Long-Term Maintenance of Weight Loss: Current Status

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Intervention strategies for promoting long-term weight loss are examined empirically and conceptually. Weight control research over the last 20 years has dramatically improved short-term treatment efficacy but has been less successful in improving long-term success. Interventions in preadolescent children show greater long-term efficacy than in adults. Extending treatment length and putting more emphasis on energy expenditure have modestly improved long-term weight loss in adults. Fresh ideas are needed to push the field forward. Suggested research priorities are patient retention, natural history, assessment of intake and expenditure, obesity phenotypes, adolescence at a critical period, behavioral preference--reinforcement value, physical activity and social support, better linkage of new conceptual models to behavioral treatments, and the interface between pharmacological and behavioral methods.

Key words: obesity, treatment, maintenance review

Obesity is defined as an unhealthy amount of body fat. Primary considerations in developing an operational definition, therefore, are the measurement of body fat and the determination of what constitutes an unhealthy amount. Considerable progress has been made in our ability to measure fat as well as other body components directly. Nevertheless, because of the high cost of direct measurement, obesity is defined primarily in terms of weight in relation to height (i.e., overweight) for most research and applied purposes. The most widely used height-weight index in adults is body mass index (BMI), which is defined as weight in kilograms divided by meters squared, a measure that is correlated about 0.7 with more precise measures of body fatness (Keys, Fidanza, Karvonen, Kimura, & Taylor, 1972). Obesity in children can be defined in relationship to percentage over average weight for age, gender, and height or average BMI for age and gender (Must, Dallal, & Dietz, 1991a, 1991b).

Because there is a graded relationship between these height-weight indices and measures of health (e.g., cardiovascular risk factors), specific cutpoints for defining what is unhealthy are fundamentally arbitrary. BMI cutpoints for defining health risk in adults have varied over the years. Epidemiological studies consistently suggested that lowest overall mortality in adults is associated with a BMI in the range of 20 to 23. Recommended BMI cutpoints for overweight have been variously set at 30, 27, and most recently as low as 25 (National Heart, Lung, and Blood Institute [NHLBI] Obesity Education Initiative Expert Panel, 1998). Using any of these definitions, the prevalence of overweight in the United States is high. The average BMI in the adult population is slightly more than 25. Thus, using the newest definition, more than half of all adults have weight levels that may be of concern, and about 20% of adults in the United States currently have BMIs above 30 (Kuczmarski,

Historical trends in prevalence of overweight and obesity have generally been upward over the last century. Figure 1, the recent National Institutes of Health guidelines for the evaluation and treatment of obesity (NHLBI Obesity Education Initiative Expert Panel, 1998), shows trends in the population prevalence of BMIs above 25 between the early 1960s and the early 1990s using data from population surveys conducted by the National Center for Health Statistics. Figure 1 shows that the proportion of the U.S. population believed to be overweight is high. It also draws attention to a dramatic rise in prevalence of overweight in the last decade or two. This phenomenon, seen also in children (Troiano, Flegal, Kuczmarski, Campbell, & Johnson, 1995), has greatly increased concerns about overweight as a public health issue.

Sociodemographic risk factors for obesity include age, social class, and ethnicity. Table 1 shows average weight gains between age 25 and 35 observed in participants in the CARDIA study, an NHLBI-sponsored longitudinal study of cardiovascular risk factors in young adults (Burke et al., 1996). Average weight gain over 10 years was approximately 10 kg, with a range from 7 kg in White women to 11 kg in African American women. Social class is inversely associated with prevalence of overweight in women (Sobal & Stunkard, 1989). Native American, African American, and Mexican American adults are more likely to be obese than individuals from the majority population of European ancestry (Broussard et al., 1991; Kuczmarski et al., 1994).

Table 1
Mean Weight (in Kilograms) Over 10 Years in a Cohort of Young Adults (CARDIA)

<table>
<thead>
<tr>
<th>Population</th>
<th>Mean age (years)</th>
<th>25</th>
<th>27</th>
<th>30</th>
<th>32</th>
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<td>76</td>
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<td></td>
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<td>67</td>
<td>69</td>
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</tr>
<tr>
<td>White</td>
<td>77</td>
<td>79</td>
<td>81</td>
<td>83</td>
<td>85</td>
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</tr>
</tbody>
</table>

