

## Review Article

# State of the science: behavioural treatment of obesity

LaShanda R Jones PhD and Thomas A Wadden PhD

*University of Pennsylvania School of Medicine, Department of Psychiatry*

---

Obesity is a global and preventable epidemic with serious health consequences for individuals worldwide, particularly for those in developed countries. The World Health Organization estimates that at least 1 billion people worldwide are overweight, and 300 million are obese. Research has demonstrated that weight losses as small as 7-10% of initial weight produce significant health benefits. These include reducing the risk of heart disease, stroke, and some cancers. This paper describes behavioural methods to modify maladaptive eating and activity habits to achieve a healthy weight. It also examines the short- and long-term results of behavioural treatment for obesity and methods to improve long-term weight control.

**Key Words:** behaviour therapy, obesity, lifestyle intervention, weight-loss, physical activity

---

### Introduction

This article describes the behavioural treatment of obesity, including its short- and long-term results and approaches to improve long-term weight loss. The terms “behavioural treatment,” “lifestyle modification,” and “behavioural weight control” are used interchangeably.<sup>1</sup> They all encompass three principal components: diet, physical activity, and behaviour therapy. The latter term, as applied to weight control, refers to a set of principles and techniques used to help patients adopt new diet and exercise habits that can be sustained long-term to promote health.

### Principles and characteristics of behavioural treatment

Behavioural treatment, as applied to obesity, seeks to identify and improve eating, activity, and thinking habits that contribute to a patient’s weight problem. This comprehensive approach recognizes that body weight is affected by factors other than behaviour. These include genetic, metabolic, and hormonal influences<sup>2-7</sup> that likely predispose some persons to weight gain and may set the range of attainable weights that an individual can achieve. Behavioural treatment helps overweight individuals develop a set of skills (e.g. consuming a low-calorie diet and adopting a physically-active lifestyle) to regulate weight at the lower end of their weight range, even though patients may remain overweight after treatment.<sup>3</sup>

### Principles

The principle of classical conditioning is central to behavioural treatment. It asserts that stimuli repeatedly presented before or simultaneously with a given behaviour will subsequently become associated with that behaviour.<sup>8</sup> The more often two events are paired together, the stronger the association between them, so that eventually the presence of one automatically triggers the desire for the other. For instance, after repeatedly eating cookies while watching television, simply turning on the TV may trigger a craving

for cookies. The goal of behavioural treatment is to identify and extinguish cues (i.e., antecedent events) that trigger maladaptive behaviours such as overeating or physical inactivity. Although eating can be triggered by a single cue, typically several events linked together lead to overeating or inactivity, as illustrated in the behaviour chain in Figure 1.<sup>9</sup>

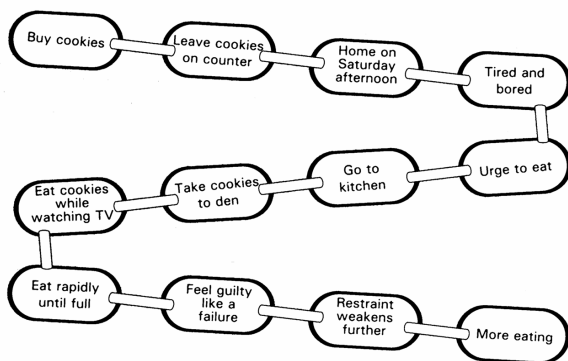
In addition to targeting eating and exercise behaviours themselves, behavioural treatment examines the antecedents and consequences of these behaviours.<sup>8,10</sup> Once antecedents of problem behaviours (e.g., overeating) are identified, steps are taken to control or modify those events. For example, thoughts and images are internal cues that can affect behaviours. Thus, a person who overeats at a party and then tells himself that he has blown his diet (antecedent) may proceed to eat triple the original amount (consequence) because of feelings of disgust and despair.<sup>9</sup> Cognitive therapy teaches a patient to correct negative thoughts so they do not lead to negative behaviours.<sup>11</sup>

Consequences are assessed to determine the function of behaviours. Behaviours, such as eating favourite foods, that are reinforcing (i.e. provide pleasant consequences), are likely to be repeated. Those that yield negative effects, such as exercising to exhaustion, are unlikely to be practiced regularly.

---

**Correspondence address:** Dr LaShanda Jones, University of Pennsylvania, 3535 Market Street, Suite 3124 (3<sup>rd</sup> floor), Philadelphia, PA 19104, USA  
Tel: + 215-746-7189; Fax: +215-898-2878  
Email: lashanda@mail.med.upenn.edu  
Accepted 30 June 2006





**Figure 1.** A behaviour chain. This figure presents an example of a behaviour chain, illustrating how one behaviour, linked to another, can contribute to an overeating episode. What appears to be an unexpected dietary lapse can be traced to a whole series of small decisions and behaviours. The behaviour 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. Reprinted with permission from reference 9.

For example, if a sedentary person begins a weight-management program by trying to run 4 miles a day, s/he is likely to experience soreness and other discomfort that may lead to abandonment of exercise all together. If the person had begun by walking 10 minutes per day, s/he might have experienced more positive consequences (i.e. less muscle soreness and a sense of accomplishment) and been motivated to continue exercising.

The examination of antecedent events, behaviours, and consequences (i.e. the ABC model) provides a practical functional analysis through which patients can evaluate their behaviour.<sup>3,8</sup> Patients can identify cues (i.e. times, places, events, and people) that are associated with inappropriate eating and physical inactivity, and the cognitive and emotional consequences of these behaviours. With practice, patients ultimately will be able to identify new behaviours to substitute for maladaptive ones.

### Characteristics

Behavioural treatment has three distinctive characteristics.<sup>12</sup> First, it is goal-oriented. Goals are specified in clear terms that can be easily measured. This is true whether the goal is increasing physical activity by 10 minutes per day, reducing calorie intake by 3500 kcal per week, or rehearsing at least one positive self-statement per day.

