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Behavioral treatment of obesity

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The Diabetes Prevention Program recently provided compelling evidence of the health benefits of modest weight loss [1]. This 4-year study examined more than 3200 overweight or obese individuals with impaired glucose tolerance. It found that a lifestyle intervention, designed to induce a 7% reduction in initial weight and to increase physical activity to 150 minutes a week, reduced the risk of developing type 2 diabetes by 58% compared with placebo. The intervention also was more effective than metformin, a medication for type 2 diabetes. Results of a similar study from Finland yielded the same findings. Individuals who lost 4.3 kg with diet and exercise reduced their risk of developing type 2 diabetes by 58% compared with a control group [2]. These two studies leave little doubt that small weight losses can have big health benefits [3].

This article describes the behavioral treatment of obesity, its short- and long-term results, and methods to improve long-term weight loss. The terms "behavioral treatment," "lifestyle modification," and "behavioral weight control" are often used interchangeably [4]; however, they all encompass three principal components: (1) diet, (2) physical activity, and (3) behavior therapy. This latter term, as applied to weight control, refers to a set of principles and techniques used to help patients adopt new habits.

Principles and characteristics of behavioral treatment

Behavioral treatment for obesity seeks to identify and modify eating, activity, and thinking habits that contribute to a patient's weight problem.

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This approach recognizes that body weight is affected by factors other than behavior. These factors include genetic, metabolic, and hormonal influences [5–8] that likely predispose some persons to obesity and may set the range of possible weights that an individual can achieve. Behavioral treatment helps obese individuals develop a set of skills (eg, a low-fat diet, a high-activity lifestyle, realistic expectations) to regulate weight at the lower end of this range, even though patients may remain overweight after treatment [9].

Principles

The principle of classical conditioning plays a central role in behavioral treatment. It holds that stimuli that are repeatedly presented before or simultaneously with a given behavior will become associated with that behavior [10,11]. For example, eating is often associated with watching television or socializing with friends. The more often two events are paired, the stronger the association between them, so that eventually the presence of one automatically triggers the other. For example, after repeatedly eating ice cream while watching television, simply turning on the set may trigger a craving for ice cream. Behavioral treatment attempts to identify and extinguish cues (ie, antecedent events) that trigger overeating (or inactivity). Although eating can be triggered by a single cue, more typically, several events, linked together, lead to overeating, as illustrated in the behavior chain in Fig. 1 [12].

Behavioral treatment also examines the consequences (ie, reinforcement value) of eating and physical activity [11,13]. Behaviors, such as eating favorite foods, that are rewarded with pleasant consequences are likely to be repeated. Those that yield negative effects, such as exercising to exhaustion, are unlikely to be practiced regularly. An obese sedentary man, for example, who tries to run 5 miles a day, is likely to experience soreness and other discomfort that will lead him to abandon his activity program. If he had begun by walking 20 minutes a day, he might have felt more successful and thus motivated to continue exercising.

In the last 20 years, cognitive therapy also has been incorporated in the behavioral treatment of obesity [12]. The underlying assumption of cognitive therapy is that thoughts (ie, cognitions) directly affect feelings and behaviors [14]. Negative thoughts frequently are associated with negative outcomes, as in the case of a woman who overeats, tells herself she's "blown her diet," and then proceeds to eat triple the original amount because of feelings of disgust and despair. Cognitive therapy teaches patients to correct negative thoughts that occur when they do not meet their goals [15,16].

The examination of antecedent events, behaviors, and consequences (ie, the "ABC model") provides a functional analysis of behavior, a key tool of behavioral weight control [9,11]. Such analysis identifies events (eg, times, places, events, and people) that are associated with inappropriate eating and

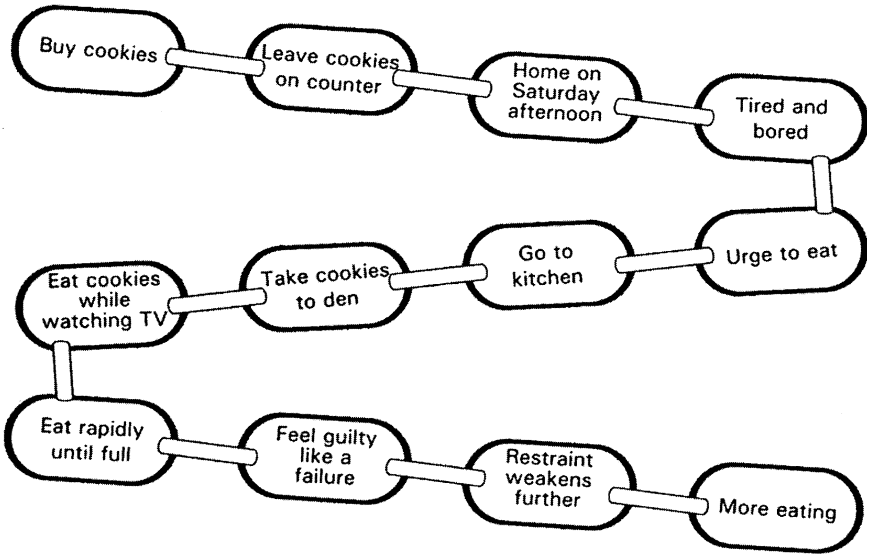

Fig 1. A behavior chain shows how one behavior, linked to another, can contribute to an overeating episode. What appears to be an unexpected dietary lapse can be traced to a series of small decisions and behaviors. The behavioral chain also reveals where the individual can intervene in the future to prevent unwanted eating. Thus, the individual might avoid bringing cookies into the house or at least store them out of sight to reduce impulse eating. (*From* Brownell KD. The LEARN program for weight management 2000. Dallas, TX: American Health Publishing; 2000; with permission.)

activity behaviors and the cognitive and emotional consequences of these behaviors. Furthermore, the analysis identifies opportunities for intervention, as described later.