Note. CARDIA = coronary artery risk development in young adults.
In another study, reported dieting to lose weight predicted weight gain, not loss, over 2 years (French et al., 1994). Increases in the population prevalence of overweight over time despite high rates of dieting also suggests that, in the aggregate, successful weight losses are being offset by failures. One factor that may contribute to the fact that people who report weight loss attempts do not often succeed is that what many people describe as weight loss attempts are behavior changes of short duration. Williamson, Serdula, Anda, Levy, and Byers (1992), for example, reported that a typical weight loss attempt averaged only 4 to 6 weeks in length. Similarly, in a recent study examining the cumulative duration of weight control behaviors over a 4-year period, it was observed that even the most commonly reported methods, increasing exercise and reducing fat intake, are used less than 25% of the time (French, Jeffery, & Murray, 1999). In this study, it was found that longer reported durations of several weight control strategies were protective against weight gain with age. However, on average, the population gained about 0.5 kg/year.

Research on behavioral interventions for treating obesity has now spanned more than 20 years. A summary of this research, taken from a review by Perri, is shown in Table 2 (Perri & Fuller, 1995). The greatest achievement over this time period has been in the ability to enhance the magnitude of initial weight losses. Average weight losses in behavioral treatment studies increased by approximately 75% between 1974 and 1994. Although a variety of refinements have been made in behavioral treatment methods over this time that have contributed to this improvement, the most recognizable correlate of increased success may be increased treatment length. That is, an approximate doubling of average weight losses over two decades has been accompanied by an approximate doubling of treatment duration.

Improvements in long-term weight loss have so far lagged behind improvements in short-term weight loss. Data illustrating the typical pattern observed in behavioral weight loss treatments expressed as percentage of body weight loss over 4 years of follow-up are shown in Figure 2 (Kramer, Jeffery, Forster, & Snell, 1989). This study monitored 114 men and 38 women annually for 4 years who were treated in a 15-week behavior program. Initial weight losses averaged 8% and 12% of initial body weight in women and men, respectively. After treatment, slow but steady weight gain was observed for 2 years, and then weight stabilized at approximately 4% below baseline values. This particular study did not include any follow-up treatment beyond the initial intervention period. However, similar long-term results were observed in other studies in which continuing follow-up care was provided. Among the longest studies of behavioral treatments yet done are those used in clinical trials examining the effects of weight control on blood pressure, that is Hypertension Prevention Trial (HPT; HPT Research Group, 1990), Treatment of Mild Hypertension Study (Elmer et al., 1995), and Trial of Nonpharmacologic Interventions in the Elderly (Welton et al., 1998). These studies all used behavioral intervention methods that included periodic nutrition, exercise, and behavioral counseling over a lengthy time period. Sustained weight losses of approximately 4% of baseline weight were achieved in treated individuals compared with those not receiving treatment, and these weight losses were associated with statistically significant benefits in regard to blood pressure control. Although such clinical benefits are gratifying, there is obviously still room for improvement of behavioral methods for treating obesity.

The long-term weight loss results described previously are for adults. Although this article focuses primarily on adult intervention studies, it is noteworthy that long-term weight control success in preadolescent children has generally been somewhat better. In a series of studies conducted by Epstein, Valoski, Wing, and McCurley (1994), for example, it has been shown that in follow-ups as long as 10 years, sustained reductions in age-adjusted percentage overweight in the 10% to 15% range is achievable.

The natural history of weight loss and regain among patients participating in behavioral treatments for obesity is remarkably consistent. The rate of initial weight losses is rapid and then slowly declines. The point of maximum weight loss is usually reached approximately 6 months after the initiation of treatment. Weight regain then begins and continues gradually until weight stabilizes somewhat below baseline levels. This temporal pattern is fairly independent of initial weight loss. That is, individuals who lose more weight in treatment seem to follow the same temporal sequence. The difference between large weight losers and small weight losers is the rate of initial weight loss rather than the duration of weight loss efforts. This phenomenon is illustrated in Figure 3, which shows the time course of

Table 2

<table>
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<tr>
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</thead>
<tbody>
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<td>Number of studies</td>
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<td>15</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td>Length of treatment (weeks)</td>
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<td>13.2</td>
<td>17.2</td>
<td>21.5</td>
</tr>
<tr>
<td>Mean weight loss (%)</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>

Figure 2. Long-term outcomes for behavioral weight loss treatment (Kramer et al., 1989).
Research on Improving Long-Term Weight Loss

