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Where Do Diets, Exercise, and Behavior Modification Fit in the Treatment of Obesity?

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Obesity is a significant public health concern that affects a growing number of people in the United States and throughout the world. While substantial advances have been made in the development of new pharmacotherapies and in understanding the biological underpinnings (e.g., genetics and physiology) of obesity, lifestyle modification, which involves the application of behavior modification principles to alter eating and activity patterns, is the foundation of any comprehensive obesity management. The purpose of this article is to provide a practical overview of the benefits of dietary and activity change and to review behavior modification principles that have been used successfully in obesity management.

Key Words: Diet; physical activity; exercise; behavior modification.

Introduction

Obesity has been estimated to contribute to 280,184 (range = 236,111–341,153) deaths per year in the United States *(1)*. In fact, the number of obesity-related deaths actually rises after controlling for other health risks, with the mean estimate for obesity-related deaths equal to 324,940 (range 262,541–383,410) per year. Although the total population burden of obesity in the United States cannot be precisely quantified, it clearly constitutes a major health concern. In response to the rising tide of obesity, there has been an explosion of treatment programs, diets, low-fat foods, fitness centers, medications, and specially trained medical professionals dedicated to combating excessive body weight *(2)*. Despite the attention and resources directed at the problem of obesity, its prevalence continues to climb *(3)*.

Because obesity is the result of an energy imbalance, the goal of treatment programs is to produce a net energy deficit. By increasing energy output (i.e., by increasing physical activity), decreasing energy intake (i.e., a hypocaloric diet), or optimally both, a net energy deficit is produced. The resulting weight loss is proportional to both the size and duration of the energy deficit *(4)*. Most obesity experts advocate a comprehensive treatment program including behavior modification, dietary improvements and restrictions, and physical activity in order to achieve long-term weight loss and reduce health comorbidities *(5,6)*. Diet and exercise programs are included in behavioral approaches to the treatment of obesity because they are learned behaviors that influence body weight and can be modified *(7)*. Furthermore, behavioral programs can be used to treat binge eating and other psychologic problems that may interfere with weight loss *(6)*. Although we believe that behavior modification is key to changes in diet and physical activity, we provide an overview of each component individually.

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Dietary Treatment of Obesity

The dietary restriction necessary to produce weight loss depends on a number of factors, including severity of obesity, other health characteristics of the individual, activity level, and the availability of medical supervision *(4)*. Dietary influences on obesity primarily include overall caloric intake and fat consumption *(6,8,9)*.

Very Low Calorie Diets

Although starvation was advocated as an effective means of weight loss in the 1950s and 1960s, evidence of medical complications and high relapse rates led to its discontinuation *(4,10)*. As an alternative, very low calorie diets (VLCDs), which provide 400–800 kcal/day have been a viable option for individuals who are 30% or more overweight *(11,12)*. When including protein (from a source such as lean meat, fish, or fowl, or protein formulas for liquid diets), VLCDs have been found to be safe under medical supervision for a limited time (16 wk or fewer) *(10–13)*. The use of protein from food sources such as lean meat and fish, as opposed to liquid protein sources, has been associated with less hunger and less disruption of eating patterns. One of the benefits of VLCDs compared to fasting is that they preserve lean body tissue largely because protein is included.

Today, the majority of VLCDs derive most of their calories from protein. VLCDs are often used for a period of 8–16 wk and are often administered by multidisciplinary

teams, including physicians, psychologists, dietitians, and exercise specialists *(14)* who work together to increase adherence to the diet and exercise habits, often using behavioral methods such as self-monitoring and stimulus control. The greatest benefit of the VLCD is the significant weight losses that are usually more than double those associated with conventional 1000–1500 kcal/d diets. In fact, the average weight loss associated with a VLCD is approx 20–25 kg in over 12–16 wk *(11,12)*. Although extending the duration of the VLCD produces additional weight loss, it does so at a point of diminishing returns *(14,15)*. VLCDs also have been utilized prior to obesity surgery to reduce weight and the risk of surgical complications.

The benefit of quick weight loss with VLCDs is apparent, and their short-term efficacy has been established *(11)*. However, their efficacy may be owing to patients having a fixed energy intake, which allows them to stay away from other foods (especially if the diet is liquid), facilitating high levels of adherence *(4)*. Unfortunately, there is little controlled research on the long-term efficacy *(11)*. The few long-term studies available generally have found that individuals treated by a VLCD alone tend to regain substantial amounts of weight within a year *(4,11–13,16)*. This may be owing to high attrition rates, which can range from 25 to 44% *(17)*, or lack of maintenance owing to inconvenience and cost.

