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Long-Term Effects of Interventions for Weight Loss Using Food Provision and Monetary Incentives

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One hundred seventy-seven men and women who had participated in an 18-month trial of behavioral interventions involving food provision and financial incentives were examined 12 months later. Food provision, but not financial incentives, led to better weight loss than standard behavioral treatment during the 18-month trial, but over 12 additional months of no-treatment follow-up, all treated groups gained weight, maintained only slightly better weight losses than a no-treatment control group, and did not differ from each other. Weight loss success during both active treatment and maintenance was associated with increase in exercise, decrease in percentage of energy from fat, increase in nutrition knowledge, and decrease in perceived barriers to adherence. Obesity treatment research should focus on developing better ways to maintain changes in the diet and exercise behaviors needed for sustained weight loss.

Most research on the outpatient treatment of obesity has focused on methods for inducing weight loss. The cumulative effect of numerous studies that have compared the short-term efficacy of alternative intervention approaches has been an overall improvement in the ability to induce significant weight loss in obese patients (Brownell & Jeffery, 1987; Brownell & Wadden, 1991). Difficulties in maintaining weight loss, however, have remained. Although well-controlled long-term follow-up studies are relatively few in number, most indicate that individuals who refer themselves to obesity treatment have difficulty maintaining weight losses regardless of their initial treatment regimen (Goodrick & Foreyt, 1991; Kramer, Jeffery, Forster, & Snell, 1989; Stalonas, Perri, & Kerzner, 1984; Wadden & Stunkard, 1988). Thus, weight maintenance is a priority area for obesity treatment research.

A number of fundamental questions about weight maintenance are at present unanswered. Although data suggest that better initial weight losses are related to better long-term outcome among individuals (Jeffery, Wing, & Stunkard, 1978), it is unclear whether the same can be said of interventions (i.e., do treatment approaches that increase initial weight losses also produce better long-term effects?). Likewise, although sustaining interventions over a longer time period improves weight loss (Bennett, 1986; Perri, Nezu, Patti, & McCann, 1989; Wadden et al., 1994), the superiority of such treatments after intervention stops is not well established. It is also unclear whether behavioral and psychological changes that accompany successful initial weight losses are equally important in weight maintenance (Brownell, Marlatt, Lichtenstein, & Wilson, 1986).

The present investigation attempted to address some of these questions about long-term weight maintenance. It specifically evaluated the long-term efficacy of two new behavioral interventions for obesity treatment, one using direct reinforcement for weight loss and the second using food provision. These interventions were initially evaluated over a period of 18 months, during which it was found that adding food provision, but not direct reinforcement to a standard behavioral program significantly improved weight losses (Jeffery et al., 1993). Food provision was also associated with greater attendance at treatment sessions, lower dietary fat intake, and improved nutrition knowledge. Correlational analyses at an individual level showed that increases in exercise and decreases in dietary fat intake were the strongest behavioral predictors of weight change over this time period (Harris, French, Jeffery, McGovern, & Wing, 1994).

The present article reexamines participants in this trial at 30 months, 12 months after the termination of all treatment. The goals were to assess (a) whether any of the weight loss therapies tested would lead to successful long-term weight loss, compared with a no-treatment control group; (b) whether the superiority of the food provision treatment would be maintained after food was no longer provided; and (c) whether process variables that were associated with success during the active phase of treatment would also be associated with weight loss maintenance.

Method

Participants

Participants in this study were 101 men and 101 women recruited through public advertisement in Pittsburgh, Pennsylvania, and Minneapolis–St. Paul, Minnesota. To participate, individuals had to be between 14 and 32 kg above insurance industry standards for height and

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weight (Metropolitan Life Insurance Company, 1983), 25 to 45 years of age, nonsmokers, moderate drinkers or nondrinkers, not on any special diet, not taking prescription medications, and free of serious medical problems. Participants averaged 37 years of age and had a mean body mass index of 31. Ninety-two percent were Caucasian, and 50% were college educated.

