefits of pre/probiotics. This literature is founded on the premise that behavioral and physiological changes that occur in BED – including diet and lifestyle – generate changes in the gut microbiome that can impact immune responses, inflammatory processes, intestinal permeability, and production of postbiotics (products generated by gut microbes, including short-chain fatty acids and neurotransmitters) that are critical for neurological functioning (88). It follows then that if the gut microbiome changes (or “signatures”) associated with BED can be identified, specific probiotics can be identified to correct those changes and potentially improve BED severity. This premise is supported by findings that demonstrate associations between gut microbes and host metabolism and behavior (412-415) along with reported differences between gut microbiota composition in patients with anorexia nervosa vs. healthy individuals (415-423). However, information on the gut microbiome signature and its potential impact on etiopathogenetic behavioral factors in the context of BED is speculative at this time.

Navarro-Tapia et al. (2021) conducted a review of studies investigating microbial signatures observed in patients with generalized anxiety and/or eating disorders, including BED (88). They report on six studies identified in the literature (88, 424-429), including two case-control studies (427, 428), one cross-sectional study conducted in 101 individuals with obesity from the Food4Gut cohort(429), and three preclinical investigations in rodent models (424-426). One of the case-controlled studies observed significantly greater antimicrobial prescription use in adult males with BED (n = 144) vs. controls (n = 6,368)(*p* < 0.001). The authors interpret these findings to suggest that increased infections and antimicrobial prescription use in individuals with BED could either drive or result from some of the biophysiological consequences and factors of BED (e.g., hyperglycemia, weight gain, and possible gut dysbiosis associated with disrupted eating behaviors) (428).

A second case-controlled study builds on existing preclinical work (424-426) investigating the plasma levels of caseinolytic protease B (ClpB), a postbiotic produced by gut bacteria including Escherichia coli, that mimics α-melanocyte-stimulating hormone (α-MSH), an anorexigenic and anxiogenic neuropeptide, in 13 individuals with BED vs. 29 healthy controls (427). The study found that plasma levels of ClpB were increased in individuals with BED relative to healthy controls; however, the increase was not significant (p = 0.1) (427). Plasma ClpB concentrations also correlated with Eating Disorder Inventory-2 (EDI-2) scores in the categories of ineffectiveness (Pearson’s r= 0.48), maturity fears (Spearman’s r= 0.55) and drive for thinness (Pearson’s r= - 0.64), all p<0.05, BED duration (r = -0.78, p<0.01), and plasma concentrations of total α-MSH-reactive immunoglobulin g (α-MSH IgG total)(P. *r* = 0.32, p<0.05). The authors interpret these findings to support a link between elevated plasma concentrations of bacterial ClpB in BED, possible reductions in anorexigenic effects of α-MSH, and BED psychopathology. However, the preclinical work investigating the role of E. coli (an enteric bacteria that produces α-MSH) in food consumption and metabolism has not yet been replicated in clinical models, and further research is needed before probiotic interventions can be identified and tested.

Lastly, the cross-sectional study conducted in 101 individuals with obesity from the Food4Gut cohort with and without BED (n = 15 and 24 respectively) found impaired self-regulation (p=0.02), positive affect (p=0.02), emotional balance (p=0.02), emotional eating (p<0.001), external eating (p<0.001), flexibility errors (p=0.01), and inhibition reaction time (p=0.01); reductions in the gut microbes *Akkermansia* (p=0.01) and *Intestinimonas* (p=0.04), increases in *Anaerostipes* (p=0.03) and *Roseburia* (p=0.03); and increases in plasma levels of the food contaminant Bisphenol A bis(2,3-dihydroxypropyl) ether (BADGE.2H(2)O)(p<0.05) and the food-derived metabolite Isovalerylcarnitine (p<0.05) in individuals with obesity and BED (vs. obesity alone) (429).