Factors responsible for the substantial weight regain that usually follows successful weight loss with behavioral treatments have not yet been clearly identified. Behavioral treatments for obesity are based on the premises that (a) excess weight is caused by an imbalance between behaviors controlling energy intake (eating) and those controlling energy expenditure (exercise), (b) these behaviors are learned, and (c) long-term success in weight control involves learning new behaviors. The fact that people lose weight when taught new eating and exercise behaviors testifies to the fact that the behavior changes being recommended are sufficient—if not necessary or optimal—for weight loss. The fact that weight regain is accompanied by a deterioration in adherence to these behavior changes identifies the proximal behavioral causes of relapse. Whether failure to maintain behavior changes is due to loss of knowledge and skills, loss of motivation, aversive side effects of behavior change (e.g., hunger, psychological stress, or social pressure), or other variables is unclear. Biologically oriented scientists tended to interpret difficulty in weight maintenance as evidence for the importance of biological determinants of body weight. Behaviorally oriented scientists tended to view the same phenomenon as evidence underscoring the difficulty of achieving lasting change in environmental factors that influence behaviors. Both points of view, however, lacked both a compelling description of a mechanism of action that has empirical support.

A review of studies that have attempted to improve long-term maintenance of weight loss has been organized for the present purposes into five categories: (a) increasing intensity of initial treatment, (b) extending the length of treatment, (c) altering dietary and exercise prescriptions, (d) enhancing motivation, and (e) teaching maintenance-specific behavioral skills.

Increasing Intensity of Initial Treatment

In recognition of the fact that people often find it difficult to sustain a consistently negative energy balance over lengthy time periods on an outpatient basis, one approach to improving long-term weight loss has been to increase the intensity of initial treatment and thus to maximize the amount of weight loss during the period when people are best able to follow diet and exercise instruction. This approach has a long history in obesity treatment and has included such approaches as inpatient starvation. The most extreme form of highly intense obesity treatment that is now considered safe for outpatient populations is the very-low-calorie diet (VLCD). This approach asks patients to restrict their food intake for periods of 2 to 3 months to levels that are considerably lower than in conventional low-calorie diets (600–800 kcal/day vs. 1,000–1,200 kcal/day). Adherence is sometimes also promoted by providing prepared foods such as liquid mixtures to be substituted for some or all normal meals. VLCDs have clearly been successful in achieving the objective of producing larger initial weight losses. Whereas typical weight losses observed in behavioral interventions using moderately restricted calorie diets are in the 10-kg range, average weight losses of about twice that amount over similar time periods have been achieved using VLCDs (National Task Force on the Prevention and Treatment of Obesity, 1993). VLCDs, however, have not been markedly successful in improving long-term weight loss outcomes. That is, larger weight losses induced by more severe calorie restriction are followed by larger and somewhat more rapid regains so that net effects 2 or more years after treatment are no better than with more traditional approaches.

A study illustrating this phenomenon is presented in Figure 4. This study, by Wadden, Sternberg, Letizia, Stunkard, and Foster (1989), compared a behavior therapy program using a conventional low-calorie diet versus behavior therapy with a VLCD. Patients were monitored for 5 years after initial treatment. Figure 4 clearly shows that initial weight losses using the VLCD were better than those using a traditional low-calorie diet approach. Superiority in net weight loss was maintained 1 year after treatment, although both groups regained significant weight. By 3 years after...
treatment, however, there were no significant differences between the two groups, and by 5 years most patients had returned to their initial body weights.

In summary, intensifying initial treatments for obesity by encouraging more severe restriction of energy intake can produce larger weight losses. Increasing initial weight losses by this method, however, has had little effect on long-term maintenance of weight loss. Studies addressing the efficacy of intensifying other aspects of intervention regimens for long-term weight have not been conducted (e.g., increasing exercise recommendations or increasing the frequency or length of treatment visits).

**Extending the Length of Treatment**

As noted, the most important accomplishment of behavior research on obesity treatment over the last 20 years has been to increase initial weight loss. Moreover, the treatment factor most clearly associated with this improvement appears to be increased duration of treatment. Given this observation, one might argue that the best way to improve long-term outcomes for overweight treatment would be to continue treatment indefinitely. Indeed, some argued that a chronic disease model for obesity treatment similar to that used for other chronic conditions such as diabetes and hypertension might be a more appropriate treatment model than the acute care model embodied in short-term treatments with little or no follow-up (Perri, Nezu, & Viegener, 1992). Perri, Nezu, Patti, and McCann (1989) conducted the only experiment specifically evaluating the relationship between treatment duration and weight loss success. In this study they compared a behavioral treatment of 20 weeks duration with a treatment of 40 weeks duration. They then followed up both groups through 72 weeks. Results of this study are shown in Figure 5. Treating people for a longer period of time was associated with more weight loss. After discontinuation of active treatment, weight regain was observed; the rate of regain was comparable in the short and long treatment conditions.