Second, treatment is process-oriented.<sup>12</sup> In addition to helping people decide what they want to accomplish, it helps them identify how to do so. Patients identify the specific behaviour they wish to adopt and then specify exactly when, where, how, and with whom they will practice the new behaviour. In cases in which adopting the new behaviour proves difficult, attention is devoted to examining new strategies or problem solving barriers to change. This skill-building philosophy views weight management as a set of skills to be learned rather than as willpower to be enhanced.

Third, behavioural treatment advocates small successive changes rather than large ones.<sup>12</sup> This is based on the learning principle of *shaping* in which incremental

steps are taken to achieve complex goals. Making small changes provides patients successful experiences on which to build, rather than attempting drastic changes, which are difficult to maintain.

### Components and structure of behavioural treatment

Nearly 40 years of research on the behavioural treatment of obesity have yielded a comprehensive approach that includes several components such as self-monitoring, stimulus control, problem solving, cognitive restructuring, and relapse prevention.<sup>13</sup> These techniques have been summarized in several manuals, including the LEARN Program for Weight Management.<sup>9</sup> Given the availability of such manuals and reviews of the literature,<sup>8,10,13</sup> this section will review only three components of behavioural treatment: self-monitoring, cognitive restructuring, and stimulus control.

#### Self-monitoring

Self-monitoring (i.e. recording one's behaviour) is perhaps the most important component of behavioural weight loss treatment.<sup>9,10</sup> Patients are taught to 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. Equipped with this information, patients then work to reduce hidden sources of fat and sugar from their diet and, thus, decrease their energy intake by approximately 500-1000 kcal/d. Self-monitoring records often reveal patterns of which patients were previously unaware, such as consuming 500 kcal/d (2100 kJ) from high-sugar sodas or juices. Record keeping is increased over time to include information about times, places, and feelings associated with eating. The records also yield targets for intervention, as suggested by the behaviour chain in Figure 1.<sup>9</sup> Patterns are examined to determine the precipitants of inappropriate eating and to plan interventions. Several studies have demonstrated that self-monitoring is associated with successful long-term weight control.<sup>14,15</sup> We note that record keeping decreases, but does not eliminate, patients' tendencies to underestimate their caloric intake (often by as much as 40% to 50% per day).<sup>16,17</sup>

#### Cognitive restructuring

Cognitive restructuring teaches patients to modify irrational thoughts that frequently undermine weight control efforts.<sup>8,9</sup> Thoughts typically fall into one of three categories: the impossibility of successful weight control (in view of previous failed attempts); unrealistic eating and weight loss goal; and self-criticism in response to overeating or gaining weight.<sup>9,13</sup> Patients are taught to identify their negative thoughts (through self-monitoring) and then challenge and correct them with more rational, reality-based thoughts.<sup>9</sup> A common cognitive distortion involves catastrophizing, as captured by the statement, "I've blown my diet so I might as well eat whatever I want." A more rational response would be, "I've over-eaten today, but only by about 400 kcals. If I stop now, I can easily make up the difference by cutting back over the next couple of days."

Several investigators have proposed the use of cognitive therapy to help patients feel more positive about

modest weight losses.<sup>18,19</sup> Most obese individuals lose only about one-third of the weight they would like, which may lead to disappointment and abandonment of continued weight loss efforts.<sup>20,21</sup> Acceptance of modest weight losses could be facilitated by helping patients focus on health-related rather than appearance-related aspects of weight loss. Additionally, acceptance of modest losses could be achieved by helping patients improve their body image and self-image. Several studies found that cognitive therapy improved body image in obese individuals in the absence of weight loss.<sup>22</sup> Cognitive therapy is also effective in the treatments of anorexia, bulimia nervosa, and other psychiatric conditions.<sup>23-26</sup> There have been few specific studies, however, of its efficacy with obesity.

### Stimulus control

Stimulus control techniques help patients manage cues associated with overeating or eating in the absence of hunger.<sup>8,9</sup> Patients are taught to control stimuli by 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. Other strategies such as not storing high-fat foods in the home, storing tempting items out of sight, serving modest portion sizes, keeping serving dishes off the table, and clearing plates immediately after eating (to decrease nibbling on leftovers) may help to reduce inappropriate eating.<sup>9</sup> All of these interventions support the importance of controlling the environment and overeating cues. They illustrate the belief 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. These techniques only have been tested as part of the larger behavioural package.

Stimulus control also can be used to increase physical activity. This might include placing a treadmill in a frequently used room (i.e., the bedroom rather than the basement), placing walking shoes at the front door, or keeping exercise clothes readily available in the car or office.<sup>9</sup> One study found that the use of large colorful signs in public areas increased the use of stairs in lieu of escalators, which is a convenient way to increase activity.<sup>27</sup>

### Structure of treatment

Behavioural treatment typically is provided weekly for an initial period of 16 to 26 weeks.<sup>10,13</sup> This time-limited approach provides a clear starting and finishing point that helps patients pace their efforts. In hospital- and university-based clinics, therapy often is provided to groups of 10 to 20 individuals (during 60- to 90-minute sessions) by registered dietitians, behavioural psychologists, or related health professionals. Group sessions provide a combination of social support and accountability. The weekly weigh-ins appear to motivate patients to monitor their progress and adhere to their dietary and physical activity goals. A well-controlled study found that group treatment induced a larger initial weight loss (approximately 2 kg) than did individual treatment.<sup>28</sup> This held true even for patients who indicated that they

preferred individual treatment but were randomly assigned to receive group care.<sup>28</sup> These individuals lost more weight than people who preferred individual treatment and received it. Group treatment also is more cost-effective than usual care.<sup>28</sup>

Treatment sessions are conducted using a structured curriculum, as provided by the LEARN program.<sup>9</sup> At each session, the practitioner reviews patients' completed food and activity records, helps them generate strategies to cope with problems identified, and introduces new behavioural strategies for weight loss. Lecturing is held to a minimum in favor of participants asking questions or discussing their progress in completing assignments. Visits conclude with discussion of behavioural assignments for the coming week.

