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# Behavioral Interventions for Obesity in Children and Adults: Evidence-Base, Novel Approaches, and Translation into Practice

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## Abstract

Obesity in adults has nearly doubled in the past 30 years and has risen similarly in children and adolescents. Obesity affects all systems of the body and the serious health consequences of obesity include an increased risk for cardiovascular disease, such as type 2 diabetes or high blood pressure, which are occurring at ever younger ages. The present article provides an introduction to traditional, behavioral weight loss strategies designed to change energy-balance behaviors (i.e., dietary and physical activity behaviors) and the contexts within which these interventions have typically been delivered. The applicability of findings from behavioral economics, cognitive processing, and clinical research which may lead to more potent weight loss and weight loss maintenance interventions are also considered. Given the pervasiveness of obesity, this paper concludes with a discussion of efforts towards wider-scale dissemination and implementation of behavioral treatments designed to address obesity and to reduce the risk of cardiovascular disease.

### Keywords

obesity; behavioral treatment; behavioral health; cardiovascular disease risk

Obesity is a serious and complex disease, affecting more than one third of U.S. adults and 17% of children (Ogden, Carroll, Kit, & Flegal, 2014). In adults, obesity is defined as a body mass index (BMI; kg/m$^2$) of 30 and above and in children, due to natural variation in body composition over development, it is defined as a BMI at or above the 95$^{th}$ percentile on growth curves based on age and sex (Kuczmarski et al., 2000). Notably, the prevalence of severe obesity in adults (i.e., BMI greater than 40) and children (i.e., BMI ≥ 120% of the 95$^{th}$ percentile) continues to rise, along with the associated cardiovascular disease risks (Ogden et al., 2014; Skinner, Perrin, Moss, & Skelton, 2015). Obesity is a costly disease,

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both economically (e.g., increased medical care costs, impaired work productivity) and psychosocially (e.g., increased depressive symptoms, stigmatization) (DiBonaventura, Le Lay, Kumar, Hammer, & Wolden, 2015; Puhl & Heuer, 2010). While pharmacological and surgical interventions are available for the treatment of obesity, they are recommended for use only after attempts to modify weight using behaviorally-based interventions have failed, they are limited in their availability/applicability, particularly for children and adolescents, and are accompanied by significant health risks (Alamuddin, Bakizada, & Wadden, 2016; Inge et al., 2004). Furthermore, on-going changes in dietary and physical activity behaviors are still recommended for continued weight loss or weight loss maintenance with these medical interventions. Therefore, the availability of effective behavioral change interventions to promote healthier lifestyle behaviors and decrease obesogenic behaviors remains a consistent and critical need for both children and adults and is necessary to improve public health (Spring et al., 2013).

## Behavioral Weight Loss Interventions

The primary focus of behavioral weight loss (BWL) programs is the modification of energy-balance behaviors to improve weight status (i.e., decreasing energy intake and increasing energy expenditure) using behavior modification strategies (Wadden, Brownell, & Foster, 2002; Wing, 2002). Cognitive strategies (e.g., self-monitoring for the identification of overeating triggers, behavior chains, problem solving, cognitive restructuring, relapse prevention), while not traditional, are also commonly used (Pimenta, Leal, Maroco, & Ramos, 2012; Wilfley, Kolko, & Kass, 2011). Examples of well-tested behavioral weight loss programs designed to reduce body weight and prevent the development of chronic diseases associated with obesity include the Diabetes Prevention Project (DPP) and the Look AHEAD study for adults (DPP, 2002; Look AHEAD Research Group, 2014), and family-based behavioral weight loss programs (FBT) for children (Epstein et al., 2007b; Wilfley et al., 2007, in press). Systematic reviews in this area show that adults participating in 12–26 session BWL programs lose approximately 6% of their body weight (USPSTF, 2012), while children participating in at least 26 sessions of BWL lose 0.2 zBMI (O'Connor et al., 2017), both clinically-significant weight losses associated with multiple health improvements.