Given the greater success in longer treatment programs, the concept of continuing behavioral support for maintenance of weight loss indefinitely has appeal. A review of seven studies that used extended contact schedules that were at least biweekly for between 20 and 52 weeks after initial treatment suggested that the approach has promise (Perri, 1998). The difficulty encountered by some with this approach, however, has been the unwillingness of patients to continue to participate in therapies that involve regular clinic visits over long periods of time. Although we are aware of no studies that have specifically evaluated whether continuing obesity treatment indefinitely at the same intensity level used in initial treatment (i.e., weekly treatment visits) over long periods of time (i.e., years) would improve long-term maintenance, at least two used weekly visits for 52 weeks, and several examined the efficacy of continuing treatment contacts at monthly intervals for periods of a year or more after treatment. Attendance at these extended treatment visits, however, has been disappointing. In a study by Jeffery et al. (1993), for example, that included weekly treatment sessions for 20 weeks followed by sessions every month thereafter, attendance at treatment sessions over the first 6 months, the period of initial weight loss, averaged about 65%. Over the next 12 months, however, it averaged only 25%. Study participants also gained weight steadily between 6 and 18 months. Whether the declining attendance at therapeutic sessions contributes to weight regain or whether failure to maintain weight losses causes lack of attendance is unclear. However, at present the overall efficacy of continuing clinic-based behavioral treatments over long periods of time seems to need further study. One study showed that forms of therapeutic contact that are less costly to patients than clinic visits (i.e., telephone contacts) can be completed on a weekly basis for at least 1 year after initial weight loss (Wing et al., 1996). Unfortunately, telephone contacts used in this study were only modestly effective in preventing weight regain.

Because of its lesser demands on the patient and the greater long-term adherence that it achieves, medication is increasingly used in the treatment of obesity. A major stimulus of this increased usage was Weintraub's 1992 publication that showed continuing weight loss for as long as 3 years in patients who received the combination of dl-fenfluramine and phentermine. Since then, treatments with other medications for durations as long as 2 years have been reported.

**Modifying Behavioral Approaches to Energy Balance**

A third category of approaches to long-term maintenance of weight loss that has attracted some attention is modification of the behavioral recommendations used in behavioral programs. Although behavioral recommendations for weight control can only be effective to the extent that they change energy balance and thus must involve increased energy expenditure, decreased energy intake, or both, it is possible that some diet or exercise prescriptions may be more sustainable than others.

A research question that has attracted particular attention on the intake side of the energy balance equation is whether nutritional advice emphasizing fat intake may be superior long term compared with advice focusing on total energy intake. Arguments in favor of a focus on dietary fat rather than total energy are based on two general propositions.
First, because fat is both high in energy density and high in palatability, it may be more difficult for people to control energy intake when their diets are high in fat than when they are low in fat. Second, some argued that the macronutrient composition of habitual diet may have a direct physiological effect on the set point for body fat mass.

Unfortunately, although these arguments are plausible, experimental research in this area has been relatively disappointing with respect to the applied goal of improving long-term weight loss. Studies that specifically compared dietary prescriptions focused on fat intake rather than total energy intake concluded that both short- and long-term weight losses associated with a fat-restricted diet are no better than those associated with an energy-restricted diet. An illustrative study, shown in Figure 6, found that a diet that restricted energy but not fat produced similar weight losses over a 6-month period compared to a diet that restricted fat but not energy. Long-term weight loss over 12 months of follow-up, however, was the same in both groups, suggesting that a fat-restricted diet is no easier to maintain than an energy-restricted diet (Jeffery, Hellerstedt, French, & Baxter, 1995).