Characteristics

Behavioral treatment has several distinguishing characteristics [17]. First, it is goal-oriented. It specifies clear goals in terms that can be easily measured. This characteristic is true whether the goal is walking 3 times per week, lengthening meal duration by 5 minutes, or decreasing the number of self-critical comments. Specific goals allow a clear assessment of progress.

Second, treatment is process-oriented [17]. It is more than helping people decide *what* they want to accomplish; it helps them identify *how* to do so. Patients are encouraged to identify the specific behavior they wish to adopt and when, where, and how (and with whom) they will practice it. In cases in which the behavior is not adopted, attention is devoted to finding new strategies or to removing barriers. This skill-building philosophy views weight management as a set of skills to be learned rather than as willpower to be enhanced [12].

Third, behavioral approaches advocate small rather than large changes [17]. This method is based on the learning principle of successive approximation in which incremental steps are taken to achieve more distant goals. Making small changes gives patients successful experiences upon which to build, rather than attempting drastic changes, which are typically short-lived.

Components and structure of behavioral treatment

The behavioral treatment of obesity has evolved into a "package" that includes several components, such as self-monitoring, nutrition education, stimulus control, slowing eating, physical activity, problem solving, and relapse prevention [9]. This approach has been summarized in several manuals, including the *LEARN Program for Weight Management 2000* [12]. Given the availability of such manuals, and reviews of the literature [9,11,13], this article reviews only four components of behavioral treatment: (1) self-monitoring, (2) stimulus control, (3) exercise, and (4) cognitive restructuring.

Self-monitoring

Self-monitoring is the cornerstone of behavioral treatment [11,12]. Patients keep detailed records of their food intake, physical activity, and weight throughout treatment. In the initial weeks, they record daily the types, amounts, and caloric value of foods eaten. Armed with this information, they try to reduce hidden sources of fat and sugar from their diet and thus decrease energy intake by approximately 500 to 1000 kcal/day. Record-keeping is increased over time to include information about times, places, and feelings associated with eating. Self-monitoring records often reveal patterns of which patients were previously unaware, such as consuming 500 kcal/day from sodas or fruit juices. The records also yield targets for intervention, as suggested by the behavior chain in Fig. 1 [12]. Record-keeping decreases, but does not eliminate, obese individuals' tendency to underestimate their food intake (by ~40%–50%/d) [18,19].

Several studies have shown that recording food intake correlates with long-term weight loss [20–22]. It may be a particularly effective strategy during periods of heightened risk for weight gain [23,24]. In addition, recording food intake contributes favorably to treatment with weight loss medications [25,26]. Among obese adolescents treated with sibutramine, for example, those who completed the most food records had the greatest decrease in body mass index (BMI) during the first 6 months of treatment [27].

Stimulus control

Stimulus control techniques teach patients to control cues associated with inappropriate eating [10–12]. Chief among these techniques are avoiding

high-risk venues, such as fast-food restaurants, all-you-can-eat buffets, convenience stores, and certain aisles of the grocery store. Reducing exposure to problem foods is likely to reduce their consumption. Shopping from a list also aids this effort. At home, patients are taught to store foods out of sight, to serve modest portion sizes, to keep serving dishes off the table, and to clean plates immediately after eating (to decrease nibbling on leftovers) [12]. These interventions capitalize on the premise of "out of sight, out of mind, out of mouth." Despite their common-sense appeal, there have been no specific studies of stimulus control techniques. They only have been tested as part of the larger behavioral package.

Positive cues are used to increase physical activity. These cues might include placing a treadmill in a frequently used room (eg, the bedroom rather than the basement), leaving walking shoes at the front door, or keeping an activity calendar on the refrigerator [12]. Two studies showed that the use of large colorful signs in public areas increased the use of stairs in lieu of escalators [28,29].

Physical activity

The addition of 30 to 60 minutes of physical activity, 3 times a week, to a behavioral weight loss program increases weight loss by an average of 2 kg, a modest amount considering the effort involved [30,31]. This finding is not unexpected, given that approximately 70 miles of walking is required to burn 1 kg of fat. Physical activity, however, contributes significantly to the maintenance of weight loss, as described later. It also confers important health benefits that include reducing lipid levels, blood pressure, and the risks of developing coronary heart disease, certain types of cancer, and osteoporosis [32]. In patients with type 2 diabetes, exercise also improves insulin sensitivity, abdominal adiposity, and glycemic control [33]. Increased physical activity may decrease the risk of cardiovascular morbidity and mortality, even in the absence of achieving normal body weight. Lee et al [34] found, in a longitudinal study of 25,000 men, that those who were fit but obese had lower rates of death from cardiovascular disease than those who were lean but unfit. Collectively, these findings indicate that obese individuals should increase their physical activity to improve their health, regardless of its impact on their weight [32].