Treatment Groups

Study participants were randomized by gender and center to one of five experimental groups. These groups have been discussed previously in detail in other publications (Jeffery et al., 1993) and are summarized as follows:

1. A control group, which received no intervention.
2. A standard behavior therapy (SBT) group that participated in group counseling sessions once per week for the first 20 weeks and once per month thereafter, with weekly weigh-ins between sessions. Behavioral counseling included instruction on diet, exercise, and behavior modification techniques. Dietary goals were assigned at 1,000 or 1,500 kcal per day depending on initial body weight. Exercise recommendations were to walk or bike 5 days per week, beginning with a weekly goal of 250 kcal per week and gradually increasing to 1,000 kcal per week. Participants were asked to keep eating and exercise diaries regularly throughout the program.
3. Participants in the third treatment group, SBT + food, were given SBT and also were provided with food each week for 18 months. Food consisted of premeasured and packaged dinners and breakfasts for 5 days per week.
4. The fourth treatment condition, SBT + incentives, consisted of SBT plus an incentive program through which each participant could earn financial rewards up to $25 per week for achieving and maintaining weight loss.
5. The last treatment group, SBT + food + incentives, included all of the treatment elements described earlier in combination (i.e., SBT, food provision, and incentives).

Outcome Measures

The treatments described earlier terminated at 18 months. The present report focuses on the 12 months after this active intervention (i.e., Months 18 to 30). There was no contact between participants and study staff in this interval. Study outcomes were measured at baseline and at 6, 12, 18, and 30 months. The primary outcome of interest was body weight. Secondary measures were total energy intake and percent of energy from fat as assessed by the Block Food Frequency Questionnaire (Block et al., 1986), regular physical activity as assessed by the Paffenbarger Physical Activity Recall (Paffenbarger, Hyde, Wing, & Hsieh, 1986), perceived barriers to adherence derived from a 15-item questionnaire specifically designed for this study, and nutritional knowledge, which was assessed both by a 15-item multiple-choice-true-or-false test and by assessing the accuracy with which participants could estimate the energy content of 22 specific food items. These measures have been described in more detail previously (Jeffery et al., 1993).

Attendance at scheduled treatment sessions was also assessed throughout the 18 months of active treatment as a measure of compliance to treatment recommendations, degree of exposure to intervention influence, or both.

Analysis

The present evaluation focused on (a) weight changes occurring between the end of treatment and follow-up (i.e., between 18 and 30 months), and (b) overall weight losses from baseline to 30 months. Statistical analyses used to assess between group differences were repeated measures analyses of variance (ANOVAs), run separately on changes in the outcome variables between 18 and 30 months and between baseline and 30 months. Factors included in the analysis model were sex, center, treatment group, time, and their interactions. Planned orthogonal contrasts were also included to specifically test for treatment effects that were due to food provision, incentives, the interaction between food provision and incentives, and all active treatments versus the control group.

We conducted process analyses using attendance at treatment sessions, change in energy intake, change in percent calories from fat, change in exercise, change in perceived barriers to adherence, and change in nutrition knowledge as predictors of weight change. Because the distribution of the attendance variable was highly skewed, it was dichotomized for analyses using a median split. The remaining variables were analyzed as continuous variables. Analyses of the associations between weight change and changes in energy intake, fat intake, exercise, perceived barriers, or nutrition knowledge included all five experimental groups. Associations were examined for each time interval (baseline to 18 months, 18 months to 30 months, and baseline to 30 months) by performing bivariate correlations. In addition, multivariate regressions were performed that also controlled for treatment group, sex, and baseline body weight. Bivariate and multivariate analyses showed the same pattern of significant findings. Thus, for simplicity in interpretation, the bivariate associations are the primary focus of the results presented later.

Analyses of attendance as a predictor of long-term weight loss were necessarily restricted to participants in the four active treatment groups. Analyses included bivariate t tests for each time interval and regression analyses that controlled for weight change during the active treatment phase (baseline to 18 months).

Results

Of the 202 individuals enrolling in the study, 177 (88%) completed the 30-month follow-up evaluation. There were no differences among treatment groups, centers, or sex in the percent of participants lost to follow-up.