### Short-terms results of behavioural treatment

Table 1 summarizes the results of behavioural treatment from 1974 to 2002, as determined from randomized controlled trials published in four journals: *Addictive Behaviours*, *Behaviour Research and Therapy*, *Behaviour Therapy*, and *Journal of Consulting and Clinical Psychology*. Only studies representative of standard behavioural treatment are included in the table.<sup>15,29-37</sup> All interventions prescribed a diet that provided at least 900 kcal/day (3780 kJ).

**Table 1.** Summary of behaviour therapy for obesity

	1974	1985-87	1991-1995	1996-2002*
Number 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 studies sampled were published in the following four journals: *Addictive Behaviours*, *Behaviour Therapy*, *Behaviour Research and Therapy*, and *Journal of Consulting and Clinical Psychology*. 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. The data are adapted and updated from reference 29. \*Studies included in 1996-2002 sample are found in references 15, 30-37

Examination of early (i.e 1974) and more recent (1996-2002) studies shows that weight losses have increased almost three fold over the past 30 years as treatment duration has increased by the same amount.<sup>15,29-37</sup> Studies between 1996 and 2002 show that patients treated with a comprehensive group behavioural approach lose approximately 10.7 kg (about 10% of initial weight) in 30 weeks of treatment. In addition, about 80% of patients who begin treatment complete it.<sup>30-37</sup> Thus, behaviour therapy yields very favorable results as judged by the criteria for success (i.e a 5%-10% reduction in initial weight) proposed by the World Health Organization (WHO).<sup>38,39</sup>

### Dietary interventions

Investigators have sought to induce greater weight losses with behavioural treatment by using more calorie-

restricted diets. Chief among these approaches is the use of meal replacements, in the form of shakes and bars. Meal replacements provide patients a fixed amount of food with a known calorie content. They also simplify food choices, require little preparation, and allow dieters to avoid contact with problem foods. This may increase patients' adherence to their targeted calorie goals.

Dietschuneit *et al.*, found that patients who replaced two meals and two snacks a day with a liquid supplement (e.g. 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 (i.e. 1200-1500 kcal) but who consumed a self-selected diet of conventional foods.<sup>40</sup> Patients who continued to replace one meal and one snack per day with SlimFast products maintained a loss of 11% at 27 months and 8% at 51 months.<sup>41</sup>

#### **Portion-controlled diets**

Portion-controlled servings of conventional foods also improve the induction of weight loss. For example, one study<sup>42</sup> compared weight loss among groups that received standard behavioural treatment plus: 1) no additional structure; 2) structured meal plans and grocery lists; 3) meal plans with food provided at reduced cost; and 4) meal plans with free food provision. 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 18 months' follow-up than did those in group 1. There were no differences in weight loss among groups 2, 3, or 4. This finding suggests that specifying which foods and what amounts patients should eat improves weight loss, but that providing the food has no additional effect.<sup>42</sup>

#### **High-protein, low-carbohydrate diets**

High-protein, low-carbohydrate diets also appear to facilitate dietary adherence and weight loss. Such diets simplify food choices by eliminating an entire class of macronutrients (i.e. carbohydrates). In addition, the high protein intake may increase feelings of fullness (i.e., satiety).<sup>43</sup> A recent study of obese patients found that those 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 vs. 1.9 kg, respectively) and had greater improvements in triglyceride levels and insulin sensitivity.<sup>44</sup> Weight losses of the two groups did not differ significantly at 1 year.<sup>45</sup> Makris and Foster<sup>46</sup> reviewed four randomized studies that compared low-carbohydrate with low-calorie, low-fat diets. Across all four studies,<sup>43,45,47,48</sup> participants who followed the low-carbohydrate diet lost significantly more weight during the first six months of treatment than did those who consumed a low-fat diet. Weight losses ranged from 3.9% to 12.9% in the low-carbohydrate groups and 2.3% to 6.7% in the low-fat groups. However, differences between groups were not significant at 1 year.<sup>43,45,47,48</sup> More research is needed to determine the efficacy of these two dietary approaches for long-term weight management.

#### **Long-term results of behavioural treatment**

Weight regain remains an inevitable challenge for all weight loss interventions. As shown in Table 1, patients treated by behaviour therapy for 20-30 weeks typically regain about 30%-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.<sup>49</sup> These results illustrate the need for long-term treatment to prevent weight regain. There are several methods of providing continued care including on-site, telephone, and internet/e-mail contact.