Cognitive restructuring

Cognitive restructuring teaches patients to identify, challenge, and correct the irrational thoughts that frequently undermine weight control efforts [11,12]. Thoughts typically fall into one of three categories: (1) the impossibility of successful weight control (in view of previous failures), (2) unrealistic eating and weight loss goals, and (3) self-criticism in response to overeating or gaining weight [9,12]. Patients identify their negative thoughts through self-monitoring and role-play their rational responses to them [12].

A common cognitive distortion involves catastrophizing, as shown by the statement, "I've blown my diet so I might as well eat whatever I want."

Cooper et al [35] and Cooper and Fairburn [36] have proposed the use of cognitive therapy to help patients accept (and value) the modest weight losses they are able to achieve. Most obese individuals lose only about one third of the weight they would like to lose, which may lead to disappointment and abandonment of continued weight loss efforts [16,26,37]. Acceptance of modest weight losses could be facilitated by improving patients' satisfaction with their body image. Several studies found that cognitive therapy improved body image in obese individuals in the absence of weight loss [38–40]. Cooper and Fairburn are currently evaluating their intervention to facilitate the maintenance of weight *lost* (rather than weight *loss*). In addition, cognitive therapy is effective in the treatments of depression, bulimia nervosa, and other psychiatric conditions [41–44]. There have been no specific studies of its efficacy with obesity, however.

Structure of treatment

Patients typically attend treatment weekly for an initial period of 16 to 26 weeks [9,13]. This time-limited approach provides a clear starting and finishing line that helps people pace their efforts. In university clinics, therapy is usually provided to groups of 10 to 20 individuals (during 60- to 90-minute sessions) by registered dietitians, behavioral psychologists, or related health professionals. Group sessions provide a combination of social support and friendly competition [9]. The weekly weigh-in seems to be a major motivator for participants, who compare weight losses (either formally or informally) with each other. A well-controlled study found that group treatment induced a larger initial weight loss (ie, ~2 kg) than did individual treatment [45]. This finding was true even in patients who indicated they preferred individual treatment but were randomly assigned to receive group care. They lost more weight than persons who preferred individual treatment and received it. Group treatment also is more cost-effective.

Treatment visits are usually conducted following a structured curriculum, as provided by the LEARN program [12] or the protocol for the Diabetes Prevention Program [1]. The practitioner typically reviews patients' completion of their food and activity records, helps them identify strategies to cope with problems identified, and then introduces a new topic for the week. Lecturing is held to a minimum in favor of participants asking questions or discussing their progress in completing assignments. Visits conclude with discussion of homework for the coming week. Sessions occasionally provide patient support in coping with life stressors or discussing experiences related to being obese (eg, prejudice, discrimination, or shame) [9]. Adherence to the prescribed eating and activity regimen,

however, as reflected by patients' completion of daily monitoring records, is the strongest predictor of weight loss [20].

Short-term results of behavioral treatment

Table 1 summarizes the results of behavioral treatment from 1974 to 2002, as determined from randomized controlled trials published in four journals: *Addictive Behaviors*, *Behavior Research and Therapy*, *Behavior Therapy*, and *Journal of Consulting and Clinical Psychology*. Only studies representative of standard behavioral treatment are included in the table. No interventions prescribed a diet providing fewer than 900 kcal/day.

The data indicate that patients currently treated by a comprehensive group behavioral approach lose approximately 10.7 kg (~10% of initial weight) in 30 weeks of treatment. In addition, approximately 80% of patients who begin treatment complete it. Thus, behavior therapy yields favorable results as judged by the new criteria for success (ie, a 5%–10% reduction in initial weight) proposed by the National Institutes of Health (NIH) National Heart, Lung, and Blood Institute [31], the World Health Organization [46], and the Dietary Guidelines for Americans [47].

A comparison of early (ie, 1974) and more recent (1996–2002) studies reveals that weight losses have more than doubled over the past 25 years as treatment duration has increased threefold. Thus, for example, in 1974, treatment of 8.4 weeks was associated with a mean loss of 3.8 kg, whereas treatment from 1996 to 2002 averaged 31.6 weeks and produced a mean loss of 10.7 kg. Although several new components, including cognitive restructuring, have been added to the behavioral approach since 1974, the most parsimonious explanation for the larger weight losses is the longer

Table 1
Summary of behavior therapy for obesity

Characteristics	1974	1985–1987	1991–1995	1996–2002[a]
No. of studies	15	13	5	9
Sample size	53.1	71.6	30.2	28.0
Initial weight, kg	73.4	87.2	94.9	92.2
Length of treatment, wk	8.4	15.6	22.2	31.4
Weight loss, kg	3.8	8.4	8.5	10.7
Loss per week, kg	0.5	0.5	0.4	0.4
Attrition, %	11.4	13.8	18.5	21.2
Length of follow-up, wk	15.1	48.3	47.7	41.8
Loss at follow-up, kg	4.0	5.3	5.9	7.2

All values, except for number of studies, are weighted means; thus, studies with larger sample sizes had a greater impact on mean values than did studies with smaller sample sizes.