In addition to improvements in weight status, BWL treatment is also associated with improvements in other physiological and behavioral health-related outcomes. For example, BWL is associated with improvements in cardiometabolic outcomes (e.g., blood pressure, glucose, lipids) in both children (O'Connor et al., 2017) and adults (LeBlanc et al., 2011), as well as improved diet quality (Hayes et al., 2016), physical activity (Unick et al., 2011), and sleep (Martin et al., 2016). Moreover, BWL has psychosocial benefits, such as improved quality of life (Williamson et al., 2009) and reduction in depressive symptoms (Fabricatore et al., 2011). One common concern for BWL programs is that "dieting," particularly in children, may increase risk for eating disorder symptoms; however, in BWL programs that focus on healthy eating and activity behaviors, eating disorder pathology is not affected or is decreased (Balantekin et al., in press; Macpherson-Sanchez, 2015). Reductions in symptomology may be due to active treatment components, such as promotion of flexible and moderate dietary restriction, gradual weight loss, and encouragement of social network support (Goldschmidt & Wilfley, 2008). Furthermore, while adverse events are uncommon

in BWL programs (O'Connor et al., 2017; LeBlanc et al., 2011), frequent monitoring promotes early identification of adverse events such as rapid weight loss and increased eating disorder pathology that can then be addressed.

The following section reviews common BWL strategies, including goal setting, preplanning, self-monitoring, behavioral incentives, stimulus control, and social support.

## Goal Setting, Pre-Planning, and Self-Monitoring

In obesity treatment, goals are typically set for weight, diet, and physical activity behaviors, and are individualized to focus on specific behaviors most needing improvement. Adult weight loss programs generally aim for a loss of 5–10% of body weight and include behavioral goals to support this change. For example, the DPP sets a goal of 7% body weight loss and daily calorie and macronutrient goals vary based on initial weight, ranging from 1200 kcal/day (33 g of fat) for participants weighing 120–170 pounds to 2000 kcal/day (55 g of fat) for participants weighing over 250 pounds (DPP, 2002). The physical activity goal is 150 minutes of moderate intensity physical activity per week. Child obesity programs may strive for a loss of at least 0.25 zBMI points, a clinically-significant outcome (Ford, Hunt, Cooper, & Shield, 2010), and in FBT, typical behavioral goals include 1000–1400 kcal/day, 5 servings of fruits and vegetables per day, fewer than 15 high-energy density foods per week, 90 minutes of physical activity 5 times per week, and less than two hours of screen time a day (Epstein et al., 2007; Wilfley et al., 2007, 2017).

Pre-planning meals and exercise in advance aids in goal achievement, as it allows one to prospectively outline the ways in which goals are to be attained (Mann, de Ridder, & Fujita, 2013). This may involve making a meal plan for the week or deciding when and where to exercise. Implementation intentions are a specific type of pre-planning strategy that specify the when, where, and how of behaviors leading to goal attainment and are widely used for health behavior change (Gollwitzer & Sheeran, 2006). As such, they have shown promise for inclusion in weight loss interventions (Luszczynska et al., 2007).

Self-monitoring involves recording weight as well as dietary (e.g., food consumption, calories, etc.) and physical activity (e.g., minutes spent active) behaviors over time to track progress towards goals, and is a consistent predictor of weight loss outcomes (Burke, Wang, & Sevick, 2011). Increased frequency of self-monitoring has been associated with improved weight loss outcomes in both children (Mockus et al., 2011; Saelens & McGrath, 2010) and adults (Wadden et al., 2005), and has been shown to improve weight maintenance in both populations (Butryn, Phelan, Hill & Wing, 2007; Wilfley et al., 2007).

Goal-setting and self-regulatory skills have been shown to both predict and mediate weight outcomes in pediatric and adult populations (Wilfley et al., 2017; Teixeira et al., 2015).