#### **Long-term on-site treatment**

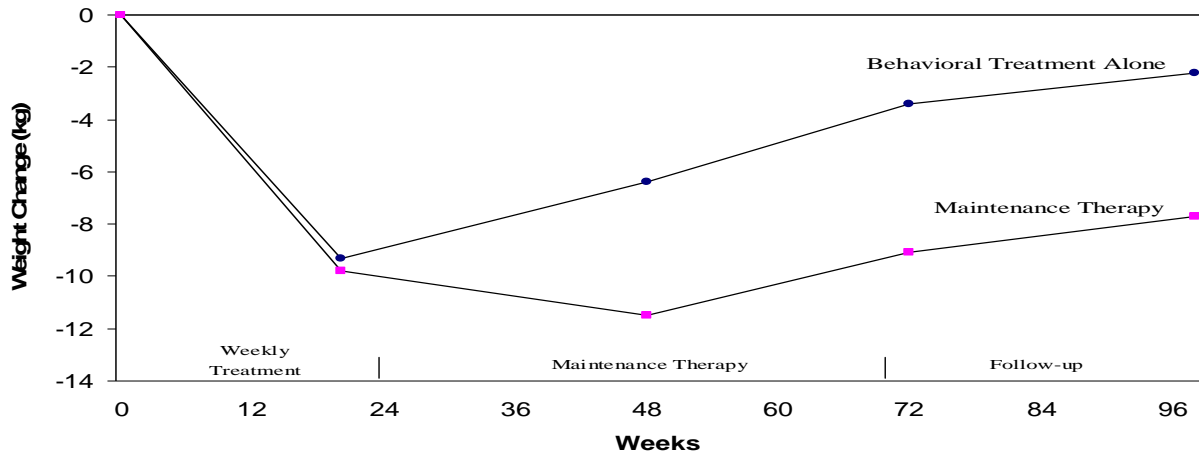
Numerous studies have shown the benefits of patients continuing to attend weight maintenance classes after completing an initial 16-26 week weight-loss program.<sup>49,50</sup> Perri and colleagues,<sup>50</sup> for example, found that individuals who attended every-other-week group maintenance sessions for the year following weight reduction maintained 13.0kg of their 13.2kg end-of-treatment weight loss, whereas those who did not receive such therapy maintained only 5.7kg of a 10.8kg loss. Maintenance sessions appear to provide patients the support and motivation needed to continue to practice weight control skills, such as keeping food records, maintaining calorie goals, and exercising regularly.<sup>50</sup>

In reviewing 13 studies on this topic, Perri and Corsica 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.<sup>49</sup> Figure 2 illustrates the difference in weight loss produced by standard and long-term treatment, as determined from three randomized trials<sup>36,50,51</sup> in which all participants received behavioural weight control for the first 20 weeks. Thereafter, half the patients continued to have every-other-week treatment for 1 year, while the other half received no further care.

The figure shows a clear limitation of long-term behavioural treatment in that it appears only to delay rather than to prevent weight regain. Patients maintain their full end-of-treatment weight loss as long as they participate in bi-weekly maintenance sessions. In fact, 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 appear to be sufficient to maintain end-of-treatment weight loss.<sup>52</sup>

#### **Telephone and mail contact**

Long-term contact also may be provided by telephone or mail, which may be more convenient than on-site visits. Perri and colleagues<sup>53</sup> found that participants who received mail and phone contact for 24 weeks following 15 weeks of on-site treatment, achieved and maintained significantly greater losses (9.2 kg at the end of treatment



**Figure 2.** Long-term results of standard behavioural treatment with or without bi-weekly maintenance therapy. Data are taken from references 36, 50 and 51. Note: Data for week 96 are available for Perri and colleagues' 1986 and 1988 studies only.

and 10.3 kg 1 year after treatment concluded) than did those who received no further contact (8.5 kg at the end of treatment and 2.9 kg at 1 year after treatment). Although phone contact can be an effective tool for weight loss maintenance, maintaining the same contact person is an important component of its effectiveness. When scheduling phone 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.<sup>54</sup>

#### **Internet and E-mail**

Recent studies indicate that the internet and e-mail can be used to provide both short- and long-term behavioural treatment. In an initial study, Tate and colleagues<sup>55</sup> assigned participants to one of two 6-month weight loss programs delivered over the internet: 1) an education intervention, which provided a directory of on-line resources for weight control and 2) a behaviour therapy intervention, which provided internet resources as well as 24 weekly lessons conducted by e-mail, weekly submission of self-monitoring diaries, and an on-line bulletin board. The behaviour therapy participants lost significantly more weight at 6 months than participants in the education group (4.1 kg vs. 1.6 kg, respectively). In a 1-year study, Tate *et al.*,<sup>56</sup> randomly assigned individuals to an internet weight loss program or to the same intervention with the addition of weekly behavioural counseling, delivered by e-mail. Participants in the latter group lost significantly more weight at 1 year than those in the internet-alone group (4.4 kg vs. 2.0 kg, respectively).

These studies, taken together, underscore the importance of completing behavioural assignments (e.g., food and activity records) and suggest that even the most effective internet interventions are likely to produce only half the weight loss of traditional on-site behavioural programs. Several studies<sup>57-59</sup> have examined the use of the internet as a means of facilitating weight maintenance. Harvey-Berino and colleagues<sup>57</sup> 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. There were no significant differences among the three maintenance groups in total weight loss. However, participants in the on-site program were more satisfied with their treatment and attended more sessions than those in the internet program.

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

#### **The importance of physical activity**

Increased physical activity plays a critical role in the management of obesity. Practitioners and their patients, however, should understand that exercise has different short- and long-term effects. On a short-term basis, increased physical activity has minimal effects on weight loss. The addition of 30 minutes of walking, five times a week, to a behavioural weight-loss program increases weight loss by an average of 2 kg over 16-26 weeks, a modest amount considering the effort involved.<sup>60</sup> This is not unexpected, given that approximately 70 miles of walking is required to burn 1 kg of fat! Thus, realistic expectations are critical to prevent patients from becoming disappointed when they do not see a weight loss after having walked 5 miles on a hot summer's day.