Data adapted and updated from Browell KD, Wadden TA. The heterogeneity of obesity: fitting treatments to individuals. Behav Ther 1991;22:153–77.

[a] Studies included in 1996–2002 sample are found in Refs. [88,101–108].

duration of treatment. The rate of weight loss has remained constant at about 0.4 to 0.5 kg per week.

Very-low-calorie diets

Investigators have experimented with different dietary interventions to increase initial weight losses with behavioral treatment. Some of the earliest efforts examined the use of very-low-calorie diets (VLCDs), which are reserved for patients with a BMI of 30 kg/m^2 or greater. These diets provide 400 to 800 kcal/day and large amounts of dietary protein, approximately 70 to 100 g/day, to preserve lean body mass [48]. The diets are safe when provided to appropriately selected patients under careful medical supervision [49,50]; however, they are associated with an increased risk of gallstones. VLCDs induce reductions of approximately 15% to 20% of initial weight in 12 to 16 weeks of treatment—losses nearly double the size of those produced by a conventional low-calorie diet in a comparable period. All but one [51] of seven [51–57] randomized trials that compared the two diets found no differences in weight losses between the two approaches 1 year after treatment, however, because VLCD-treated patients regained 35% to 50% of their lost weight during this time.

Meal replacements

VLCDs largely have been replaced by diets of 1000 to 1200 kcal/day that combine two servings or more a day of a liquid diet with a meal of conventional foods. Ditschuneit et al [58] found that patients who replaced two meals and two snacks a day with a liquid supplement (eg, SlimFast) lost 8% of initial weight during 3 months of treatment, compared with a loss of only 1.5% for patients who were prescribed the same number of calories (ie, 1200–1500 kcal) but consumed a self-selected diet of conventional foods. Patients who continued to replace one meal and one snack a day with liquid-diet products maintained a loss of 11% at 27 months and 8% at 51 months [59]. A meta-analysis by Heymsfield et al [60] recently confirmed the superiority of meal replacements to isocaloric diets composed of conventional foods. Meal replacements provide patients a fixed amount of food with a known caloric content. They also simplify food choices, require little preparation, and allow dieters to avoid contact with problem foods. These factors seem to facilitate patients' adherence to their targeted calorie goals [50].

Portion-controlled servings

Jeffery et al [61] have shown that portion-controlled servings of conventional foods also improve the induction of weight loss. Patients, for example, who were prescribed a diet of 1000 kcal/day and provided the actual foods for five breakfasts and five dinners a week lost significantly

more weight than participants who were prescribed the same number of calories but consumed a diet of self-selected table foods. A second study compared weight loss among groups that received standard behavioral treatment plus the following: (1) no additional structure, (2) structured meal plans and grocery lists, (3) meal plans with food provided at reduced cost, or (4) meal plans with free food provision [62]. Although the calorie goals were equivalent across groups, participants in groups 2, 3, and 4 lost significantly more weight after 6 months of treatment and maintained greater losses at an 18-month follow-up period than did those in group 1. There were no differences in weight loss among groups 2, 3, or 4. This finding indicates that specifying the foods (and amounts) patients should eat improves weight loss significantly. Providing the food has no additional benefit.

High-protein, low-carbohydrate diets

High-protein, low-carbohydrate diets, as recommended by Atkins [63], also seem to facilitate dietary adherence and weight loss. Such diets simplify food choices by eliminating an entire class of macronutrients (ie, carbohydrates). In addition, the high protein intake may increase feelings of fullness (ie, satiety) [64]. A recent study of severely obese patients, many of whom had diabetes or the metabolic syndrome, found that participants randomly assigned to consume a low-carbohydrate diet for 6 months, compared with those assigned to a low-fat diet, lost more weight (5.8 kg versus 1.9 kg, respectively) and had greater improvements in triglyceride levels and insulin sensitivity [65], A second study similarly found significantly greater weight losses for a low-carbohydrate diet at 6 months (6.9 kg versus 3.2 kg, respectively), but differences between groups were not significant at 1 year (4.3 kg versus 2.5 kg, respectively), because of weight regain with both diets [64]. Additional studies are needed of long-term ($\geq$2 years) changes in both weight and health outcomes to determine the ultimate benefit of high-protein, low carbohydrate diets [64].

Long-term results of behavioral treatment

Weight regain is a problem following virtually all dietary and behavioral interventions. As shown in Table 1, patients treated by behavior therapy for 20 to 30 weeks typically regain about 30% to 35% of their lost weight in the year following treatment. Weight regain slows after the first year but by 5 years, 50% or more of patients are likely to have returned to their baseline weight.

Obesity is increasingly recognized as a chronic disorder that requires long-term care [31]. When considered from this perspective, the long-term results of obesity treatment are not entirely surprising. Few practitioners, for example, would expect 30 weeks of antihypertensive medication to provide adequate control of blood pressure for 1 year, or even 1 month,

after medication was terminated [66]. The same holds true of the treatment of type 2 diabetes. In both cases, continuous long-term care is needed [67]. When long-term treatment—in the form of behavior therapy—is similarly applied to obesity, the maintenance of weight loss improves significantly. There are several methods of providing continued care, including on-site treatment, telephone, and Internet and e-mail.