*Akkermansia muniphila* produces the postbiotic short-chain fatty acids propionate and butyrate, which help regulate satiety and intestinal inflammatory and immune responses, respectively, and is also associated with improved insulin resistance and obesity, suggesting reduced *Akkermansia* may negatively impact food intake behavior (88, 430, 431). *Intestinimonas* have been found to metabolize toxic products from processed foods and contribute to proper gut function through the metabolism of lysine to butyrate and acetate (432) (88). *Anaerostipes* are suggested to regulate behavior and have been found to be increased in psychiatric disorders, including depression and bulimia nervosa, suggesting elevated *Anaerostipes* may contribute to BED psychopathology (88). *Roseburia* is related to cardiometabolic benefits, such as the reduction of hypertension and atherogenesis (88, 429). These findings support *Akkermansia,* *Intestinimonas*, *Anaerostipes*, *Roseburia*, BADGE.2H(2)O, and Isovalerylcarnitine as components of an enteric and metabolomic profile for BED; however, further investigation is required to understand their role(s) as potential drivers or biomarkers of BED and identify whether the imbalances can be improved with probiotics or fecal transplantations.

Overall, no empirical evidence exists demonstrating the benefits of probiotic use in BED. That said, the Binge Eating Genetics Initiative (BEGIN, NCT04162574) is a large-scale multi-pronged investigation of the genomic, gut microbial, and behavioral signatures of individuals with BED – and the way these factors interact to contribute to and maintain BED etiopathogenesis that included 1,000 patients with BED and/or bulimia nervosa (BN) and was completed in 2019 (415)(clinicaltrials.gov). Since its completion, the study has yielded one publication thus far (433), which included 265 patients with BED and/or BN (71.3% with a self-reported lifetime history of BED and BN; 98.7% total with a lifetime history of BED; 44.5% with a current BED diagnosis). The study did not detect statistically significant associations of binge-eating frequency with the abundance of any gut microbial taxa or diversity indices but did identify that participants who self-reported any laxative use had significantly reduced abundance of four intestinal microbes/microbial groups (the potentially beneficial/anti-inflammatory short-chain fatty acid producers *Eubacterium ventriosum* and *Alistipes* and the opportunistic “pathobionts” *Bilophila,* and *GCA900066575*, linked to colitis and cardiovascular risk factors, respectively) and reductions in three intestinal microbial diversity indices (Chao-1 Index, Faith phylogenetic diversity, and Shannon diversity) relative to individuals who reported no laxative use (q<0.05 for all) (433). The authors interpret these findings to underscore the importance of collecting data on laxative use and dietary intake, especially when estimating the effects of BED on the enteric system and microbiome. Overall, future work from the BEGIN study holds promise and hope for the field.

### Limitations and Strengths – Vitamins, Supplements, Herbs, and Pre/Pro/Postbiotics

While many practitioners view herbs and supplements as having the potential to correct biological and physiological deficiencies and impact mood in individuals with BED, many BED experts have mixed views on this modality (vitamins, supplements, herbs, and pre/pro/postbiotics) as an intervention (23). Mixed views pertain to the lack of empirical support, potential harms related to unregulated substances in many supplements, and potentially harmful endorsement of weight loss over addressing the psychological underpinnings of the BED. Additionally, true prescriptions of vitamins, herbs, and supplements should be done after confirmation with functional testing, such as micronutrient testing and the Dutch hormone test. These tests are often expensive and not covered by insurance, presenting another barrier to the use of this avenue.

*“I think the [CIH interventions] that are* ***important to note for all the wrong reasons*** *are probably* ***diet supplements****, which are very much presented as being complementary therapies [but] all you're doing really is feeding the person full of either* ***the next molecule down from amphetamine*** *or stuffing them full of caffeine and oddly enough, that's not on the [product labeling]. …A few years ago, it was* ***green tea capsules*** *[that] were being pumped like mad here for people wanting to lose weight and that’s fine if you say, ‘by the way, this contains the* ***equivalent of seven espressos****.’ Then the person buying it would [be] able to make sense of that, but that's not said. [****What is said is that] it’s your ‘miracle weight loss cure****,’ which messes with the person's nutrition and emotions. It messes with their biology to the point where they're* ***quite likely to binge even more****. So that's what I'm most worried about [regarding the use of CIH interventions like supplements that lack empirical support].” (P8 as quoted in Bray et al., 2023*(95)*))*