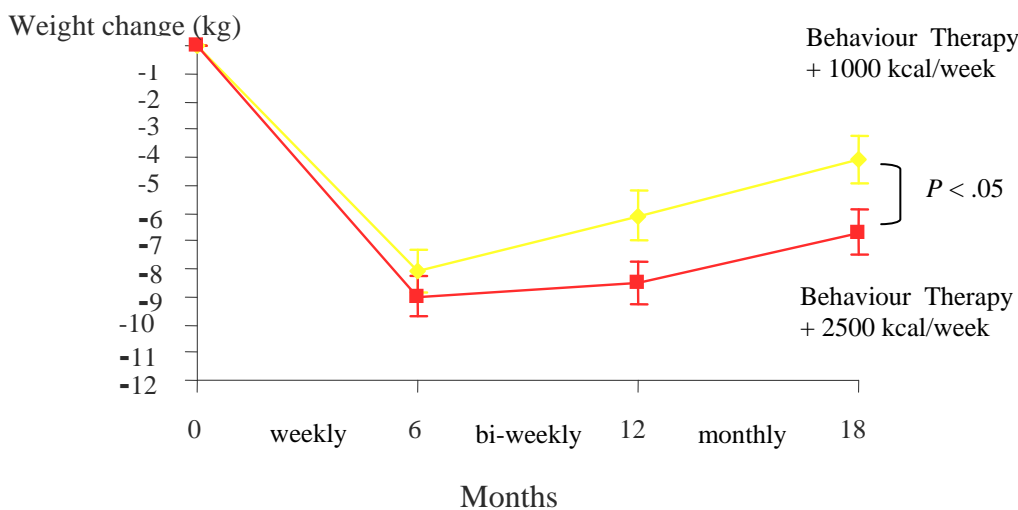
#### **Long-term effects**

On a long-term basis, increased physical activity is the single best predictor of weight loss maintenance. Numerous studies have shown that persons who continue to exercise regularly, after losing weight, are more likely to keep the weight off than are individuals who lapse in their physical activity.<sup>1,61,62</sup> Additional studies have revealed the importance of high levels of activity, as demonstrated in a recent randomized trial by Jeffery *et al.*<sup>63</sup> Patients in

a high-activity group were instructed to expend 2500 kcal/wk, while those in a low-activity group were prescribed a goal of 1000 kcal/wk. As shown in Figure 3, weight losses of the two treatment conditions did not differ significantly at the end of 6 months, during which participants attended weekly group meetings. Participants in the high-activity group, however, maintained their losses significantly better at both the 12- and 18-month follow-up assessments than did patients in the low-activity group. Jakicic and colleagues<sup>64</sup> similarly found, in secondary analyses of results of a randomized trial, that obese individuals who exercised 200 or more minutes a week achieved significantly greater weight losses at 18 months than persons who exercised less than 150 minutes a week.

### Health benefits

Regular physical activity confers important health benefits that include reducing lipid levels, blood pressure, and the risks of osteoporosis.<sup>62</sup> In patients with type 2 diabetes, exercise also improves insulin sensitivity, abdominal adiposity, and glycemic control.<sup>66</sup> Increased physical activity may decrease the risk of cardiovascular morbidity and mortality, even in the absence of achieving normal body weight. Lee and colleague<sup>67</sup> found in a longitudinal study of over 21,000 men that those who were fit but obese had lower rates of death from cardiovascular disease than those who were lean but unfit (Fig. 4). Collectively, these findings indicate that obese individuals should increase their physical activity to improve their health, regardless of its impact on their weight.<sup>62</sup>



**Figure 3.** Short and long-term weight losses for participants assigned to low-intensity exercise (i.e. 1000 kcal/week) or high intensity exercise (i.e., 2500 kcal/week). Data are taken from reference 63.

### Programmed vs Lifestyle Activity

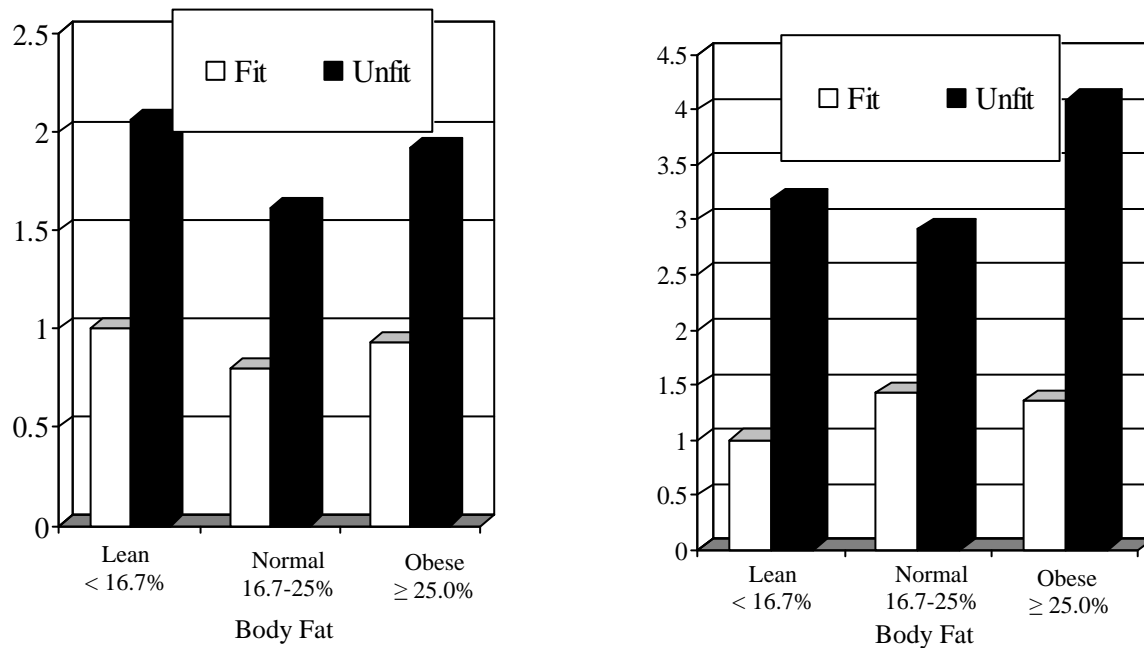
Individuals can increase their energy expenditure in two ways: programmed and lifestyle activity. Programmed activity (e.g., jogging, biking, aerobics) is planned and completed in a discrete period of time (i.e. 30-60 min intervals) at a relatively high level of intensity (i.e. 60-80% of maximum heart rate). Lifestyle activity, by contrast, involves increasing energy expenditure while completing everyday tasks. Examples include parking farther away from an entrance, taking the stairs instead of the elevator, and walking or biking to work rather than driving. Andersen and colleagues<sup>65</sup> compared the effects of programmed and lifestyle activity in women. Results revealed that both types of activity, when combined with a 1200 kcal/d diet, produced a weight loss of approximately 8 kg in 16 weeks. Participants in the lifestyle activity group tended to maintain their weight losses better than those in the programmed-exercise group, although the difference was not statistically significant. These results were promising. Future studies are needed to determine if these results are replicable in men and in larger samples of individuals.