VLCDs can lead to reductions in lean body mass, growth problems, cardiac problems, diuresis, dehydration, ketosis, electrolyte imbalances and nutrient deficiencies, lower resting metabolic rate (RMR), lethargy, lightheadedness, anemia, constipation, menstrual irregularity, and hair loss *(4,11)*. Therefore, VLCDs should be used with caution and supplemented with vitamins, potassium, magnesium, other minerals, and adequate carbohydrates *(6)*. Generally, if used correctly and under the supervision of a physician, patients experience minimal compliz ïˆons (e.g., fatigue, dizziness, headache, cold intolerance). Symptoms usually subside when the treatment is completed *(16)*.

Low-Calorie Diets

Low-calorie diets (LCDs) are based on the same principle of reducing energy intake as the VLCD, but with LCDs the caloric intake is generally between 1200–1500 kcal/d. LCDs are the basis of many commercial weight loss programs (e.g., Weight Watchers, Jenny Craig, Nutri/System, and Diet Center). Although LCDs are less likely to result in metabolic complications that are often associated with VLCDs, LCDs are still below RMR for many adults, so the benefits can be significant. LCDs generally are based on regular foods (vs liquid diets that are the basis of many VLCDs), which is beneficial in developing healthy long-term eating habits. Although weight loss is not as rapid and pronounced as with VLCDs, individuals should be examined and medically cleared by their physician before beginning an LCD. In addition, they may need to supplement their diet with essential recommended daily allowances of minerals and vitamins, and consume adequate fiber and fluids *(4)*. LCDs also should be used in conjunction with an exercise plan and behavior modification in order to facilitate a change in lifestyle *(4)*.

Diet Composition

Regardless of the diet option chosen, diet composition is important because it can influence weight loss, the advent of nutritional deficits, loss of lean tissue, and dehydration. Therefore, diets should be carefully balanced and monitored. Many obese individuals prefer foods that are higher in fat (and more palatable) *(18,19)*. However, given the established relationship between high-fat diets, excess adipose stores, and obesity *(6)*, reducing fat intake is usually necessary. Restricting fat and total energy intake has been found to be more efficient in producing weight loss than restricting fat alone, because weight loss is primarily influenced by the amount of energy restriction *(6)*. Thus, restricting fat intake to <30% of total calories is recommended.

Protein is an especially important component of any diet, because deficiencies can lead to a loss of lean muscle tissue, resulting in problems in metabolism, cardiovascular function, exercise tolerance, and resistance to infection *(4)*. A minimum of 70 g of protein is recommended daily. VLCDs may require more protein because amino acids are used to maintain blood sugar and energy levels when energy intake is insufficient *(4)*. LCDs typically contain 15–20% of calories from protein.

Carbohydrates also are important in order to maintain fluid balance and blood sugar levels. It is recommended that individuals consume at least 100 g/d so that insulin levels do not fall, which can lead to protein being used for energy and hence dehydration. Diets containing <100 g of carbohydrates/d are considered to be ketogenic. It is recommended that LCDs include 55% or more of calories from carbohydrates.

Dietary fiber and adequate fluid intake also should be monitored, because they are important in maintaining hydration, laxation, and general health. Other basic guidelines for diet programs include having medical examinations, offering palatable foods *(6)*, and providing nutrition education *(16)*. Vitamin and mineral intake needs to be monitored in any diet containing <1200 kcal/d *(4)*.

Physical Activity

The benefits of physical activity on obesity are well established. Numerous studies *(20–23)* have produced impressive evidence demonstrating that exercise can reduce morbidity and mortality. There are many potential mechanisms by which exercise may facilitate maintenance of lower levels of body weight. They include increased fat-free mass, elevated RMR, increased concentrations of metabolic hormones, decreased preference of high-fat foods, energy expenditure associated with the recovery

process, increased cycling of substrates, and improved psychologic well-being *(24)*.