*“The* ***consumer trend of probiotics and prebiotics and supplementation is so enormous and it's fascinating and ridiculous****… When you look at the* ***economic data on probiotics and prebiotics, it's stunning****, I mean, it's just stunning, the* ***consumer uptake****. I think it speaks to* ***how much consumers want to feel better, and they want to do whatever they can to feel better...*** *[P60, contd. below]*

*“And so yeah,* ***our people with eating disorders are coming in in droves [saying] like, ‘here's my 17 supplements, and here's my three for this, and my five this and oh my gosh, I have so much gas****, and then they unload their five different, you know, probiotic supplements, [and it’s] like, ‘no wonder you have so much gas, your gut microbiome is freaking out in there! So let's ratchet back some of those and maybe we'll see if that won't help.* ***Maybe it's not your food or not eating [that’s causing your gas], it's, you know, [all of these supplements]...*** *[P60, contd. below]*

*“…* ***it's not like ‘I got this supplement and I'm always going to be happy,’ but that's the consumer message, right****? Like ‘if you eat enough yogurt and you eat enough kimchi and you have enough kombucha, life will be great.’ Yeah, you'll probably be very gassy if you do.” (P60 as quoted in Bray et al., 2023*(95)*)*

# Considerations Related to Empirical Support for Complementary and Integrative Health Use in Binge Eating Disorder

While the literature base on CIH interventions used in the context of BED is growing, specific barriers need to be addressed.

First, a substantial portion of the eating disorder CIH research is conducted in individuals with anorexia nervosa or in populations of individuals with mixed eating disorders rather than in populations of individuals with BED. This notation aligns with a historical trend to view all eating disorders from an anorexic-centric paradigm (7). This outdated but continued convention limits the generalizability of findings produced in individuals with eating disorders broadly to the context of BED, as anorexia nervosa, bulimia nervosa, and BED are distinct eating disorders that have different neurobiologies and pathologies (2, 154, 434-439) and thus often face different barriers to recovery and require different and individually-tailored solutions. It is not sufficient to assume a CIH intervention will or will not work in BED based on its effectiveness in other eating disorders.

Second, many CIH interventions are highly individualized to the patient. The individualization – while likely part of what makes CIH interventions effective – also presents a challenge to the standardization which is often required and highly valued in research and implementation alike. For example, Traditional Chinese Medicine may identify a need for acupuncture and herbs in one patient and Tai Chi in another; moreover, different patients may require the use of different herbs and/or acupuncture points). This challenge was summarized by an anonymous BED expert in a recent mixed-methods study of BED experts’ views on CIH use in BED: “*[the call for empirical support] also becomes difficult, because everybody is different and what might work for someone might not work for another person, and you need thousands of people to figure that out and that has been difficult,” (P53)*(95).This barrier is not unique to the use of CIH in BED (67). This barrier has been addressed in other fields by using protocols that allow for some variation around a certain level of standardization. For example, an acupuncture protocol may utilize a dual-diagnosis option with a fixed acupuncture protocol based on TCM diagnosis or may use a semi-fixed structure, in which five acupuncture points are used in all participants – unless strongly advised otherwise by the practitioner – and up to five additional points may be used, according to the practitioner’s discretion (440, 441).

Similarly, a third barrier to the field is the variety of skill levels and techniques among practitioners and interventions. For example, many different forms of yoga exist, ranging from yoga nidra and kundalini to hatha and more contemporary “hot yoga sculpt.” The yoga experience varies widely according to the type of yoga practiced as well as to the studio and teacher/practitioner. The same is true for meditation, acupuncture, massage, and nearly all forms of CIH intervention. This variation can pose a challenge in research and in translating research findings into real-world practice, where these variables cannot be standardized. However, researchers and clinicians can minimize this limitation by requiring that practitioners have a set amount of practice in the field (e.g., at least 3–5 years of practice).