The second area of behavioral focus that has attracted particular interest from obesity researchers is exercise. In the early years of behavioral studies on the treatment of obesity, the primary focus of intervention was on diet. More recently, greater attention has been given to exercise because a convergence of both correlational and experimental studies indicated that not only is increased attention to exercise beneficial for weight control but the benefit is particularly evident in the long term. Results from two exemplary studies are shown in Figures 7 and 8. Figure 7 presents data from a study by Pavlou, Krey, and Steffee (1989), in which, among other things, a standard low-calorie diet was examined in combination with or without an exercise program. Adding a strong exercise component to this behavioral intervention improved weight loss both short term and at 18-month follow-up. Figure 8 shows data from a study by Sikand, Kondo, Foreyt, Jones, and Gotto (1988) comparing exercise versus no exercise in conjunction with a VLCD rather than the more traditional low-calorie diet. Initial weight losses were larger in this study than in Pavlou’s study, presumably because of the VLCD. Adding exercise again improved both short-term losses and long-term losses. Neither study, however, showed that exercise instruction prevented weight regain.

Another approach to varying behavioral approaches to weight loss was examined in a series of two studies by Wing et al. (1996) and Jeffery et al. (1993). The core intervention in the studies was conventional behavior therapy with a conventional low-calorie diet. The first study in the series examined the efficacy of outpatient feeding to support dietary compliance, which was operationalized as giving patients prepackaged foods for five breakfasts and five dinners per week for 18 months. Effects of this treatment on initial weight loss were positive. Individuals receiving the outpatient feeding treatment lost approximately 30% more weight over a 6-month period than those not receiving food (11.0 kg vs. 8.5 kg). This differential between treatment groups was also maintained through 18 months. However, substantial weight gains were observed in both groups after 6 months. The second study in the series demonstrated that initial weight loss effects resulting from outpatient feeding could also be produced by providing patients with specific menus for five breakfasts and five dinners per week.

In summary, the finding about long-term weight loss from studies comparing different behavioral approaches for weight loss that has attracted most interest recently is the effects of exercise. Putting greater emphasis on exercise as a component of obesity treatment appears to enhance weight loss at all time points and may possibly help slow weight regain after initial treatment. Variations in recommendations for the macronutrient content of diets that have been tested to date have not been successful in improving either short- or long-term outcomes. Advising patients to follow specific

Figure 6. Fat restriction versus calorie restriction in weight control (Jeffery et al., 1995).

Figure 7. Exercise in weight control (Pavlou et al., 1989).

Figure 8. Exercise in weight control (Sikand et al., 1988).
menus has been shown to enhance short-term, but not long-term, weight loss.

Enhancing Motivation

A fourth area of research directed specifically at long-term weight loss has been enhancement of long-term motivation for weight control. The rationale for using motivational enhancement procedures is that, although the health and psychosocial benefits of sustained weight loss are well established, these natural incentives are not sufficient by themselves to motivate long-term behavior change. Experimental studies of methods for enhancing motivation have focused in two primary areas: tangible incentives (usually money) and social support enhancement procedures.

Two types of financial incentives systems have been examined empirically for long-term weight loss. One is direct payment, from external funds, for successful long-term weight loss, and the second is repayment of deposits made by patients at the beginning of treatment contingent on long-term weight loss. Figure 9 shows data from a study by Jeffery et al. (1993) describing weight losses in kilograms for individuals who were paid up to $25 per week over an 18-month period based on their progress in achieving weight loss objectives determined at the beginning of treatment compared with individuals not paid for weight loss (Jeffery et al., 1993). Payment for weight loss did not enhance initial weight loss. It also did not slow down rate of regain after initial weight loss. This study, of course, does not definitively prove that you cannot motivate people to lose weight with money. Variation in amount, frequency, and outcomes on which money rewards are contingent could make a difference (Kirby, Marlowe, Festinger, Lamb, & Platt, 1998; Silverman et al., 1998). Modest rewards delivered weekly contingent on cumulative success in weight control, however, are apparently not sufficient.

Figure 10 shows the results of a study in which deposit contracts were used to try to promote maintenance of weight loss beyond an initial treatment period. Participants in this study deposited $100 with the experimenter at the beginning of the treatment program. They were treated with behavioral methods for a period of 20 weeks and then were randomized to one of three maintenance conditions. In one condition the initial deposit was returned at the beginning of the maintenance interval. In the second, a proportion of the deposit was returned contingent on attendance at periodic weigh-ins over the course of the subsequent year. In the third condition, a portion of the deposit monies were refunded at each weigh-in visit contingent on maintaining weight losses achieved in initial treatment. Although several studies showed that deposit contracts incentive systems are effective in enhancing the amount of initial weight loss in behavioral treatments (Kramer, Jeffery, Snell, & Forster, 1986), the results of this study suggest that such systems may not be as effective for supporting weight loss maintenance.