The best approach in the treatment of obesity may be to review the overall health benefits (in addition to lower weight) with patients in order to offer continual reinforcement for increased physical activity. Physical activity may reduce the risk of death owing to cardiovascular disease, coronary heart disease, hypertension, high cholesterol, colon cancer, type 2 diabetes, obesity, and mental health problems *(20,22,23,25–28)*. For example, physically active people are at a substantially lower risk for major coronary events. Studies also have found that even one bout of physical activity can result in an improved blood lipid profile, which may last for days *(29)*. Physical activity has been shown to have a beneficial effect on relieving symptoms of depression and anxiety and on improving mood *(28)*.

Resistance Training

Recently, the use of resistance training has gained more appeal because it increases muscular strength, preserves fat-free mass, and increases daily expenditure *(24)*. The American College of Sports Medicine recommends performing strength-developing activities at least twice per week *(28)*. Poehlman et al. *(30)* conducted a cross-sectional study examining the effects of exercise on metabolic rate that included aerobics-trained, resistance-trained, and control males. They found that RMR among the resistance-trained group was 5% higher than that of the control subjects and that the RMR of aerobics-trained males was 10% higher than that of the control subjects.

Aerobic Exercise

Aerobic activity often is used for weight loss or maintenance in obesity management. According to the U.S. Surgeon General's report on physical activity *(28)*, aerobic activity is defined as "training that improves the efficiency of aerobic energy-producing systems and that can improve cardiorespiratory endurance" (p. 21). For example, several intervention studies *(31–33)* indicated that endurance training significantly increased total energy expenditure (TEE) in men (total change in TEE ranged from 301 to 956 kcal/d). There are several different levels of physical activity, i.e., low/light (e.g., walking 2 mph or riding a stationary bicycle), moderate (e.g., walking 3 to 4 mph), hard or vigorous (e.g., cycling, karate, tennis, or walking 4 to 5 mph), and very hard or very vigorous (e.g., circuit training, jumping rope, running, or swimming) *(34)*, but aerobic endurance training usually occurs only when an individual is active at moderate or greater intensity for at least 2 d/wk *(35)*. Thus, the American College of Sports Medicine now recommends that everyone over the age of 2 should engage in at least 30 min of endurance-type physical activity, of at least moderate intensity, on most, but preferably all, days of the week *(28,36)*.

Lifestyle Activity

Recently, it has been determined that increasing lifestyle activity may offer similar health benefits as regular aerobic activity *(28)*. Lifestyle activity includes many common activities that people can easily do every day such as climbing stairs, parking farther away from the door at work or elsewhere, increasing housework or yard work, and walking briskly. Specific examples of low/light intensity lifestyle activities include sweeping the carpet and mowing the lawn with a riding mower. Moderate intensity lifestyle activities may include general housecleaning or mowing the lawn with a power mower. Finally, hard intensity lifestyle activities may include moving furniture and mowing the lawn using a hand mower.

Exercise initiation and adherence represent two major challenges for obese patients. Many obese patients perceive exercise as a chore and have difficulty adhering to structured exercise programs *(37)*. This may be because many providers prescribe physical activity plans that are not suited to obese individuals (e.g., the plan may be very strenuous and painful for obese patients). Studies have suggested that for obese individuals, diet plus lifestyle activity may offer health benefits similar to those provided by traditional programs of diet and vigorous physical activity *(38)*. Thus, researchers have suggested that health care providers focus more on modest, but consistent, lifestyle activity *(39)*. This may be the best option because of the detrimental impact more vigorous activity has on the obese patient's body *(40)*. Lifestyle activity also may improve adherence to increased physical activity because it requires no extra time or equipment *(38)*.

Unfortunately, physical activity alone is generally insufficient in producing substantial weight loss in obese patients. However, exercise is usually associated with sustained weight loss maintenance *(41,42)*. Comprehensive weight control programs combining diet modification with increased exercise and other lifestyle changes often are very effective in producing significant weight loss in people with mild to moderate obesity *(37)*.

Behavioral Strategies

Behavioral strategies can play a significant role in helping individuals overcome some of the motivational and practical problems inherent in beginning and maintaining exercise and healthy eating habits *(43)*. Behavioral techniques such as goal setting, self-monitoring, stimulus control, contracting, cognitive restructuring, stress management, social support, financial incentives, and relapse prevention may be some of the most promising techniques in adopting and maintaining healthy lifestyles *(44,45)*. Behavioral techniques may be used alone or in a combination.