# A Case for Research Funding for Complementary and Integrative Health Interventions for Binge Eating Disorder

Although empirical support for CIH intervention use in the context of BED treatment is growing, it is far from adequate. Given the low treatment rates (1, 8), high recurrence rates (1, 15), high rates of treatment dissatisfaction (16), and early discontinuation of care (16) associated with current conventional treatment options, there is a strong need for research that can identify, develop/standardize, and test new treatment options that may be effective in producing clinically meaningful outcomes in the ~56–62% of individuals with BED who do not respond to current treatment approaches. Moreover, ~93–97% of individuals who meet DSM criteria for BED never receive a formal diagnosis (24, 25), 67% do not perceive the need for formal treatment (24), and between 56–87% of individuals with a formal diagnosis never receive or pursue standard treatment (1, 24). These findings highlight the importance of identifying, developing, and testing new treatment options that overcome the treatment barriers addressed in Bray et al. 2023 (23) and in the introduction here, as well as elsewhere, including:

1. High treatment costs (23, 26-32).
2. Inadequate insurance coverage (23, 31, 32).
3. Stigmatization from healthcare providers (4, 23, 26, 32, 37-39).
4. Insufficient provider screenings (4, 23-26, 37, 42).
5. Denial, shame, and self-stigmatization (4, 23, 24, 26, 32, 39, 51).
6. Provider scarcity (23, 39, 442).
7. Geographic access to treatment (23, 32).
8. Miseducation about who can have an eating disorder (4, 23, 24, 39, 44).
9. Ignorance that BED is in fact a clinical mental health diagnosis (23).
10. Prioritization of physical complications associated with BED (e.g., weight, gastrointestinal issues) over the underlying psychopathology (e.g., emotion dysregulation, trauma history, negative affect, negative urgency (7, 53))(4, 7, 23-26, 37, 42, 443).
11. Fear of letting go of the coping behavior (23, 444).
12. Time constraints (23, 39, 445).
13. Fear of tolerating treatment hardships (23, 446).

Many CIH interventions offer solutions to these treatment barriers. For example, all CIH interventions emphasize “whole person” healing by definition (66), thus offering potential for reduced stigmatization among providers. Many CIH interventions are also free or low-cost and easily accessible, thus overcoming many current treatment barriers. For example, mindfulness, meditation, and yoga, can all be delivered virtually (71, 74) and often require no delivery once the intervention is learned. Free/low-cost, at-home acupuncture protocols like the NADA ear acupuncture protocol (<https://acudetox.com/nada-protocol/>) have also been developed and have gained recent traction in the field (364, 365, 369, 370, 377, 378)(however, see footnote 3 above).

The ease of access to these interventions – including at-home delivery and low cost also removes or minimizes the treatment barriers of stigmatization (including stigmatization in the healthcare system and shaming from healthcare providers, as well as self-stigmatization, embarrassment, guilt, and self-denial), insurance coverage, lack of a formal diagnosis, and even lack of identifying BED within oneself. For example, an individual could elect to use yoga or acupuncture for movement, weight stabilization, or anxiety management and receive additional benefits pertaining to BED, even if BED is undetected or diagnosed within the individual.

In fact, a review on BED epidemiology noted that less than half of adults with BED are recognized within the healthcare system (447). These findings suggest a possibility that adults with BED may already be using – or have used – CIH interventions to manage BED symptoms outside of conventional healthcare systems, thus underscoring the need for current information on CIH use in general and in individuals with diagnosed and undiagnosed BED.

Our findings highlight the importance of funding and resources to support research that can empirically test the use of different CIH interventions when used as a complement to (or integrated with) current standard BED treatments. The information we present here can be used to help identify CIH intervention candidates that can be used to target and treat specific aspects of BED pathology, both clinically and in preliminary safety and feasibility studies.

# Conflict of Interest

*The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest*.

# Author Contributions

Conceptualization, investigation, resources, data curation, and writing – original draft preparation: B.B.; writing—review and editing, B.B., H.T.M.L., A.G., A.J.S., S.M., A.S., D.A.W., and H.Z. All authors have read and agreed to the published version of the manuscript. All authors agree to be accountable for the content of the work.