Long-term on-site treatment

Several studies have demonstrated the benefits of patients continuing to attend weight maintenance classes after completing an initial 16- to 26-week weight loss program [61,68,69]. Perri et al [68], for example, found that individuals who attended every-other-week group maintenance sessions for the year following weight reduction maintained 13.0 kg of their 13.2-kg end-of-treatment weight loss, whereas those who did not receive such therapy maintained only 5.7 kg of a 10.8-kg loss. Maintenance sessions seem to provide patients the support and motivation needed to continue to practice weight control skills, such as keeping food records and exercising regularly [68]. In reviewing 13 studies on this topic, Perri and Corsica [69] found that patients who received long-term treatment, which averaged 41 sessions over 54 weeks, maintained 10.3 kg of their initial 10.7-kg weight loss [69]. Fig. 2 illustrates the difference in weight loss produced by standard and long-term treatment, as determined from three randomized trials in which all participants received behavioral weight control for the first 20 weeks. Thereafter, half the patients continued to have every-other-week treatment for 1 year, whereas the other half received no further care.

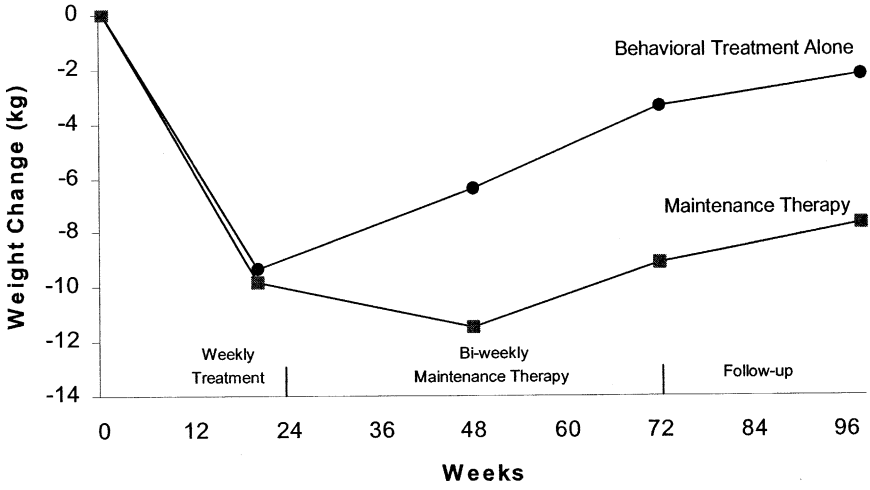

Fig 2. Long-term results of standard behavioral treatment, with or without biweekly maintenance therapy. (*Data from* Refs. [68,107,109]. Note: Data for week 98 [not shown] are available for [109] and [68] studies only.)

Limitations of long-term treatment

Fig. 2 shows a clear limitation of long-term behavioral treatment—it seems only to delay rather than to prevent weight regain. Patients maintain their full end-of-treatment weight loss as long as they participate in biweekly maintenance sessions. Furthermore, they lose additional weight during the first 6 months of extended treatment but regain the additional loss during the second 6 months of therapy. Weight gain continues with the termination of maintenance therapy. The optimal frequency of maintenance therapy is not known. Patients eventually tire of attending sessions twice monthly (and 50% drop out), but monthly visits do not seem to be sufficient to maintain end-of-treatment weight loss [61].

Behavioral maintenance therapy is generally successful in sustaining losses of 10% to 12% of initial weight but not reductions of 20% or more, as shown in Fig. 3. Both groups of patients in this study attended weekly group behavioral treatment for the first 52 weeks and had biweekly visits from weeks 52 to 78. Those who consumed a 1200 kcal/day balanced deficit diet lost approximately 12% of initial weight, which they maintained at week 78. By contrast, those who lost 20% of initial weight, by consuming a VLCD for the first 4 months, regained 50% of their lost weight by week 78, even while attending the weekly and biweekly maintenance sessions. These findings indicate that most obese individuals should aim for an initial loss of 10% to 15% of initial weight [31,70]. Larger losses are difficult to