Approximately a dozen published studies have experimentally evaluated social support enhancement procedures as a method of motivating weight loss. The predominant form of such treatment has been to include spouses or significant others in the treatment process with the objective of teaching them to provide social support for their partner's weight loss efforts. The overall success of these treatments in supporting long-term maintenance of weight loss has been modest. In a meta-analysis, Black, Gleser, and Kooyers (1990) concluded that there are significant short- and long-term benefit of including spouses in obesity treatment. The effect size, however, was quite small.

Other studies in the social support area have taken a broader view of the social support issue and have observed somewhat more positive results. A study by Jeffery et al., for example, evaluated the comparative efficacy of deposit contracts for weight loss over a 15-week period that were contingent on either individual weight loss or average group weight losses. Significant positive effects for group relative to individual contingencies were shown both in the 15-week treatment period and at a subsequent 1-year follow-up evaluation (Kramer et al., 1986). Both groups gained weight after initial treatment, however. Perri et al. (1988) similarly reported superior maintenance through 18 months of follow-up with a maintenance support strategy involving both group monetary contingencies and social support strategies compared with a control group receiving no contact during the maintenance phase. A recent study by Wing and Jeffery (1999), although relatively short for the evaluation of long-term effects, found that individuals who participated in a behavioral treatment program with a group of four friends were better able to maintain weight losses 6 months after a

![Figure 9](Image)

**Figure 9.** Long-term weight loss as a function of direct payment for weight loss (Jeffery et al., 1993).

![Figure 10](Image)

**Figure 10.** Deposit contracts in long-term weight loss (Kramer et al., 1986).
4-month behavioral treatment than were individuals who participated in a similar program on their own.

Overall, efforts to increase motivation for weight maintenance have to date not been dramatically successful in enhancing long-term clinical outcomes. Direct incentives and deposit contract incentives have not proved particularly effective. Social support manipulations have shown some promise, although no clearly effective strategy for preventing weight regain after behavioral treatment has yet to emerge.

**Teaching Maintenance-Specific Skills**

A final category of strategies for improving maintenance of weight loss is the provision of specific training in skills that are thought to be valuable for maintenance as opposed to initiation of weight loss. This approach rests on the assumption that strategies that might be effective for maintaining an energy deficit in a period of weight loss may be different from those involved in maintaining a stable energy balance around a lower weight. The maintenance-specific approach that has received most discussion is relapse prevention, which involves instruction aimed at teaching people to identify situations in which lapses in behavioral adherence are likely to occur, to plan strategies in advance for avoiding lapses, and to get back on track should they occur. The relapse prevention approach is based on the idea that short-term violations of "rules" about behavioral adherence can often lead to negative psychological reactions that precipitate a return to pretreatment patterns.

Training in relapse prevention skills has been a popular addition to traditional behavioral treatments for obesity. Indeed, most behavioral programs now incorporate elements of these ideas. We are aware of no studies, however, that have explicitly tested the efficacy of "relapse prevention" training in isolation from other treatment components for maintenance of weight loss. A study by Wing et al. (1996) is an interesting example of an effort to test a somewhat different relapse prevention approach and to document its efficacy. This study was done with a group of obese individuals who had received behavioral treatment for obesity for a 6-month period that included an outpatient feeding component to enhance dietary adherence. After the initial weight loss period, study participants were randomized either to receive no contact over the following year or to a maintenance support program that involved giving them the option of reinitiating outpatient feeding in response to dietary indiscretions or weight gain. It was thought that a well-defined relapse response strategy might help people preserve weight losses over time. Unfortunately, however, this strategy was not effective. People for whom a specific relapse response plan was available used it infrequently and were no more effective in controlling their weight over the year after treatment than were individuals who were left to their own devices.

In summary, the number of studies that attempted specifically to design and test such strategies is limited, and the results to date have not been impressive.