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# Tables

## Figure 1

A diagram of a brain

Description automatically generated

Fig 1: Neuralcircuitry proposed to be involved in eating and binge eating behaviors include **mesostriatal dopamine**- and **corticolimbic circuits** and structures associated with **reward** and motivation as well as **frontoparietal systems** associated with **decision-making, self-regulation**, and regulating appetitive responding (96, 97, 99-107). In the **mesostriatal dopamine circuit** (also termed the **ventral pathway** associated with impulsivity [see Fig. 2]), dopaminergic neurons in the medial **ventral tegmental area (VTA)** innervate the **ventral striatum** (mainly the medial **nucleus accumbens shell (NAc),** which sends GABAergic and dopaminergic projections to the **ventral pallidum (VP)** in turn, conveying the reward salience of pleasurable experiences and substances (e.g., food, drugs, etc.))(108, 109). The VP integrates accumbal inputs with dopaminergic inputs directly from the VTA to influence consummatory behaviors, including consumption, cue-induced feeding, taste reactivity, and food preference (109). In the nigrostriatal dopamine pathway (also termed the **dorsal pathway** associated with compulsivity), dopaminergic neurons in the VTA innervate the **dorsomedial and dorsolateral striatum**, including the **caudate nucleus** and **putamen**, which are essential for orchestrating goal-directed and habitual decision-making (112-114). The dorsal pathway largely involves a circuit by which dorsal striatal projections innervate the **paraventricular nucleus of the thalamus (PVN/PVT)**, which integrates homeostatic and hedonic feeding signals with physiological and environmental stress signals, anticipatory feeding needs, and cognitive inputs to regulate food-seeking and consumption (115). The thalamus (innervates the **orbitofrontal cortex (OFC)** in turn [described below], which feeds back onto the striatum (448). Additionally, preclinical findings demonstrate that dopamine sensitization in the dorsal striatum accelerates the development of habit formation from previously goal-directed behaviors (114, 116-118), possibly contributing to compulsivity.

The **corticolimbic system** also contributes to reward and motivational processes, and includes the amygdala, hippocampus, and prefrontal cortex (PFC) (119). The VTA sends dopaminergic neurons to the **amygdala** and **hippocampus**, which are thought to be involved in learning and remembering reward cues, and innervate the nucleus accumbens as part of the mesolimbic pathway. The **orbitofrontal cortex (OCF)** in the **prefrontal cortex (PFC)** is also thought to be involved in reward (and punishment) processing and reward-based decision-making (120-124). It receives and integrates various sensory inputs (e.g., taste, smell, touch, vision, sound) and learns (and reverses) associations between stimuli and their outcomes (e.g., foods and their salient/rewarding properties/pleasantness), adapting to valuation changes as needed (e.g., changes in food value), thus contributing to reward-based decision-making processes that guide behavior (120-124). The **insula** and **thalamus** (described above), **hypothalamus**, and **brainstem/pons** are also thought to be part of the corticolimbic circuitry that drives eating and binge eating behaviors (96).

**Frontoparietal systems associated with decision-making, corrdinating goal-driven behaviors, self-regulation, and regulating appetitive responding** include the OFC (as described above) as well as the PFC at large and the **anterior cingulate cortex (ACC)**(96, 97, 99-107, 125, 126). Specifically, the OFC sends projections and reward information to the ACC, which integrates spatial and action-related information from the parietal cortical areas, thus connecting rewards to actions and rewrd-cues, while the **posterior cingulate cortex (PCC)** projects to the hippocampus system, thus storing reward memroies (130).