## Behavioral Incentives, Behavioral Economics and Stimulus Control

Behavioral incentives, derived from Skinner's work on operant conditioning (1938), are used in BWL interventions to help reinforce commitment to goals and to aid in the achievement of the desired behavioral change targets (Petry, 2000). While there are many incentives intrinsic to weight loss that can reinforce behavior change (e.g., clothes feeling looser,

finding it easier to breathe while walking upstairs), weight loss and its accompanying physical changes are often slow, and more immediate, material incentives may be more effective in reinforcing healthy behaviors (Levy, Finch, Crowell, Talley & Jeffery, 2007). A number of strategies have been tested for adults including coupons/discounts for healthy foods, provision of free foods, direct cash payments, and deposit contracts in which money is deposited and refunded based on goal achievement. While variations in incentives and incentive schemes make conclusions difficult, studies assessing the role of financial incentives generally demonstrate positive short-term outcomes for behavior change (Purnell, Gernes, Stein, Sherraden, & Knoblock-Hahn, 2014), although findings are mixed for weight loss and long-term outcomes (John et al., 2011; Sykes-Muskett, Prestwich, Lawton, & Armitage, 2015).

FBT programs for children often involve the use of incentive systems focused on positive reinforcement. To develop a family-based incentive system, parents and children work together to determine appropriate and appealing incentives for goal attainment. Ideal incentives are those that increase social support and reinforce the value of targeted behaviors, such as a family bike ride or a walk with friends. Children earn points for achieving their diet, physical activity, and behavioral goals and can exchange their points for incentives. Unfortunately, there is limited research specifically examining the efficacy of behavioral incentives in childhood obesity treatment (Epstein, Paluch, Kilanowski, & Raynor, 2004), especially for older, racially diverse pediatric populations. One multiple-baseline pilot study of six African-American youth found that contingent rewards for weight loss increased adolescent weight loss but only for youth whose parents were actively involved in the intervention (Hartlieb et al., 2015).

Incentivizing behaviors consistent with weight loss may be particularly challenging since food is a powerful reinforcer. Individuals with higher levels of food reinforcement (i.e., those who are highly motivated by food and will work hard to obtain it) are more likely to experience obesity and also have poorer treatment outcomes (Best et al., 2012). Behavioral choice theories and behavioral economic research, which assesses the influence of psychological factors on economic decisions, applied to the design of obesity treatments have provided guidance as to how to address this challenge (Jacques-Tiura & Greenwald, 2016). One way to do this is to increase the reinforcing value of other choices in the environment, and subsequently make food less *relatively* reinforcing. For example, children participating in FBT who were positively reinforced through a point system to engage in behaviors other than eating reported more time spent on nonfood-related activities and reported fewer eating episodes than those in traditional FBT (Epstein, Roemmich, Stein, Paluch, & Kilanowski, 2005). Another way involves increasing the behavioral cost of obtaining unhealthy foods (i.e., increase how hard one must work to obtain food). One laboratory study showed that as women had to work harder to obtain desired snack foods, they were more likely to switch their choice from these foods to healthier non-food alternatives (Epstein et al., 2014).

The practical implications of these studies suggest that if high-calorie foods are not kept easily accessible and require more work to obtain, then healthier choices that require less effort will become more reinforcing. Changing the environment to increase the likelihood of

engaging in desired behaviors is referred to as stimulus control (Terrace, 1966) and is based on the assumption that behaviors are controlled by environmental antecedents, or cues. In obesity treatment, participants are encouraged to increase the number of cues for healthy behaviors within their environments (e.g., putting a bowl of fruit on the counter, keeping running shoes in plain view) and to decrease the number of cues for unhealthy behaviors (e.g., keeping unhealthy food choices out of the house, moving television out of the living room). Over time, the strength of the reinforcing value of these healthier alternatives will be increased through greater exposure via learning and conditioning (Epstein & Wrotniak, 2010). It is also important to consider the process of habituation when using stimulus control. Briefly, individuals may become less interested or motivated (i.e., habituated) to obtain foods after repeated exposure (Epstein et al., 2013). Thus, decreasing not only the amount, but also the variety of unhealthy foods and sedentary activities in the environment may optimize the use of stimulus control within behavioral weight loss programs for both adults and children.