Overall, the weight losses observed in this study (baseline to 30 months) were as follows. Individuals in the control condition gained an average of 0.6 kg (SD = 5.3), those in the SBT group lost 1.4 kg (SD = 7.2), those in the SBT + food group lost 2.2 kg (SD = 6.6), those in the SBT + incentives group lost 1.6 kg (SD = 5.5), and those in the SBT + food + incentives group lost 1.6 kg (SD = 6.3). A repeated measures ANOVA indicated that there was no overall difference between treatment groups in average weight loss at 30 months, $F(4, 157) = 0.87$, $p > .45$. The post hoc planned contrast analyses indicated an effect, comparing all treatment groups with the no-treatment group, that approached conventional levels of statistical significance, $F(1, 157) = 3.14$, $p < .08$. However, the superiority of food provision that was seen at earlier time points was not maintained at 30 months. The proportion of participants losing ≥9 kg from baseline to 30 months ranged from 0% in the control group to 8 to 17% in the active treatment groups; the proportion maintaining some weight loss ranged from 53% in the control group to 51 to 73% in the active treatment groups.

The patterns of weight change over the entire study are shown in Figure 1 by treatment group. The numbers in this figure are based on individuals who were present at every assessment session throughout the study (N = 153) and, thus, are not identical numerically to those noted earlier. Individuals in the two food provision conditions lost more weight than those in other

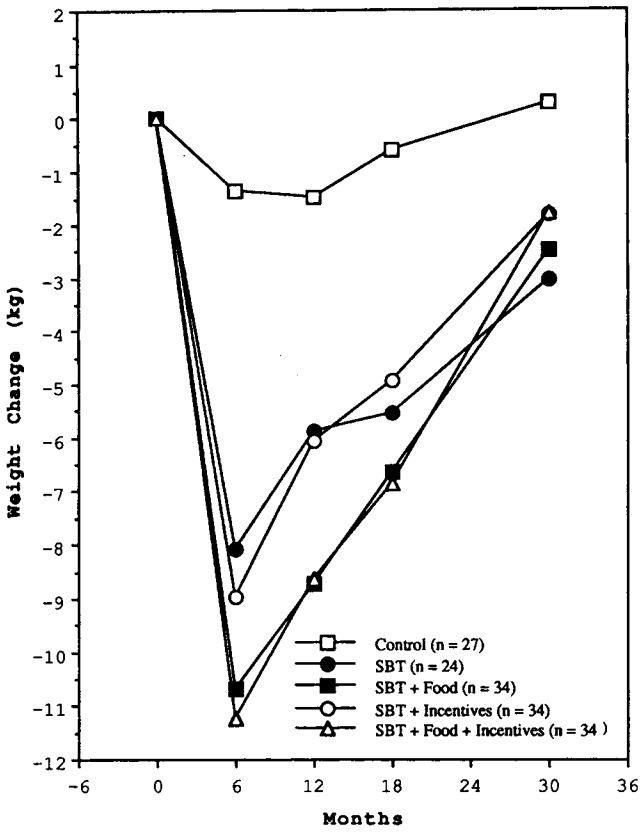

Figure 1. Weight change over time by treatment group. SBT = standard behavioral treatment.

groups initially and, although individuals in all weight loss groups gained weight gradually after 6 months, this differential was maintained throughout the 18 months of active treatment. Once formal treatment was withdrawn, weight "regain" continued in the active treatment groups so that all converged in average weight loss toward the no-treatment condition. Statistical analysis of changes in weight between 18 and 30 months revealed a significant Time × Treatment Group interaction, $F(4, 147) = 5.94$, $p < .0002$. Planned orthogonal contrasts showed this effect to be primarily due to greater weight gain in all active treatment conditions than in the control group during this time period, $F(1, 147) = 17.38$, $p < .0001$, and, to a lesser extent, to greater weight gain among participants in the incentive groups versus those not receiving incentives, $F(1, 147) = 4.75$, $p < .03$. There were no significant effects for food provision or the interaction between food provision and incentives.

Further analyses also showed that the rapid weight gain among treated individuals after the termination of formal treatment was strongly related to initial weight loss success. When analysis of weight change from 18 to 30 months was repeated with weight loss from 0 to 6 months as a covariate, the significant Time × Treatment effect disappeared, $F(4, 136) = 0.83$, $p > .50$, as did the effects associated with the planned contrasts. In other words, virtually all of the difference in weight regain between 18 and 30 months was accounted for by differences in initial weight loss, $F(1, 136) = 20.46$, $p < .0001$.