## Figure 2

A diagram of the brain

Description automatically generated

**Figure 2: Impulsivity and compulsivity in BED.** **A)** **Impulsivity** is associated with defieint inhibition of the **ventral/mesolimbic dopamine pathway** [Fig. 1], by which dopaminergic neurons in the medial **ventral tegmental area (VTA)** innervate the **ventral striatum** (mainly the medial **nucleus accumbens shell (NAc)**, which projects onto the thalamus, which projects onto the **anterior cingulate cortex (ACC)** [see Fig. 1 for description] which projects back onto the ventral striatum both directly and through the **ventromedial prefrontal cortex (vmPFC)**. The vmPFC is largely associated with exerting inhibitory control over the NAc and reward-seeking behaviors in turn (449, 450), with decreased vmPFC thickness in binge eating and obesity thought to render this inhibitory system unable to prevent binge eating (110). The resulting disinhibition is thought to contribute to impulsivity, both in impulsive, disinhibited binge eating and in general (110, 111).

**B)** **Compulsivity** is associated with the **dorsal/nigrostriatal dopamine pathway** [Fig. 1], by which dopaminergic neurons in the VTA innervate the **dorsomedial and dorsolateral striatum**, including the **caudate nucleus** and **putamen**, which are essential for orchestrating goal-directed and habitual decision-making (112-114). Dorsal striatal projections innervate the **paraventricular nucleus of the thalamus (PVN/PVT)**, which integrates homeostatic and hedonic feeding signals with physiological and environmental stress signals, anticipatory feeding needs, and cognitive inputs to regulate food-seeking and consumption (115). The thalamus innervates the the **insular cortex** (the primary taste cortex involved in appetite, motivated behavior, emotional processing, and emotional, stress-driven eating (451)) and **orbitofrontal cortex (OFC),** which are situated in junction to one another and both project back onto the striatum (448, 451-453). The insular cortex also projects to the OFC as well as to the mPFC, amygdala, cingulate, and autonomic centers (453, 454). The OFC then feeds back onto the striatum in turn (448). Preclinical findings demonstrate that dopamine sensitization in the dorsal striatum accelerates the development of habit formation from previously goal-directed behaviors (114, 116-118), possibly contributing to compulsivity.

The shift from impulsivity to compulsivity involves neuroplastic changes in the mesolimbic dopamine system (esp. in the NAc) and in prefrontal systems, including the extended amygdala (174), as well as dopamine desensitization in the dorsal striatum (of the nigrostriatal dopamine system) that accelerates the development of habit formation from previously goal-directed behaviors (114, 116-118).

## Table 1

| Table 1: CIH Interventions Associated with Different Utilities/Factors Relevant to BED | |
| --- | --- |
| ***BED Factor /Outcome/Intervention Utility*** | ***CIH Interventions Empirically Shown to Improve BED Factor/Outcome*** |
| Regulating/Managing Anxiety/Stress/Mood/Emotions | |
| Reducing Anxiety | Acupuncture (86, 344)‡, Yoga (455)‡ |
| Managing Stress | Acupuncture (Reduction in Stress Responses) (344)‡, Yoga (reductions in cortisol reactivity to stress)(456)‡, Supplements (Rhodiola rosea, Salidroside, reduction in stress-induced cortisol increases and stress-induced binge eating) (408, 409)\*\* |
| Managing Mood | Yoga (Negative Affect, Alexithymia‡)(84, 236),(455)‡, Acupuncture (Depression) (86, 344)‡; Mindfulness/MBIs (Depression)(235); Bright Light Therapy (63)‡ |
| Emotion Regulation | Mindfulness/MBIs (235, 457, 458) |
| Healing & Strengthening Positive Relationships with the Body & Movement | |
| Relationship with the Body | Yoga (84, 85, 236, 459) |
| Relationship with Body Image | Yoga (84, 85, 236, 459) |
| Relationship with Movement and Exercise | Yoga (84) |
| Healing Trauma Related to Exercise/Movement | Yoga (84) |
| Biological/Physiological Benefits | |
| Specific Supplements | Rhodiola rosea, Salidroside (abolishing stress-induced cortisol increases and stress-induced binge eating) (408, 409)\*\* |
| Improvements in BMI, Hip, and Waist Measurements | Acupuncture (343)‡, Yoga (85) |
| Other Biophysiological Issues | Acupuncture (Inflammation, [Para]Sympathetic Tone, Hormone Secretion Regulation)(344)‡,\*\* |
| Directly Supporting Recovery | |
| Improving global eating disorder psychopathology (e.g., BES scores) | Mindfulness (75), Yoga (85) |
| Reducing BE, Overeating, and LOC Eating | Mindfulness/MBIs (75, 235), Yoga (84, 236), Acupuncture (63, 86, 338-350, 354, 356, 358-363)‡, Supplements (Rhodiola rosea, Salidroside) (408, 409)\*\* |
| Tolerating Treatment and Coping with Symptoms | Acupuncture – General Use (86)‡, Acupuncture – NADA Protocol (354, 362, 364-378)‡ |
| Behavior Change | Mindfulness (75, 84), Yoga (84, 236), Acupuncture (63, 86, 338-350, 354, 356, 358-363)‡ |
| General Healing | |
| Healing/Addressing Trauma | Yoga (84, 460)£, EMDR (461)† |
| Patient-Driven, Bottom-Up, “Inside-Out” Healing | Acupuncture (86)‡ |
| **Table Legend:** ‡Findings observed in an overweight or eating disorder population not specific to BED (e.g., anorexia nervosa, overweight and obesity). \*\*Some findings observed in preclinical (rodent) models. £Specifically in the context of shame/stigma-based trauma related to the body and exercise/movement. †Findings in the context of individuals with PTSD, not BED or an ED. **Abbreviations:** BE, binge eating; BED, binge eating disorder; BES, Binge Eating Scale; CIH, complementary and integrative health; DUTCH, dried urine test for comprehensive hormones (dutchtest.com); ED, eating disorder; EMDR, Eye Movement Desensitization and Reprocessing; GI, gastrointestinal; MBI, mindfulness-based intervention; TCM, Traditional Chinese Medicine. | |