**Medication**

As noted, continuing clinic-based behavioral treatments over long periods of time do not seem to be acceptable to many patients. More acceptable may be treatments that use medication. Such treatments attracted widespread attention with the publication in 1992 of the aforementioned 3-year trial of the combination of the appetite suppressants dl-fenfuranime and phentermine (fen-phen; Weintraub, 1992). This trial, in which patients regained weight as soon as they discontinued medication, appeared to validate the long-standing view that appetite suppressants act by lowering a body weight set point and that, as a result, they should be used continuously or not at all (Stallone & Stunkard, 1992; Stunkard, 1982). The report was followed by widespread use of this combination of medications, which was abruptly ended by the discovery of heart valve damage in a substantial number of patients (Connolly et al., 1997). Fenfluramine was promptly withdrawn from the market, but the experience did not dampen the enthusiasm of the pharmaceutical industry for safe medications that could produce similar results, and vast sums are being spent in the search for such medication. Sibutramine (Meridia; Bray et al., 1996), a serotonin reuptake inhibitor, has been approved by the Food and Drug Administration. After completion of two recent long-term trials (cf. Davidson et al., 1999), approval has been granted for orlistat (Xenical), a medication that inhibits digestion of dietary fat (see Figure 11). Far more important than the introduction of these new medications, however, is the fact that traditional empirical research on appetite suppressant medication is being superseded by drug discovery based on our increasing knowledge of mechanisms that control body weight. These developments mean that we may expect a number of increasingly effective (and safe) medications in the relatively near future.

Most weight loss medications tested to date have shown maximum efficacy when combined with traditional programs of behavior modification. An intriguing report by Wadden et al. (1997), however, raised the question of whether behavioral supports needed to maximize medication efficacy can be provided more economically. In this study, an abbreviated behavioral program, delivered monthly for 15 min during medication visits, proved as effective as a traditional 16-week group program. As the pharmacological treatment of obesity develops, its relationship to specific components of behavior therapy may also require careful study. The aspects of behavioral intervention that are most critical may well be different depending on the specific mechanism of action of the medication.

**Interactions Between Weight Loss and Other Risk Behaviors**

We live in an era in which scientists suggest that a diverse array of lifestyle factors contribute to good health. Health-enhancing behavioral recommendations include the following: Increase exercise and dietary fiber intake, reduce dietary fat and sodium, do not smoke, use alcohol in moderation (if at all), reduce psychological stress, wear seatbelts, and so
on. The question of whether these diverse behavioral recommendations are synergistic, antagonistic, or independent of each other is intriguing. Some suggested that, for individuals with multiple behavioral risk factors, it may be best to attack all problems simultaneously. Others argued that multiple change goals are difficult to attend to simultaneously and that some may have a negative effect on others. Thus, tackling one objective at a time may be better.

As discussed to some extent, recommendations to decrease dietary fat and increase exercise seem to be positively synergistic with weight control. Both observational and experimental studies suggest that fat reduction, energy reduction, and exercise increase make independent contributions to weight control over time. Less synergistic or even antagonistic relationships for weight control have been observed, however, with at least two behavioral goals: cigarette smoking and dietary sodium intake. Smoking cessation is associated with weight gain. Thus, smoking cessation works against either weight loss or weight maintenance. Some evidence suggested that individuals who are concerned about their weight have more difficulty quitting smoking than those who are less concerned, and several studies attempted to address this issue by providing weight loss counseling in conjunction with smoking cessation programs (French, Jeffery, Pirie, & McBride, 1992). Interestingly, interventions used in these studies, which have typically been adaptations of methods used to promote weight loss in obese patients, have not been effective in preventing weight gain in smokers and also have not been effective in enhancing smoking cessation. One study even suggested that counseling people to lose weight during smoking cessation attempts is counterproductive (i.e., those being counseled to control their weight are less successful at cessation than those not being counseled; Hall, Tunstall, Vila, & Duffy, 1992).

A similar negative synergism between weight control and dietary sodium intake has also been suggested in at least one study of dietary factors on blood pressure. This study examined the independent and combined effects of weight loss and dietary sodium restriction on blood pressure. Focusing on either sodium restriction or weight loss individually produced better results for those individual behavioral objectives than did intervening on both simultaneously (HPT Research Group, 1990). The reason for this negative synergism is not known. It could be the result of divided attention to weight versus sodium. Alternatively, it could be that focusing on weight and dietary sodium simultaneously restricts dietary choices more severely than focusing on either alone and thus makes adherence more difficult.