## Social support

Supportive individuals can play a key role in either helping or hindering behavior change, and social networks can influence weight loss success (Christakis & Fowler, 2007), therefore social support in BWL treatment may help improve weight loss outcomes. Indeed, studies of BWL programs have identified support from family and friends as a predictor of greater weight loss and empirical tests of actively including a partner have been promising (Gorin et al., 2013; Wing & Jeffery, 1999; Winston et al., 2015). In one landmark study, participants were either recruited alone or with three support people (friends and/or family members), and were either given a social support intervention or were not. The combination of recruiting participants with support people and providing them with social support training was effective, and these participants had increased study retention and weight loss maintenance, compared to the group who was recruited alone who had the poorest attendance and regained the most weight (Wing & Jeffery, 1999). In another study, Black and Hispanic adults with overweight/obesity enrolled in a weight loss study had greater weight loss when supported by their children and coworkers (Winston et al., 2015).

Other research suggests that the positive benefit of including social support in treatment may only exist if the social support member is successful at losing weight him/herself. In a study where BWL participants were invited to participate with up to three partners, those who had at least one support partner who successfully lost weight lost significantly more weight themselves than those with no successful partners or without partners (Gorin et al., 2005). Similar results have been shown in African-American adults, with social support weight loss predicting participant weight loss (Kumanyika et al., 2009).

For children, parental involvement is a critical component of effective obesity treatment programs (Young et al., 2007). Given their control over the home environment and their child’s energy-balance behaviors, parents are included as active participants for their own weight loss and are taught to use positive parenting techniques, such as limit-setting and positive reinforcement, to augment their child’s weight loss (Epstein et al., 2003). In support of parent involvement, parental weight loss has shown to be the most robust predictor of

child weight loss in FBT and family and home environment have been shown to mediate weight outcomes (Wrotniak, Epstein, Paluch, & Roemmich, 2004; Goldschmidt et al., 2014; Wilfley et al., 2017). Peers may also serve as key sources of support for children and adolescents attempting to lose weight. A review of the influence of peers and friends on children's and adolescents' health behaviors concluded that involving peer networks in prevention and intervention programs are effective for modifying health behaviors (Salvy, De La Haye, Bowker, & Hermans, 2012). Furthermore, peer, as well as family, support have been found to be both a predictor and mediator for weight loss (Kulik, Valle, & Tate, 2016) and for weight loss maintenance (Wilfley et al., 2007; 2017) in youth.

## Context of Behavioral Weight Loss Interventions

While behavioral treatments for obesity have demonstrated efficacy, population, format, dose, duration, and setting can influence outcomes. Indeed, these contexts may be particularly important when considering dissemination and implementation of treatments into healthcare systems and clinical practice, as these should be maximally effective while at the same time, designed to minimize costs and burden (Brownson, Colditz, & Proctor, 2012).

### Population

Obesity disproportionally affects minority populations compared to non-Hispanic white populations (Ogden et al., 2014) and some studies indicate that BWL interventions may be less effective for certain minority groups (Fitzgibbon et al., 2012; Wadden et al., 2011). As such, consideration has been given to adapting interventions to meet the needs of different cultural and racial groups. Strategies can range from changing the program components to match observable features of a group (e.g., including racially or ethnically similar facilitators) to including content that takes into account the beliefs and values of a group (Kreuter, Lukwago, Bucholtz, Clark, & Sanders-Thompson, 2003). While some of these studies have shown promising effects in African American (Kong, Tussing-Humphreys, Odoms-Young, Stolley, & Fitzgibbon, 2014) and Hispanic (Branscum & Sharma, 2011) groups, it is unclear if they produce outcomes that are superior to non-targeted programs. More work is needed to determine the independent contribution cultural adaptations have to weight loss and which targeting strategies are most successful.