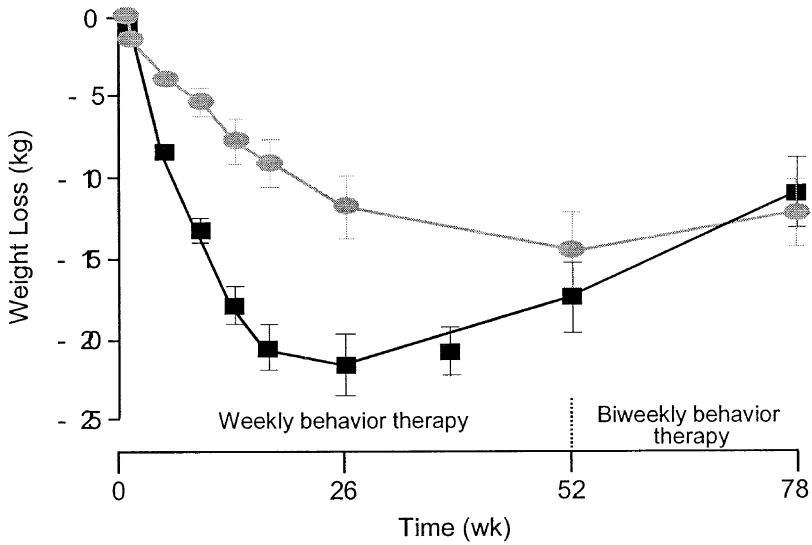

Fig 3. Long-term weight loss with a VLCD versus a 1200 kcal/day diet. (*From* Wadden TA, Foster GD, Letizia KA. One-year behavioral treatment of obesity: comparison of moderate and severe caloric restrictions and the effects of weight maintenance therapy. J Consult Clin Psychol 1994;62:165-71; with permission.)

maintain, in part, because of compensatory biologic responses to weight reduction (eg, decreases in leptin and resting energy expenditure, increases in ghrelin) [71].

Telephone and mail contact

Long-term contact also may be provided by telephone or mail. Perri et al [72] demonstrated that therapist contact by either of these modalities significantly improved weight maintenance, compared with no further intervention. When scheduling telephone calls, the same therapist optimally should contact the patient on each occasion. A study in which patients were contacted by staff members unknown to them failed to produce weight maintenance results superior to those of a no-contact group [22].

Internet and e-mail

More recently, investigators have explored Internet and e-mail as methods to provide behavioral treatment, both short- and long-term. In an initial study, Tate et al [73] assigned participants to one of two 6-month weight loss programs delivered over the Internet. The education intervention provided a directory of Internet resources for weight control. The behavior therapy intervention provided this component, and 24 weekly lessons conducted by e-mail, weekly submission of self-monitoring diaries, and an on-line bulletin board. The behavior therapy participants lost significantly more weight at 6 months (4.1 kg versus 1.6 kg, respectively). In a 1-year study, Tate et al [74] randomly assigned individuals at risk for type 2 diabetes to an Internet weight loss program or to the same intervention with the addition of weekly behavioral counseling, delivered by e-mail. Participants in the latter group lost significantly more weight at 1 year (4.4 kg versus 2.0 kg, respectively). These studies, taken together, underscore the importance of participants' keeping records of their food intake and physical activity and completing other behavioral assignments. Educational instruction alone is not sufficient to induce clinically significant weight loss. The studies also suggest that even the most effective Internet interventions are likely to produce only half the weight loss of traditional on-site behavioral programs.

Two additional studies examined the use of the Internet to facilitate weight maintenance following patients' participation in a traditional group behavioral program. Harvey-Berino et al [75] randomly assigned patients to one of three 22-week maintenance programs: (1) an on-site therapist-led program, (2) an Internet therapist-led program, or (3) a control condition. Weight loss at the end of the initial 15-week behavioral program averaged 6.5 kg. Most participants continued to lose weight during the maintenance programs so that total weight loss at the end of maintenance averaged 8.0 kg. There were no significant differences among the three maintenance groups in total weight loss. Participants in the on-site program, however,

were more satisfied with their treatment and attended more sessions than those in the Internet program. In a second study from this team [76], participants received one of three maintenance interventions: (1) on-site biweekly sessions for 12 months; (2) on-site monthly sessions for the first 6 months only; or (3) 12 months of biweekly Internet video and chat sessions, combined with e-mails from a group therapist, on-line submission of self-monitoring forms, and an e-mail discussion group. Weight loss at the end of the initial 6-month behavioral program averaged 9.5 kg. At 1-year follow-up, participants in the frequent and minimal on-site treatment conditions had significantly greater total weight loss than patients in the Internet condition (10.4 kg, 10.4 kg, and 5.7 kg, respectively). Participants in the Internet condition attended fewer (virtual) sessions and were less satisfied with their program than patients in the on-site condition who had biweekly visits.

Internet-delivered interventions, for both the induction and maintenance of weight loss, currently are not as effective as traditional interventions provided on site. Nonetheless, Internet-based programs do induce clinically significant weight losses and potentially could be provided to the millions of overweight and obese Americans who do not have access to behavioral weight control, as delivered at academic medical centers. Further research is likely to improve on these initial promising findings.

National Weight Control Registry

Long-term behavioral treatment, whatever form it takes, encourages patients to practice four key behaviors: (1) exercise regularly, (2) consume a low-calorie diet, (3) monitor weight regularly, and (4) record food intake and physical activity. The importance of these behaviors is underscored by findings from the National Weight Control Registry (NWCR). The NWCR, directed by Wing, Hill, and colleagues [77,78], identifies individuals nationwide who have lost a minimum of 13.6 kg (30 lbs) and maintained the loss for at least 1 year. It consists of more than 2900 members who have lost an average of 32.4 kg and maintained the loss for 5.5 years. These losses clearly are not representative of obese individuals in the general population who diet. Moreover, investigators have not identified the specific factors that contribute to NWCR members' success after numerous previous failures to control their weight. The NWCR, however, provides valuable descriptive information about the behaviors practiced by individuals who successfully maintain their weight loss. As shown in Table 2, NWCR members consume a low-calorie, low-fat diet. Women report eating only 1296 kcal/day and men 1724 kcal/day. They also engage in high levels of physical activity, expending approximately 2825 kcal/week, the equivalent of walking about 28 miles weekly. Registry members also weigh themselves regularly: 44% do so at least once a day, and an additional 33% do so at least once a week.