### Future Directions in Weight Maintenance Research

The experience of people trying to control their weight is a continuing source of fascination and frustration for behavioral researchers. Overweight people readily initiate weight control efforts and, with professional assistance, are quite able to persist, and lose weight, for several months. They also experience positive outcomes in medical, psychological, and social domains (NHLBI Obesity Education Initiative Expert Panel, 1998). Nevertheless, they almost always fail to maintain the behavior changes that brought them these positive results. Moreover, as we hope we have shown, efforts to date to change this weight loss-regain scenario have not been very successful. It is believed that the answer to one broad question is central to an increased understanding of weight maintenance behaviors: How do the behaviors and psychological processes involved in weight loss differ from those involved in weight maintenance? To promote an improved understanding of long-term weight loss, we recom-
mend additional research in the following eight specific areas:

1. Studies of methods for keeping overweight patients in treatment long term. Obesity is now recognized as a chronic disorder requiring continuous care (NHLBI Obesity Education Initiative Expert Panel, 1998). Whether treatment is pharmacological or behavioral, initial weight loss is likely to be regained unless an effective maintenance program is continued indefinitely. As we noted, however, clinic-based maintenance programs are often poorly attended. Cost-effective methods for delivering continuous care need to be developed.

2. Observation studies of the natural history of intentional weight loss that carefully examine psychological, behavioral, biological, and environmental factors that may be causally related to the initiation of weight loss, maintenance of weight loss, and weight regain. Of particular interest is the characterization of factors associated with successful long-term weight loss.

3. Studies designed to improve the assessment of energy intake and expenditure and of behavior patterns associated with change in energy intake and expenditure. Virtually all therapies for overweight attempt to induce and reinforce behavior changes that are either inferred from self-reports or from changes in weight. Inaccurate inferences can lead to misdirected treatment.

4. Studies addressing the issue of behavioral phenotypes within the obese population. It is widely accepted that obesity has a multifactorial cause (e.g., genetics and metabolic factors, hedonics, and social and environmental cues). Identification of phenotypic subgroups with a common cause would be of value both conceptually and clinically.

5. Studies of the role of behavioral preferences in obesity and its treatment (e.g., for energy-dense foods and physical activities). Do individual differences in the reinforcement value of food and activity play a role in the difficulty people have in maintaining changes in these behaviors? Can behavioral preferences or reinforcement values be changed in ways that would facilitate long-term weight loss? Do they change spontaneously after behavior changes?

6. Studies to examine why long-term outcomes of behavior treatment for obesity in preadolescents have been more successful than treatment for obesity in adults. Are behaviors more malleable in this age group because they are still evolving? Are biological processes more malleable?

7. Studies to examine physical activity and social support more carefully in regard to long-term weight loss. What are the mechanisms through which physical activity and social support have their effects? Can these effects be enhanced to improve long-term weight outcomes?

8. Studies that link laboratory research on models of behavior control with applied research to develop new conceptual models for understanding weight loss and maintenance. Basic research in the behavioral sciences has resulted in a variety of new conceptualizations that have not to date been well integrated into applied domains, for example, behavioral extinction (Bouton & Swartzentruber, 1991), behavioral momentum theory (Epstein & Saelens, 1999), behavioral economics (Nevin, 1993), and models of decision-making and goal-directed behaviors (Gollwitzer & Bargh, 1996). It is believed that studies linking and integrating these conceptual developments with the complex applied problems of long-term behavioral change and weight loss might yield important new insights.

9. The discovery of safer and more effective medications for the control of obesity. As drug discovery is increasingly informed by basic science information about the regulation of body weight, more effective medication can be expected. The large profits expected from such products ensures a major effort by the pharmaceutical industry.

10. Study of the integration of medications into effective programs of weight control. Studies of the interactions between medications and behavioral intervention components in obesity treatment may be of particular importance. There is a need to examine more closely the parts of behavioral interventions that contribute to their synergistic influence on pharmacological treatment and the method by which these components can be delivered economically. It also includes a more careful consideration of the specific mechanism of action of medications so that behavioral treatment components can maximize these effects.

Summary and Conclusions

Interventions for facilitating short-term weight loss have improved substantially over the last 20 years. With the notable exception of interventions for preadolescent children, however, long-term success in obesity treatments continues to develop more slowly. Interventions tested so far have shown that extending length of treatment and placing greater emphasis on exercise can at least delay weight regain. The desired permanent solution to the problem of long-term weight maintenance, however, still seems far off. At this point in time, fresh ideas are needed for attacking the problem. A careful study of differences, behaviorally and psychologically, between the processes of weight loss and maintenance is a high priority for research on this important health issue.

References


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