Age should also be a consideration in obesity treatments. Obesity tracks across development from infancy and early childhood to adulthood (Brisbois, Farmer, & McCargar, 2011; Cunningham, Kramer, & Narayan, 2014). As such, early intervention for obesity during childhood is a form of targeted prevention for obesity in adulthood. Moreover, within childhood, treatments are more effective at reducing obesity in younger children (Reinehr, Kleber, Lass, & Toschke, 2010), potentially because weight changes necessary to normalize weight are much smaller at younger ages than at older ones (Goldschmidt, Wilfley, Paluch, Roemmich, & Epstein, 2013).

## Dose and Duration

Effective doses of behavioral weight loss have been established for adults and children. A comprehensive review of the literature showed that adults lose clinically-significant amounts of weight (5–10%) in programs with anywhere from 12–24 treatment sessions (US Preventive Services Task Force, 2012) and children benefit from programs with more than 25 contact hours across at least six months (O'Connor et al., 2017).

Weight regain following treatment is a significant problem with current obesity treatments in both adults and children (Wing & Phelan, 2005); however, continued contact can positively impact long-term weight outcomes (Epstein, 2003; Wilfley et al., 2007, 2017). It is theorized that longer treatment duration allows additional time for participants to establish consistent habits related to physical activity and healthy eating across contexts, such as at home and at work, and to experience on-going support and coaching during these more repeated retrieval experiences (Bouton, 2002). Another option to enhance outcomes that may also reduce burden on participants and providers may be to tailor treatment using a mastery approach, which calibrates content and dose to the needs of the individual and has been shown to enhance weight loss outcomes (Epstein, McKenzie, Valoski, Klein, & Wing, 1994).

## Format

BWL treatment may be administered in individual, "mixed" (i.e., individual and group) or group formats. Group formats provide unique therapeutic factors, such as universality, altruism, imitative behavior, and interpersonal learning (Yalom, 2005) and should cost less to deliver. Adult studies show group formats produce similar or superior outcomes compared to individual treatments (Paul-Ebhohimhen & Avenell, 2009), whereas children may find increased benefit from family-based programs in a "mixed" format, which involve separate group sessions for parents and children as well as individual family sessions (Hayes, Altman, Coppock, Wilfley, & Goldschmidt, 2015).

## Setting

Traditionally, BWL programs and FBT interventions have been offered in academic medical settings on an outpatient basis. More recently, treatments have been developed with consideration to increased access and reach in alternative settings. Specifically, community settings, such as recreation centers (e.g., YMCA), schools, and churches, worksites, and clinical settings, such as primary care, have become additional settings for the delivery of weight management programs (Anderson et al., 2009; Quattrin et al., 2014; Sbrocco et al., 2005; Wadden, Butryn, Hong, & Tsai, 2014). Moreover, with technological advances, weight management programs with remote administration (e.g., phone, web, mobile app) are being tested (Neve, Morgan, Jones, & Collins, 2009; Williamson et al., 2006). Of note, as BWL programs and FBT interventions leave highly controlled academic medical centers, a significant risk of a decrease in the robustness of the outcomes exists (Brownson, Colditz, & Proctor, 2012), and future work is needed to potentiate outcomes in these alterative settings.