Table 2
Eating habits of National Weight Control Registry members

Characteristics	Women (n = 629)	Men (n = 155)
Maximum weight, kg	94.6	121.0
Maximum BMI, kg/m^2	34.6	37.2
Current weight, kg	66.0	85.6
Current BMI, kg/m^2	24.1	26.4
Energy intake, kcal/d	1296	1724
Energy from fat, %	24	23
Energy from protein, %	19	18
Energy from carbohydrates, %	55	56
No. of meals or snacks/d	5.0	4.5
No. of meals at fast-food restaurants/wk	0.7	0.8
No. of meals at non–fast-food restaurants/wk	2.4	2.9

Data adapted from Klem ML, Wing RR, McGuire MT, et al. A descriptive study of individuals successful at long-term maintenance of substantial weight loss. Am J Clin Nutr 1997;66:239–46; with permission.

High levels of physical activity

Numerous studies support the NWCR's finding that increased physical activity is critical to the maintenance of weight loss [79–83]. As shown in Fig. 4, Jakicic et al [82] observed both larger weight losses and superior maintenance of weight loss in patients who exercised 200 minutes/week or more. Another study found that expenditure of more than 2000 kcal/week was associated with excellent weight maintenance in the year following initial weight loss. Patients who exercised only 1000 kcal/week regained weight [83].

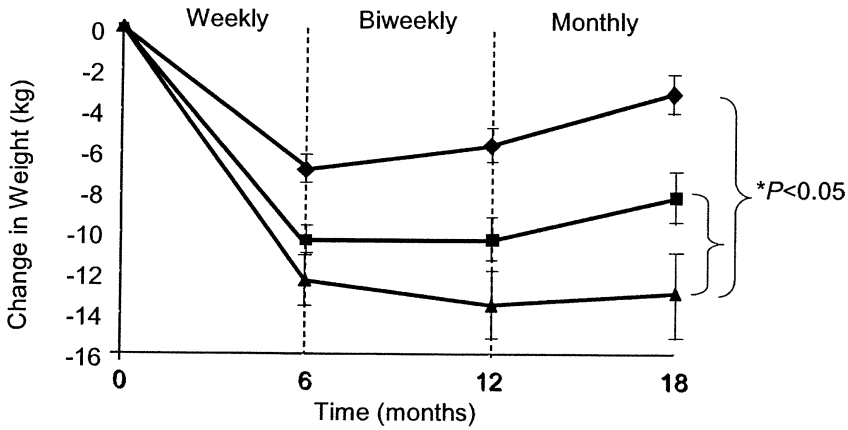

Fig 4. Dose response of exercise on weight loss over 18 months of treatment. (*From* Jakicic JM, Winters C, Lang W, et al. Effects of intermittent exercise and use of home exercise equipment on adherence, weight loss, and fitness in overweight women: a randomized trial. JAMA 1999;16:1554-60; with permission.)

Programmed versus lifestyle activity

Patients can increase their energy expenditure in two ways—by means of programmed or lifestyle activity [84,85]. Programmed activity (eg, walking, biking, or swimming) is typically planned and completed in a discrete period of time (eg, 30–60 min) at a relatively high intensity level (ie, 60%–80% of maximum heart rate). Lifestyle activity, by contrast, involves increasing energy expenditure while completing everyday tasks. Patients may, for example, increase their lifestyle activity by parking farther away from building entrances, taking stairs rather than escalators, or even by discarding the remote control to the television [84]. Andersen et al [86] compared the effects of programmed and lifestyle activity in obese women. They found that both types of activity, when combined with a 1200 kcal/day diet, produced a loss of approximately 8 kg in 16 weeks. There was a trend ($P = 0.06$) for lifestyle activity to be associated with less weight regain than was programmed exercise 1 year after treatment (0.1 kg versus 1.6 kg, respectively). Results of this study await replication in a larger sample that includes men. Initial findings, however, suggest that lifestyle activity is an ideal alternative for patients who report they "hate to exercise."

Long- versus short-bout activity

Jakicic et al [82,87] have investigated the effects of prescribing exercise in multiple short bouts, as compared with a single long bout. In a first study, all patients were instructed to exercise for 40 minutes per day. Those who were encouraged to complete their activity in multiple 10-minute bouts exercised on more days over 20 weeks than did patients who were encouraged to exercise in a single bout (87.3 and 69.1 days, respectively) [87]. There was a trend ($P = 0.07$) toward greater weight loss in participants who exercised in multiple short bouts (8.9 kg versus 6.4 kg, respectively). The superiority of short bouts of exercise was not replicated in an 18-month follow-up study [82]. Nonetheless, the finding that multiple short bouts of activity are as effective as one long bout should facilitate patients' efforts to increase their activity. They don't need to set aside a 30- to 60-minute block of time in which to "exercise." Several brief walks during the day are equally beneficial.