Goal Setting

Goal setting is an important part in the initiation of a treatment program. Patients may set goals for calories, fat, physical activity, and any other behavioral aspects they wish to modify. Short-term goals that the patient can reasonably achieve should be emphasized *(46)*. The goal in behavioral weight loss programs typically is to lose 1 to 2 lb/wk. To achieve this loss, patients are usually given a goal of total calories per day (usually 1200–1500 kcal). Working toward a realistic goal that is specific can heighten self-efficacy and promote behavioral change *(44)*. The physician or health care provider should work with the patient to set personal goals. It is necessary in most cases to include a time frame in the goal. For a person who is sedentary, a reasonable goal might be walking 20 min three times a week for the next 2 wk. When this goal is attained, the next goal level is set. If a patient is not able to attain the goal, the physician and patient can reevaluate the goal and why it was not met. Such situations can teach patients problem-solving skills *(44)*.

Self-Monitoring

Self-monitoring is a technique used to identify patterns of weight gain or loss that the patient has observed and recorded. This aids the patient in increasing awareness of situations or emotions that may be a threat to adherence *(44)*. When the patient experiences difficulties, self-monitoring provides insight to possible causes, which can prompt the use of problem-solving strategies *(44)*. Self-monitoring may include the use of a food diary to record total caloric intake, total fat intake, food groups, conditions or situations when overeating is common; a physical activity diary to record frequency, duration, and intensity; and weight or body composition measures so that changes may be noted *(47)*.

Stimulus Control

Stimulus control or cuing is a powerful tool at the disposal of the physician. Stimulus control suggests that a behavior is automatic and responsive to the stimuli to which the patient is exposed *(44)*. It involves the identification of environmental cues associated with overeating and inactivity *(47)*. For example, laying out clothes the night before exercising, wearing exercise clothes around the house, or keeping a bag of exercise equipment in the car can help stimulate the desired response of exercise. Another example is restricting the consumption of food to one place (e.g., the kitchen table) or displaying healthy food prominently in the refrigerator, while putting high-calorie/fat food out of sight. Thus, the cues associated with eating are limited and modified. Both verbal and visual prompts can be used. Verbal prompts can include a phone call, television, or a radio announcement. Some positive examples of visual prompts are billboards with people exercising, posters about fitness, observing other people exercising, or even seeing workout clothes.

Behavioral Contracting

Behavioral contracting is another useful technique; data suggest the potential of contracting to improve adherence to exercise *(44,48)*. A behavioral contract has many components. First, it is a written agreement in which contingencies are specified for compliance and noncompliance. Second, the behavior to be changed is described so that it is evident when the behavior occurs. Third, consequences are described clearly so that the patient knows exactly what will be gained or lost. Finally, time limitations and frequency are stated. To be effective, it is important to focus on specific behaviors instead of health outcome (*44*). Behavioral contracting offers several advantages, including the following:

1. Patients are involved in making the contract; thus they are involved and invested in planning their treatment.
2. Contracting provides a written outline of what behaviors are expected so that there is little disagreement or forgetfulness.
3. There is a formal commitment for all involved.
4. The contract provides incentives to change in order to attain the reward or avoid the punishment for nonadherence.

Cognitive Restructuring

Cognitive restructuring involves having patients become more aware of their thoughts and beliefs about themselves and their weight and teaching them to actively challenge and change their internal dialogues *(47)*. Behavioral programs can teach patients to recognize negative thoughts, to understand the function they serve, and then to counter negative thoughts with more positive ones *(46)*. This may be important because many obese patients tend to have poor self-esteem and body image and may hold unrealistic beliefs concerning weight loss *(49)*.

Stress Management

Stress management is a crucial behavioral component of any obesity program because stress is one of the primary predictors of relapse and overeating *(47)*. Stress management skills may include diaphragmatic breathing, progressive muscle relaxation, and meditation. The purpose of stress management is to learn how to reduce sympathetic nervous system arousal and to provide a distraction from a stressful event. This reduces the likelihood that patients will engage in stress-inducing behaviors that contribute to obesity (e.g., binge eating).

Social Support

Social support is an important component of any behavioral treatment plan. For many people, increasing support and reducing intended or unintended undermining by family members and friends can be a major part of success *(50)*.