## Novel Approaches to Weight Loss

Although multicomponent weight loss programs are effective at improving weight status and other indices of physical and psychological health (US Preventive Services Task Force, 2012; O'Connor et al., 2017), some adults and children do not see clinically-significant benefits from behavioral weight loss interventions (Unick et al., 2014) and a greater number have difficulty maintaining the losses that they do achieve (Epstein, Paluch, Roemmich, & Beecher, 2007b; Wing & Phelan, 2005). Poorer outcomes in some may be due to individual differences that make it more difficult to engage with traditional BWL programs, such as cognitive deficits, dysregulated reward pathways, and ambivalence regarding participation. As such, behavioral scientists seek ways to target potential barriers and develop more powerful and individualized interventions for obesity across the lifespan. The following section discusses three approaches. The first is motivational interviewing, which has garnered an evidence base that demonstrates efficacy at enhancing weight loss, particularly when used in combination with a BWL program, while the other two, executive function-related interventions and mindfulness-based interventions, are in their infancy and do not have the evidence base to be included in current clinical care for obesity. While these interventions have been tested as stand-alone treatments, the research suggests they may be most beneficial for weight loss when included in the context of a BWL program.

### Motivational interviewing

Motivational interviewing (MI) is a therapeutic approach for an individual considering health behavior change used to help him/her understand and articulate ambivalence towards lifestyle modifications necessary to reach health goals. MI focuses on helping clients identify motivating factors for treatment and can use objective feedback, such as weight or blood pressure, to help clients consider if and why change should be made (DiLillo & West, 2011). MI is primarily client-directed and the provider's role is to guide the conversation using reflective listening, highlighting inconsistencies to increase discomfort and encourage behavior change motivation, with the goal of negotiating behavior change without direct problem solving (DiLillo & West, 2011). Through MI, clients are able to identify personalized reasons and goals for weight loss and generate their own treatment plans (Miller & Rollnick, 2012). Evidence suggests the mechanisms by which MI exerts its effects likely include improving program engagement and adherence (DiLillo & West, 2011; Miller & Rollnick, 2012).

MI has a sizeable research base highlighting its efficacy to enhance weight loss in adults (Armstrong et al., 2011; Lundahl et al., 2013). MI interventions are often used in primary care settings, increasing access for individuals with overweight/obesity who may not seek out more intensive or specialized care. Results of MI interventions for adults in primary care specifically have shown mixed effects, with studies with more positive results providing treatment in an individual format, incorporating phone sessions and/or technology, and offering the MI intervention outside of regular primary care appointments (Van Buskirk & Wetherell, 2014). Notably, MI is found to have the most robust outcomes on weight when used in combination with or in addition to BWL programs with adult and pediatric populations (Armstrong et al., 2011; Naar-King et al., 2016).

## Executive function-related interventions

Executive functions (EFs) are a set of cognitive processes that aid in the selection and management of behaviors to align them with future goals (Diamond, 2013). EFs have been implicated as a necessary component of weight management, as they aid in the pursuit of long-term goals such as maintaining a healthy weight in a challenging, obesogenic environment, and lower EFs have been included in a cognitive profile of obesity (Jansen, Houben, & Roefs, 2015). Indeed, research demonstrates that individuals with obesity have lower EF skills compared to individuals of healthy weight (e.g., Smith, Hayes, Campbell, & Troller, 2011). As such, EFs may have important implications for the treatment of obesity and new treatment initiatives are being tested that target EF enhancement (Hayes, Eichen, Barch, & Wilfley, 2017). Computerized training of EFs for obesity treatment is an emerging area of research. In particular, research on inhibitory control training (ICT), which is made up of repeated computer trials of tasks that ask an individual to inhibit a trained behavior in response to a cue, shows individuals with obesity can immediately improve inhibitory control and engage in fewer dietary obesogenic behaviors than individuals in control conditions in the laboratory (Jones et al., 2016). However, ICT has shown mixed results on weight in adults when used alone (Allom & Mullan, 2015; Veling, van Koningsbruggen, Aarts, & Stroebe, 2014) and has been infrequently tested in combination with existing BWL programs. One study in children found that EF training during inpatient BWL aided in short-term, but not long-term, weight loss maintenance following treatment (Verbeken, Braet, Goossens, & Van der Oord, 2013)