### Cost effectiveness of behavioural treatment

The Diabetes Prevention Program provides an excellent example of a behavioural weight loss intervention. Overweight individuals with impaired glucose tolerance lost an average of 7kg during the first year of treatment and maintained a loss of 4 kg at approximately 3 years.<sup>68</sup> These individuals had a 58% reduction in the risk of developing type 2 diabetes as compared to persons in a control group. The cost of the lifestyle intervention was estimated to be \$2,780 (US) per person for the 3-year intervention.<sup>69</sup> These costs were comparable to those for treatment with metformin (\$2,542 US), which is a medication for type 2 diabetes. Participants in this group had had only a 31% reduction in the risk of developing type 2 diabetes, as compared with the control group.<sup>68,69</sup> These data suggest that behavioural treatment is cost-effective relative to other interventions. Further research is needed to determine the best method of providing behavioural weight control in an efficient and cost-effective manner to the millions of people who need it.

### Looking ahead

This review has shown that behavioural treatment clearly



**Figure 4.** Relative risks for all-cause mortality (left graph) and cardiovascular disease (right graph) by stratum of percent body fat and cardiorespiratory fitness level in 21,925 men. Data are taken from reference 67.

is effective in inducing a loss of 7%-10% of initial weight and that losses of this size are associated with significant improvements in health, as shown by the Diabetes Prevention Program.<sup>68</sup> In the U.S., the National Institute of Health currently is conducting a follow-up investigation to determine whether a weight loss  $\geq 7\%$  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 (i.e., Action for Health in Diabetes) study has enrolled over 5,000 participants from 16 sites nationwide and will 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.

#### Acknowledgement

We thank Ms. Daniele Bourget and Ms. Jessica Lahrmann for their editorial assistance in preparing this manuscript.

#### References

- Wadden TA, McGuckin BG, Rothman RA, Sargent SL. Lifestyle modification in the management of obesity. *J Gastrointest Surg* 2003; 7: 452-463.
- Price RA, Reed DR, Guido NJ. Resemblance for body mass index in families of obese African American and European American women. *Obes Res* 2000; 8: 360-366.
- Wadden TA, Butryn ML. Behavioral treatment of obesity. *Endocrinol Metab Clin North Am* 2003; 32: 981-1003.
- Caro JF, Considine RV. Leptin: From laboratory to clinic. In: Bray GA, Bouchard C, eds. *Handbook of obesity*. New York: Marcel Dekker, Inc., 2004; 275-295.
- Spiegelman BM, Flier JS. Obesity and the regulation of energy balance. *Cell* 2001; 104: 531-543.
- Hebebrand J, Sommerlad C, Geller F, Gorg T, Hinney A. The genetics of obesity: Practical implications. *Int J Obes Relat Metab Disord* 2001; 25 Suppl 1: S10-18.
- Price RA, Lee JH. Risk ratios for obesity in families of obese African-American and Caucasian women. *Hum Hered* 2001; 51: 35-40.
- Wing R. Behavioral approaches to the treatment of obesity. In: Bray GA, Bouchard C, eds. *Handbook of obesity*. New York: Marcel Dekker, 2004; 147-167.
- Brownell KD. The LEARN program for weight management. Dallas: American Health Publishing Company, 2004.
- Wing RR. Behavioral weight control. In: Wadden TA, Stunkard AJ, eds. *Handbook of obesity treatment*. New York: Guilford Press, 2002; 855-873.
- Foster GD. Goals and strategies to improve behavior-change effectiveness. In: Bessesen DH, Kushner RF, eds. *Evaluation and management of obesity*. Philadelphia: Hanley & Belfus, 2002; 29-32.
- Wadden TA, Foster GD. Behavioral treatment of obesity. *Med Clin North Am* 2000; 84: 441-461.
- Wadden TA, Crerand CE, Brock J. Behavioral treatment of obesity. *Psychiatr Clin North Am* 2005; 28: 151-170.
- Latner JD, Stunkard AJ, Wilson GT, Jackson ML, Zelitch DS, Labouvie E. Effective long-term treatment of obesity: A continuing care model. *Int J Obes Relat Metab Disord* 2000; 24: 893-898.
- Sbrocco T, Nedegaard RC, Stone JM, Lewis EL. Behavioral choice treatment promotes continuing weight loss: Preliminary results of a cognitive-behavioral decision-based treatment for obesity. *J Consult Clin Psychol* 1999; 67: 260-266.
- Lichtman SW, Pisarska K, Berman ER, Pestone M, Dowling H, Offenbacher E, Weisel H, Heshka S, Matthews DE, Heymsfield SB. Discrepancy between self-reported and actual caloric intake and exercise in obese subjects. *N Engl J Med* 1992; 327: 1893-1898.
- Prentice AM, Black AE, Coward WA, Cole TJ. Energy expenditure in overweight and obese adults in affluent societies: An analysis of 319 doubly-labeled water measurements. *Eur J Clin Nutr* 1996; 50: 93-97.