Table 1
Behavioral Characteristics of Weight Loss Maintainers vs Weight Loss Regainers and Control Subjects[a]

Behavioral factor	Weight loss maintainers	Weight loss regainers	Control Subjects	*p* value
Physical activity[b] (M, SD)				
Number of strenuous activities/wk	1.3 (2.4)	0.5 (1.0)	0.8 (1.4)	0.02
Number of sweat episodes/wk	2.8 (2.5)	1.8 (1.7)	1.9 (2.4)	0.03
Total activity score	27.8 (27.2)	16.2 (17.6)	18.2 (19.5)	0.01
Changes in eating habits[c] (M, SD)				
Avoid frying foods	1.5 (0.4)	1.7 (0.5)	1.7 (0.5)	0.01
Substitute low-fat for high fat	2.4 (0.9)	2.9 (0.8)	2.8 (0.9)	0.001
Total summary score	2.1 (0.5)	2.4 (0.4)	2.4 (0.5)	0.001
Weighing at least once a week (%)	55	36	35	0.02

[a]Adapted from ref. *55*.
[b]Scores from the Leisure Time Exercise Questionnaire.
[c]Scores from the Food Habits Questionnaire (scores positively correlate with dietary fat intake).

Numerous studies *(51,52)* have shown that patients with higher levels of support do better in weight loss programs. Patients need to learn to deal with social interactions that threaten their weight loss efforts.

Financial Incentives

Financial incentives are another behavioral strategy that can be used to improve diet and exercise adherence. Financial incentives can be used as positive reinforcement and may include lotteries *(48)* or financial rewards based on attendance *(45)*.

Relapse Prevention

Lapses are a natural part of the weight loss process. Making sure that patients understand this is an important aspect of behavioral treatment. Thus, patients are instructed how to prepare for and anticipate events that might cause them to lapse *(46)*. They develop strategies to cope with these situations. In essence, patients are prepared for whatever may happen and have some plan to cope with it.

Results of Using Behavioral Strategies

Obesity interventions that incorporate the discussed strategies are effective at producing gradual and moderate weight losses and are predictive of weight maintenance *(53,54)*. For example, McGuire et al. *(55)* found that patients who had maintained their weight losses for at least 1 yr were much more likely to engage in regular physical activity, modify their eating habits, and weigh themselves than weight loss regainers or control subjects (*see* Table 1). Summing across multiple behavioral intervention studies, results suggest that average weight losses are over 8 kg and attrition rates are generally low (13–22%) *(54,56)*. Obesity interventions using behavioral strategies last approximately 20 wk or longer and patients are able to maintain, on average, about two-thirds of their initial weight loss 9 to 10 mo after treatment termination *(54,56)*. Behavioral strategies, as part of an extended comprehensive treatment, have been found consistently to predict weight loss during treatment *(54,56)* (*see* Fig. 1).

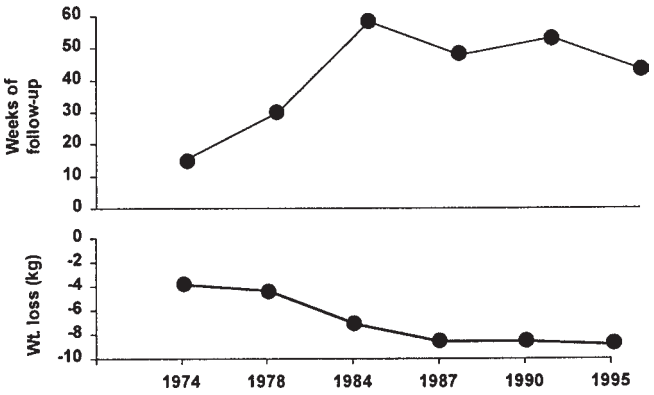

Fig. 1. Summary of research on behavior therapy of obesity from 1974 to 1995. (Used with permission from Dr. George Bray.)

Conclusion

Lifestyle modification, which involves utilizing behavior modification principles to make changes in diet and physical activity patterns, is the foundation on which all other obesity treatments rest. Although adjunctive pharmacotherapies and surgical treatments can enhance weight loss and maintenance, obese patients always have to make some alterations in their lifestyle in order to experience long-term success. Thus, the principles of behavior modification as applied to eating and activity patterns that we have outlined are necessary but not always sufficient components of any comprehensive obesity management program. Given the significant environmental influences on obesity in the United States (i.e., sedentary lifestyle and overnutrition), obesity patients will need to be trained in the methods we have discussed for long-term weight management.

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