As noted in the above section on incentives, behavioral economics, and stimulus control, individuals with obesity are also found to devalue larger rewards in the future for smaller, more immediate rewards, a time-related process known as delay discounting (DD) (Weller, Cook, Avsar, & Cox, 2008). DD may be considered a “hybrid” construct that incorporates EF skills to exert top-down control over more automatic, bottom-up reward processing. Higher DD suggests a preference for immediate gratification and is related to poorer obesity treatment outcome (Best et al., 2012). Episodic future thinking (EFT), the vivid imagination of future events, was developed to help individuals with high DD shift their time perspective to the future, in order to promote the salience of a long-term goal and improve DD (Benoit, Gilbert, & Burgess, 2011). Laboratory studies have shown that EFT reduces DD and leads to less calorie intake (Daniel, Said, Stanton, & Epstein, 2015), but only a recent pilot study shows the effect of EFT in combination with a BWL. The study assessed EFT as an adjunct to FBT and found that after a four-week treatment, parents in the EFT group lost significantly more weight than parents in the control group, and children in the EFT group showed trends towards reduction in calorie intake, but there were no differences in weight. (Sze, Daniel, Kilanowski, Collins, & Epstein, 2015).

## Mindfulness and acceptance-based interventions

Mindfulness is the practice of purposefully and non-judgmentally paying attention to the present moment and has received increasing support as an avenue to reduce both psychological and physical distress (Kabat-Zinn, 2015). Mindfulness-based interventions are theorized to aid in improving eating behaviors and reducing weight by increasing awareness of food-related thoughts and feelings (e.g., understanding internal sensations and identifying

triggers) and enhancing self-regulation (Kristeller, Wolever, & Sheets, 2013). A systematic review that included both stand-alone and adjunct mindfulness-based interventions identified positive effects of mindfulness-based interventions (interventions that included at least one training session of mindfulness skills) on weight in six out of eight peer-reviewed randomized controlled trials (RCT) (Olson & Emery, 2014). A more recent RCT found that a 5.5 month BWL program with a mindfulness training component for stress management, eating, and exercise did not produce differences in weight when compared to a standard BWL control group, but did find differences on fasting glucose and triglyceride/HDL ratio, suggesting mindfulness training may have benefits above and beyond weight, potentially through stress-related pathways (Daubenmier et al., 2016).

Mindfulness is also used in combination with other therapies such as Acceptance and Commitment Therapy (ACT), which emphasizes contextual and experiential change strategies by focusing on the context and function rather than form and mechanism of psychological experiences. ACT differs from traditional BWL programs through its more intensive focus on internal motivation and self-regulatory skills. In addition to mindfulness meditation, participants in ACT are taught skills such as “urge surfing” or cognitive defusion (i.e., separation of the self from thoughts and emotions) to help endure the discomfort of their desires to engage in weight-gain behaviors while persisting in their weight-loss behaviors aligned with their values (i.e., be more active with children) (Forman & Butryn, 2015).

Research on the efficacy of ACT for weight change and obesity treatment is in its infancy. ACT has been tested as a brief, stand-alone treatment and results showed small, but statistically-significant weight loss (Tapper et al., 2009); however, outcomes may be related to program adherence (Lillis, Hayes, Bunting, & Masuda, 2009). Greater weight losses have been shown when ACT is used in combination with a BWL intervention. Specifically, in a recent RCT, a BWL intervention that incorporated acceptance-based strategies (ABT) was compared to a standard BWL (Forman et al., 2016). The ABT and BWL programs had shared components traditionally found in obesity treatment; however, the BWL treatment included cognitive-behavioral strategies, such as identification of cognitive distortions and cognitive restructuring, while the ACT strategies targeted ongoing commitment, mindful decision-making training, and distress tolerance. The ABT group lost significantly more of their body weight at 12 months, approximately 13%, than the BWL group, who lost approximately 10% (Forman et al., 2016). Given the focus on internal experiences, it has been hypothesized that mindfulness- and acceptance-based approaches for obesity treatment may be particularly helpful for individuals who are highly responsive to eating cues and those who frequently engage in emotional eating, populations that typically struggle with BWL programs (Forman & Butryn, 2015). Future research should continue to explore the utility of mindfulness- and acceptance-based interventions for these subpopulations.