18. Cooper Z, Fairburn CG. Cognitive-behavioral treatment of obesity. In: Wadden TA, Stunkard AJ, eds. *Handbook of obesity treatment*. New York: Guilford Press, 2002; 465-479.
19. Cooper Z, Fairburn CG, Hawker DM. *Cognitive-behavioral treatment for obesity*. New York: Guilford, 2003.
20. Wadden TA, Womble LG, Sarwer DB, Berkowitz RI, Clark VL, Foster GD. Great expectations: "I'm losing 25% of my weight no matter what you say." *J Consult Clin Psychol* 2003; 71: 1084-1089.
21. Wadden TA, Berkowitz RI, Sarwer DB, Prus-Wisniewski R, Steinberg C. Benefits of lifestyle modification in the pharmacologic treatment of obesity: A randomized trial. *Arch Intern Med* 2001; 161: 218-227.
22. Rosen JC, Thompson JK. Improving body image in obesity. In: Thompson JK, ed. *Body image, eating disorders, and obesity: An integrative guide for assessment and treatment*. Washington: American Psychological Assoc 2001; 149-170.
23. Wilson GT. Cognitive behavior therapy for eating disorders: Progress and problems. *Behav Res Ther* 1999; 37 Suppl 1: S79-95.
24. Agras WS, Walsh T, Fairburn CG, Wilson GT, Kraemer HC. A multicenter comparison of cognitive-behavioral therapy and interpersonal psychotherapy for bulimia nervosa. *Arch Gen Psychiatry* 2000; 57: 459-466.
25. Wilson GT, Fairburn CC, Agras WS, Walsh BT, Kraemer H. Cognitive-behavioral therapy for bulimia nervosa: Time course and mechanisms of change. *J Consult Clin Psychol* 2002; 70: 267-274.
26. Jarry JL, Ip K. The effectiveness of stand-alone cognitive-behavioural therapy for body image: A meta-analysis. *Body Image* 2005; 2: 317-331.
27. Andersen RE, Franckowiak SC, Snyder J, Bartlett SJ, Fontaine KR. Can inexpensive signs encourage the use of stairs? Results from a community intervention. *Ann Intern Med* 1998; 129: 363-369.
28. Renjilian DA, Perri MG, Nezu AM, McKelvey WF, Shermer RL, Anton SD. Individual versus group therapy for obesity: Effects of matching participants to their treatment preferences. *J Consult Clin Psychol* 2001; 69: 717-721.
29. Brownell KD, Wadden TA. The heterogeneity of obesity: Fitting treatments to individuals. *Behav Ther* 1991; 22: 153-177.
30. Meyers AW, Graves TJ, Whelan JP, Barclay DR. An evaluation of a television-delivered behavioral weight loss program: Are the ratings acceptable? *J Consult Clin Psychol* 1996; 64: 172-178.
31. Fuller PR, Perri MG, Leermakers EA, Guyer LK. Effects of a personalized system of skill acquisition and an educational program in the treatment of obesity. *Addict Behav* 1998; 23: 97-100.
32. Perri MG, Martin AD, Leermakers EA, Sears SF, Notelovitz M. Effects of group- versus home-based exercise in the treatment of obesity. *J Consult Clin Psychol* 1997; 65: 278-285.
33. Wadden TA, Berkowitz RI, Vogt RA, Steen SN, Stunkard AJ, Foster GD. Lifestyle modification in the pharmacologic treatment of obesity: A pilot investigation of a potential primary care approach. *Obes Res* 1997; 5: 218-226.
34. Harvey-Berino J. Changing health behavior via telecommunications technology: Using interactive television to treat obesity. *Behav Ther* 1998; 29: 505-519.
35. Wing RR, Jeffery RW. Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. *J Consult Clin Psychol* 1999; 67: 132-138.
36. Perri MG, Nezu AM, McKelvey WF, Shermer RL, Renjilian DA, Viegner BJ. Relapse prevention training and problem-solving therapy in the long-term management of obesity. *J Consult Clin Psychol* 2001; 69: 722-726.
37. Ramirez EM, Rosen JC. A comparison of weight control and weight control plus body image therapy for obese men and women. *J Consult Clin Psychol* 2001; 69: 440-446.
38. World Health Organization. *Obesity: Preventing and managing the global epidemic*. Geneva: World Health Organization, 1998.
39. Wadden TA, Brownell KD, Foster GD. Obesity: Responding to the global epidemic. *J Consult Clin Psychol* 2002; 70: 510-525.
40. Ditschuneit HH, Flechtner-Mors M, Johnson TD, Adler G. Metabolic and weight-loss effects of a long-term dietary intervention in obese patients. *Am J Clin Nutr* 1999; 69: 198-204.
41. Flechtner-Mors M, Ditschuneit HH, Johnson TD, Suchard MA, Adler G. Metabolic and weight loss effects of long-term dietary intervention in obese patients: Four-year results. *Obes Res* 2000; 8: 399-402.
42. Wing RR, Jeffery RW, Burton LR, Thorson C, Nissinoff KS, Baxter JE. Food provision vs structured meal plans in the behavioral treatment of obesity. *Int J Obes Relat Metab Disord* 1996; 20: 56-62.
43. Foster GD, Wyatt HR, Hill JO, McGuckin BG, Brill C, Mohammed BS, Szapary PO, Rader DJ, Edman JS, Klein S. A randomized trial of a low-carbohydrate diet for obesity. *N Engl J Med* 2003; 348: 2082-2090.
44. Samaha FF, Iqbal N, Seshadri P, Chicano KL, Daily DA, McGrory J, Williams T, Williams M, Gracely EJ, Stern L. A low-carbohydrate as compared with a low-fat diet in severe obesity. *N Engl J Med* 2003; 348: 2074-2081.
45. Stern L, Iqbal N, Seshadri P, Chicano KL, Daily DA, McGrory J, Williams M, Gracely EJ, Samaha FF. The effects of low-carbohydrate versus conventional weight loss diets in severely obese adults: One-year follow-up of a randomized trial. *Ann Intern Med* 2004; 140: 778-785.
46. Makris AP, Foster GD. Dietary approaches to the treatment of obesity. *Psychiatr Clin North Am* 2005; 28: 117-139.
47. Brehm BJ, Seeley RJ, Daniels SR, D'Alessio DA. A randomized trial comparing a very low carbohydrate diet and a calorie-restricted low fat diet on body weight and cardiovascular risk factors in healthy women. *J Clin Endocrinol Metab* 2003; 88: 1617-1623.
48. Yancy WS, Jr., Olsen MK, Guyton JR, Bakst RP, Westman EC. A low-carbohydrate, ketogenic diet versus a low-fat diet to treat obesity and hyperlipidemia: A randomized, controlled trial. *Ann Intern Med* 2004; 140: 769-777.
49. Perri MG, Corsica JA. Improving maintenance of weight lost in behavioral treatment of obesity. In: Wadden TA, Stunkard AJ, eds. *Handbook of obesity treatment*. New York: Guilford Press, 2002; 357-379.
50. Perri MG, McAllister DA, Gange JJ, Jordan RC, McAdoo G, Nezu AM. Effects of four maintenance programs on the long-term management of obesity. *J Consult Clin Psychol* 1988; 56: 529-534.
51. Perri MG, McAdoo WG, McAllister DA, Lauer JB, Yancey DZ. Enhancing the efficacy of behavior therapy for obesity: Effects of aerobic exercise and a multicomponent maintenance program. *J Consult Clin Psychol* 1986; 54: 670-675.
52. Jeffery RW, Wing RR, Thorson C, Burton LR. Strengthening behavioral interventions for weight loss: A randomized trial of food provision and monetary incentives. *J Consult Clin Psychol* 1993; 61: 1038-1045.