1. It should be acknowledged that the role of dopamine in addiction processes has been disputed, as it does not seem to be the driving mechanism in some substance-related addiction disorders (ex: cannabis and opiates)[33]. Furthermore, additional hormones/neurohormones, neuropeptides, and neurotransmitters such as orexins, endocannabinoids, glutamate, GABA, leptin, insulin, ghrelin, glucagon-like peptide 1, melanin-concentrating hormone, oxytocin, serotonin, and corticotrophin releasing factor/hormone (CRF/CRH) are also involved. [↑](#footnote-ref-1)
2. Characterized by poorly conceived and prematurely expressed actions that are often risky or inappropriate to the situation and often result in undesirable consequences (Dalley et al., 2011; Boswell et al., 2021). [↑](#footnote-ref-2)
3. Characterized by perseverative behaviors that are often intrusive, inrelated to any long-term goals, and often also result in unwanted consequences (Dalley et al., 2011; Boswell et al., 2021). [↑](#footnote-ref-3)
4. [↑](#footnote-ref-6)
5. The development of CBT can be divided into three waves: 1) First-wave CBT came out of the tradition of behavioral therapies and relies heavily on principles of operant learning and classical conditioning to change overt behavior. It gained popularity and use in the 1940s as a short-term behavior therapy treatment for cases of depression, severe anxiety, and PTSD that were endemic in World War II veterans. 2) Second-wave CBT evolved in the 1970s from Aaron Beck’s cognitive therapy and focuses on the principle that automatic thoughts and thought patterns about negative events are more impactful on mental health than the events themselves and that learning to identify and evaluate cognitive distortions and automatic/reflexive thought processes can help an individual effect change in reflexive thinking and mental health in turn. 3) Third-wave behavioral therapies developed in 2004 and tend to have a greater emphasis on mental processes and mindfulness practiceses. These include Acceptance and Commitment Therapy (ACT), Dialectical Behavior Therapy (DBT), Mindfulness-Based Cognitive Therapy (MBCT), and Schema Therapy (see citations after footnote in text). [↑](#footnote-ref-7)
6. There is some disagreement in the field about the effectiveness of ear seed self-administration. The ear has between 50 and 200 locations, according to different sources, and there is little research on whether accuracy of location in the ear makes a difference. [↑](#footnote-ref-8)