## Translating Behavioral Weight Loss Interventions

Once the efficacy of a program is established, strategies to “scale-up” behavioral treatments need to be identified. The field of dissemination and implementation (D&I) science seeks to identify evidence-based practices for translating research interventions for public use

(Brownson, Colditz, & Proctor, 2012). Primary outcomes for this type of research are often different than those typically considered in RCTs and include treatment acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, penetration, and sustainability (Proctor et al., 2011). In particular, given the chronic and complex nature of obesity and the recent classification of obesity as a disease (American Medical Association, 2013), one major future direction for D&I science in obesity research is integrating obesity treatment into healthcare systems. Specifically, there is a call for obesity treatment within the framework of an integrated behavioral health-care model (Dietz et al, 2015). Obesity treatment provided within a primary care practice medical home allows for taking a team approach to this complex and chronic problem (Wilfley et al, 2017). Such streamlining of care may make it easier for individuals to receive all the necessary treatments and has the great potential to improve access and reach of weight loss treatment. Despite mandates for coverage for obesity-related treatment services within primary care settings by the Centers for Medicare and Medicaid Services, few individuals are receiving this much-needed care due to barriers such as restrictions on the type of provider (e.g., only primary care practitioners) (Wadden, Butryn, Hong, & Tsai, 2017). In children, despite recommendations, reimbursement and access are even more limited and inconsistent (Wilfley et al, 2017).

However, successful translation models exist. One example is the Diabetes Prevention Program (DPP) (Diabetes Prevention Program Research Group, 2002), which has maintained effectiveness in helping participants reach clinically-significant weight loss in alternative settings, including primary care and community settings (Ali, Echoufoo-Tcheugui, & Williamson, 2012). Notably, effect sizes decrease in robustness, potentially due to changes in format (i.e., group vs. individual) and remote and/or web-based administration; however, it does appear that lay community educators (e.g., YMCA staff) with intensive training were just as effective at delivering the DPP as health professionals. Accordingly, the Centers for Disease Control and Prevention has developed a standardized set of DPP curricula and a training system to allow for streamlined integration of the program into community settings while attempting to maintain the effectiveness of the original program. Moreover, a commercial version of the program that has produced 4.2% body weight loss two years after program completion is now available through many employers and health systems (Sepah, Jiang, & Peters, 2015).

For children, while there is preliminary data in support of the delivery of FBT within primary care practices to families with children two to five years of age with overweight (Quattrin et al., 2014), the PLAN with Families program, a study funded by the National Heart, Lung, and Blood Diseases Institute (NCT02873715), will test the effectiveness of co-locating a trained behavioral interventionist within primary care pediatric offices for child and parent weight loss, in addition to non-participating sibling weight loss to assess generalization of treatment response. The behavioral skills taught within the context of FBT also have the advantage of being adaptable to other health behavior problems seen by family practitioners (e.g., sleep schedule difficulties, depression) since similar targets and/or behavioral techniques can be applied across disorders or concerns providing further justification for the integration of behavioral therapists and psychologists into medical practices.

## Summary and Conclusions

Obesity is a significant public health problem affecting all ages that is associated with serious physical and psychological comorbidities that cause serious distress and impairment. Behavioral interventions have long played a role in the treatment of obesity and are effective for individuals across the lifespan at reducing weight and disease, particularly when employed at younger ages for prevention of adult obesity. New research in the psychological and cognitive sciences is currently being developed to inform and enhance current treatment interventions. As integrated care for complex behavioral health problems such as obesity becomes more common and a greater effort is made to scale interventions and tailor them to individual needs, psychologists with training in the development, testing, and implementation of behavioral therapies for obesity have an important role to play in the treatment of this disease.

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## Biographies