53. Perri MG, Shapiro RM, Ludwig WW, Twentyman CT, McAdoo WG. Maintenance strategies for the treatment of obesity: An evaluation of relapse prevention training and posttreatment contact by mail and telephone. *J Consult Clin Psychol* 1984; 52: 404-413.
54. Wing RR, Jeffery RW, Hellerstedt WL, Burton, LR. Effect of frequent phone contacts and optional food provision on maintenance of weight loss. *Ann Behav Med* 1996; 8:172-176.
55. Tate DF, Wing RR, Winett RA. Using internet technology to deliver a behavioral weight loss program. *JAMA* 2001; 285: 1172-1177.
56. Tate DF, Jackvony EH, Wing RR. Effects of internet behavioral counseling on weight loss in adults at risk for type 2 diabetes: A randomized trial. *JAMA* 2003; 289: 1833-1836.
57. Harvey-Berino J, Pintauro SJ, Gold EC. The feasibility of using internet support for the maintenance of weight loss. *Behav Modif* 2002; 26: 103-116.
58. Harvey-Berino J, Pintauro S, Buzzell P, DiGuilio M, Gold BC, Moldovan C, Ramirez E. Does using the internet facilitate the maintenance of weight loss? *Int J Obes* 2002; 26: 1254-1260.
59. Harvey-Berino J, Pintauro S, Buzzell P, Gold EC. Effect of internet support on the long-term maintenance of weight loss. *Obes Res* 2004; 12: 320-329.
60. Wing RR. Physical activity in the treatment of the adulthood overweight and obesity: Current evidence and research issues. *Med Sci Sports Exerc* 1999; 31: S547-552.
61. Wadden TA, Vogt RA, Andersen RE, Bartlett SJ, Foster GD, Kuehnel RH, Wilk J, Weinstock R, Buckenmeyer P, Berkowitz RI, Steen SN. Exercise in the treatment of obesity: Effects of four interventions on body composition, resting energy expenditure, appetite, and mood. *J Consult Clin Psychol* 1997; 65: 269-277.
62. Blair SN, Leermakers EA. Exercise and weight management. In: Wadden TA, Stunkard AJ, eds. *Handbook of obesity treatment*. New York: Guilford Press, 2002; 283-300.
63. Jeffery RW, Wing RR, Sherwood NE, Tate DF. Physical activity and weight loss: does prescribing higher physical activity goals improve outcome? *Am J Clin Nutr* 2003; 78: 684-689.
64. Jakicic JM, Winters C, Lang W, Wing RR. Effects of intermittent exercise and use of home exercise equipment on adherence, weight loss, and fitness in overweight women: A randomized trial. *JAMA* 1999; 282: 1554-1560.
65. Andersen RE, Wadden TA, Bartlett SJ, Zemel B, Verde TJ, Franckowiak SC. Effects of lifestyle activity vs structured aerobic exercise in obese women: a randomized trial. *JAMA* 1999; 281: 335-340.
66. Foreyt JP, Poston WS. The challenge of diet, exercise and lifestyle modification in the management of the obese diabetic patient. *Int J Obes Relat Metab Disord* 1999; 23 Suppl 7: S5-11.
67. Lee CD, Blair SN, Jackson AS. Cardiorespiratory fitness, body composition, and all-cause and cardiovascular disease mortality in men. *Am J Clin Nutr* 1999; 69: 373-380.
68. Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002; 346: 393-403.
69. Hernan WH, Brande M, Zhang P, Williamson DF, Matulik MJ, Ratner RE, Lachin JM, Engelgau MM. Costs associated with the primary prevention of type 2 diabetes mellitus in the diabetes prevention program. *Diabetes Care* 2003; 26: 36-47.

## Review Article

# State of the science: behavioural treatment of obesity

LaShanda R Jones PhD and Thomas A Wadden PhD

*University of Pennsylvania School of Medicine, Department of Psychiatry*

## 科學現況：肥胖的行為療法

肥胖是一個全球性的且可以預防的流行病。特別對那些發展中的國家，它會對個體的健康造成嚴重影響。世界衛生組織評估至少有十億人口是屬於體重過重、三億人口是肥胖的。有研究證明最初的減重達到原先體重的7-10%，就明顯對健康有益處。這些包括降低心臟病、中風和一些癌症的危險性。此篇研究描述用行為學的方法來修改不良的飲食與運動習慣以達成健康的體重。這篇研究也評估長期與短期行為治療肥胖的結果，而長期的方法較能達到體重良好的控制。

**關鍵詞：**行為治療、肥胖、生活型態介入、減重、體能活動