The failure of the food provision treatment to maintain its superiority over time appeared to be due to the inability to maintain superior behavior change. Whereas at 18 months the food provision group reported greater improvements in dietary fat intake and nutrition knowledge, at 30 months there were no significant differences between groups in dietary intake, exercise, perceived barriers, or nutrition knowledge.

Long-term changes in these behaviors were related to long-term outcome on an individual level. Four variables predicted weight change from baseline to 30 months in both bivariate and multivariate analysis: reductions in percentage of dietary calories from fat ($r = .20$, $p < .01$), increases in exercise ($r = .22$, $p < .01$), reduced barriers to adherence ($r = .33$, $p < .0001$), and increases in nutrition knowledge as assessed by the 15-item quiz ($r = -.21$, $p < .01$). Three of these four variables also predicted weight change in the same direction, although less strongly during the 18-to-30-month time period: change in percent calories from fat ($r = .14$, $p < .09$), change in exercise ($r = .19$, $p < .02$) and change in perceived barriers ($r = .44$, $p < .0001$).

The final process variable that was associated with success in the initial 18 months of intervention was attendance at the treatment sessions. Further analysis of weight loss in relation to this variable at 30 months indicated that it continued to predict overall weight loss. High attenders through 18 months ($n = 58$) had greater overall weight loss at 30 months, 3.6 kg, than low attenders ($n = 63$), 0.7 kg. However, attendance did not predict success in weight maintenance between the 18- and 30-month points in analyses controlling for initial weight loss.

Discussion

The overall results of this evaluation reemphasize the important point that maintaining weight loss in obese patients is a difficult and persistent problem. Use of food provision as a component of a behavioral treatment program increased weight loss during the first 18 months of the intervention, but there was no evidence that this strategy improved weight maintenance. Given that food provision produced greater changes in dietary behavior (i.e., reduction in fat intake) and greater increases in nutrition knowledge during the initial program, it is of interest that there were no lasting effects of this technique.

The interventions tested here had a reduced frequency of face-to-face counseling after 6 months, which may explain why weight maintenance between 6 and 18 months was somewhat less than in some previous studies examining long-term treatments for obesity (Perri et al., 1989; Wadden, Foster, & Letizia, 1994). Nevertheless, a substantial amount of intervention was provided over an extended time, including weekly food provision and reinforcement. The fact that treatment of any kind was only marginally better than no treatment at all at 30 months provides no evidence to suggest that extensive weight loss intervention improved weight maintenance after the treatment stopped. We found that participants who attended the most treatment sessions, and consequently might have been expected to learn the most and to establish the most consistent new eating and exercise habits, had somewhat better overall weight losses. However, there was no evidence that these individuals were less

vulnerable to weight regain after active treatment ended than those with less exposure to the treatment.

During the past decade, the weight control field has identified several new techniques to improve initial weight loss in treatment programs, including the use of very low-calorie diets (National Task Force on the Prevention and Treatment of Obesity, 1993), new pharmacologic agents (Goldstein et al., 1994), and now the use of food provision. However, none of these techniques have been found to improve long-term outcome. Whereas these techniques increase initial weight loss, posttreatment weight regain has also increased (Wing, Blair, Marcus, Epstein, & Harvey, in press). The results of the present study thus reinforce the idea that merely increasing initial weight loss is not an effective approach to improving long-term weight outcome.

Results of the present study also provide little support for the idea that behavioral processes governing weight maintenance are different from those governing weight loss (Brownell et al., 1986). The strongest predictors of weight loss during the 18-month treatment were changes in dietary fat intake, exercise, perceived barriers to adherence, and nutrition knowledge. These same variables also predicted weight change between 18 and 30 months.

It is believed that this research makes two important general points that may inform future research on weight maintenance. First, the behavior problems in maintenance often begin early in treatment and, thus, may need to be addressed at this point rather than at a later "maintenance" phase. As shown in this study, weight regain was beginning to occur as early as Month 6 of the program. Second, the same behavior changes seem to predict both weight loss and weight maintenance. Developing strategies to help participants maintain their eating and exercise behaviors and to overcome the barriers for the behavior changes is essential to long-term weight control success.