Other interventions

Researchers also have studied whether increasing the structure of physical activity [88,89] or providing incentives [89] is associated with better adherence and greater weight loss. Perri et al [88] randomized obese participants to receive 12 months of behavioral weight control that included on-site supervised exercise or a comparable program of home-based activity. They found during the first 6 months that the two groups exercised approximately the same number of minutes per week (107–120 min) and lost

comparable amounts of weight (10.6–10.9 kg). At 15 months, however, those who exercised at home engaged in more minutes of activity and had significantly greater weight losses than persons who exercised on site (11.9 kg and 9.2 kg, respectively). Wing et al [89] found that providing participants with a "personal trainer" (who met participants at home or work and led them on a walk), in addition to having three on-site supervised activity sessions per week, did not improve weight loss over the on-site activity sessions alone. In a second study in the same article, Wing et al [89] provided 24 weeks of lifestyle modification and three supervised exercise sessions weekly. In addition, patients were randomized to receive either no incentives or to be eligible for a lottery drawing that rewarded more frequent attendance at exercise sessions. The two groups did not differ with respect to weight loss or physical activity at the end of the 24-week period.

Contrary to findings that structured diets (eg, meal replacements) increase weight loss, increasing the structure of physical activity does not appear to improve short- or long-term results. Furthermore, less-structured exercise plans (eg, lifestyle versus programmed activity and home-based versus on-site exercise) seem to be more conducive to long-term success [86,88,89]. With less structure comes a reduction in exercise-related demands and barriers, such as travel time, health club dues, or embarrassment about weight or shape. The failure of structure and incentives to improve exercise adherence suggests that internal motivation and intrinsic reinforcement also may be critical to increasing physical activity [90]. Further research is needed on this topic.

A low-fat, low-energy–dense diet

As discussed previously, participants in the NWCR reported that they consumed a low-fat, high-carbohydrate diet. Additional studies suggest that such diets may facilitate long-term weight control. For instance, in a 1-year weight maintenance program, participants randomly assigned to follow a low-fat, ad libitum-carbohydrate diet, following initial weight loss, regained significantly less weight during the year than persons instructed to consume a low-calorie diet alone (regain of 0.3 kg versus 4.1 kg, respectively) [91]. Two years after initial weight loss, participants assigned to the low-fat, ad libitum-carbohydrate diet continued to show superior weight maintenance. Two other studies, however, failed to find a long-term advantage of this approach [92,93].

Researchers also are investigating diets that are not only low in fat but also in energy density. The rationale for low-energy-dense diets is that people eat a constant volume or weight of food [94]. Consumption of low-fat foods is an important, but not sole, component of low-energy-dense eating. Foods that have a high water or fiber content, such as fruits, vegetables, and whole grains, also are an important component of the diet.

Diets low in fat result in less weight loss over a period of 6 months than diets that are both low in fat and high in fiber [94]. Further research is needed to determine if low-energy-dense diets facilitate the maintenance of lost weight.

Looking ahead

This article has shown that behavioral treatment clearly is effective in inducing a loss of 8% to 10% of initial weight and that losses of this size are associated with significant improvements in health, as shown by the Diabetes Prevention Program [1]. The NIH currently is conducting a follow-up investigation to determine whether a weight loss of 7% or more of initial weight, combined with increased physical activity, will decrease morbidity and mortality in overweight individuals who already have developed type 2 diabetes. The Look AHEAD (Action for Health in Diabetes) study will enroll 5000 participants at 16 sites nationwide and evaluate patients for up to 12 years. The results will provide the most definitive assessment to date of the health consequences of intentional weight loss.

Translational research

In addition to its successes, the behavioral treatment of obesity faces several challenges at present. First, among these is making treatment more available to the millions of Americans who need to lose weight. Most of what investigators know about the treatment of obesity comes from randomized controlled trials that are conducted at academic medical centers. These studies may well include persons who are not representative of the general population. Study volunteers are probably more motivated to lose weight, as indicated by their willingness to participate in clinical research trials. In addition, most studies have assessed principally white individuals, which is troubling given that African Americans and Hispanic Americans have substantially higher rates of obesity [95]. Thus, a key challenge for behavioral treatment is to find effective methods of translating findings from randomized clinical trials into primary care and community practice [96,97]. Primary care practitioners could play a major role in the management of obesity if provided additional training and, equally important, appropriate reimbursement for treating this disorder.

Tackling the toxic environment

Far greater resources and efforts also must be devoted to the prevention of obesity if we are to halt the progression of this epidemic, let alone reverse it. The best hope for prevention may lie with children and adolescents. Efforts should be devoted to improving meals and snacks served at schools, to providing more opportunities for physical activity at school and at home, and to educating youth about the importance of diet, activity, and a healthy body

weight. Ultimately, we must tackle what Brownell and colleagues has referred to as a "toxic environment" that explicitly encourages the consumption of super-sized servings of high-fat, high-sugar foods, while implicitly discouraging physical activity, as a result of sedentary work and leisure habits [98,99]. Changing this environment will require public policy initiatives, as were needed, for example, to reduce cigarette smoking and to increase seat belt use [100]. Although behavioral treatment can assist those who already are obese, there is a pressing need for wide-scale environmental interventions that will reduce the number of individuals who require such treatment.

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