References

Bennett, G. A. (1986). Behavior therapy for obesity: A quantitative review of the effects of selected treatment characteristics on outcome. *Behavior Therapy, 17,* 554–562.

Block, G., Hartman, A. M., Dresser, C. M., Carroll, M. D., Gannon, J., & Gardner, L. (1986). A data-based approach to diet questionnaire design and testing. *American Journal of Epidemiology, 124,* 453–469.

Brownell, K. D., & Jeffery, R. W. (1987). Improving long-term weight loss: Pushing the limits of treatment. *Behavior Therapy, 18,* 353–374.

Brownell, K. D., Marlatt, G. A., Lichtenstein, E., & Wilson, G. T. (1986). Understanding and preventing relapse. *American Psychologist, 41,* 765–782.

Brownell, K. D., & Wadden, T. A. (1991). The heterogeneity of obesity: Fitting treatments to individuals. *Behavior Therapy, 22,* 153–177.

Goldstein, D. J., Rampey, A. H., Enas, G. G., Potvin, J. H., Fludzinski, L., & Levine, L. R. (1994). Fluoxetine: A randomized clinical trial in the treatment of obesity. *International Journal of Obesity, 18,* 129–135.

Goodrick, G. K., & Foreyt, J. P. (1991). Why treatments for obesity don't last. *Journal of the American Dietetic Association, 91,* 1243–1247.

Harris, J. K., French, S. A., Jeffery, R. W., McGovern, P. G., & Wing, R. R. (1994). Dietary and physical activity correlates of long-term weight loss. *Obesity Research, 2,* 307–313.

Jeffery, R. W., Wing, R. R., & Stunkard, A. J. (1978). Behavioral treatment of obesity: The state of the art 1976. *Behavior Therapy, 9,* 189–199.

Jeffery, R. W., Wing, R. R., Thorson, C., Burton, L. R., Raether, C., Harvey, J., & Mullen, M. (1993). Strengthening behavioral interventions for weight loss: A randomized trial of food provision and monetary incentives. *Journal of Consulting and Clinical Psychology, 61,* 1038–1045.

Kramer, F. M., Jeffery, R. W., Forster, J. L., & Snell, M. K. (1989). Long-term follow-up of behavioral treatment for obesity: Patterns of weight regain among men and women. *International Journal of Obesity, 13,* 123–136.

Metropolitan Life Insurance Company. (1983, January–June). 1983 Metropolitan height and weight tables. *Statistical Bulletin,* 3–9.

National Task Force on the Prevention and Treatment of Obesity. (1993). Very low calorie diets. *Journal of the American Medical Association, 270,* 967–974.

Paffenbarger, R. S., Hyde, R. T., Wing, A. L., & Hsieh, C. (1986). Physical activity, all-cause mortality, and longevity of college alumni. *New England Journal of Medicine, 314,* 605–613.

Perri, M. G., Nezu, A. M., Patti, E. T., & McCann, K. L. (1989). Effect of length of treatment on weight loss. *Journal of Consulting and Clinical Psychology, 57,* 450–452.

Stalonas, P. M., Perri, M. G., & Kerzner, A. B. (1984). Do behavioral treatments of obesity last? A five-year follow-up investigation. *Addictive Behaviors, 9,* 175–183.

Wadden, T. A., Foster, G. D., & Letizia, K. A. (1994). One-year behavioral treatment of obesity: Comparison of moderate and severe caloric restriction and the effects of weight maintenance therapy. *Journal of Consulting and Clinical Psychology, 62,* 165–171.

Wadden, T. A., & Stunkard, A. J. (1988). Three-year follow-up of the treatment of obesity by very low calorie diet, behavior therapy, and their combination. *Journal of Consulting and Clinical Psychology, 56,* 925–928.

Wing, R. R., Blair, E., Marcus, M., Epstein, L. H., & Harvey, J. (in press). Year-long behavioral weight loss treatment: Does inclusion of an intermittent very low calorie diet improve outcome for obese patients with Type II diabetes? *American Journal of Medicine.*

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