

Treatment of Obesity: An Overview

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To be overweight in the United States is to be a member of the majority. Recent data indicate that fully 64% of American adults are either overweight (body mass index [BMI] = 25.0–29.9 kg/m²) or obese (BMI ≥30 kg/m²).¹ These figures represent a sharp increase over the value of 55% in 1994² and reflect a doubling in the rate of obesity since 1980 (i.e., from 15 to 30%).¹ The World Health Organization has labeled obesity a global epidemic³; indeed, a recent report estimated that 1 billion people worldwide are overweight and 300 million are obese.⁴ In the United States, obesity has been estimated to cost approximately \$99 billion a year, principally through its association with cardiovascular disease, type 2 diabetes, and some types of cancer.⁵

There is good news amidst these alarming statistics—small weight losses can have large health benefits. Recent studies have shown that a 5–10% reduction in initial weight is associated with significant improvements in blood pressure, cholesterol levels, and glycemic control.⁶

Results of the Diabetes Prevention Program (DPP)⁷ have provided the most definitive evidence to date of the health benefits of modest weight loss. More than 3,200 overweight individuals with impaired glucose tolerance (IGT) were randomly assigned to one of three conditions: 1) placebo; 2) metformin (Glucophage, 850 mg/day); or 3) a lifestyle intervention designed to induce a loss of 7% of initial weight and to increase physical activity to ≥150 minutes per week. Participants were treated for up to 4 years. The maximum weight loss in

lifestyle-treated patients was ~7 kg (at month 6), which declined to ~4 kg (at year 4). As shown in Figure 1, participation in the lifestyle intervention reduced the risk of developing type 2 diabetes by 58% compared with placebo and by 39% compared with metformin. The preventive effect of lifestyle intervention held for members of both sexes and all racial and ethnic groups.

The DPP clearly showed that weight loss and increased physical activity can prevent the development of type 2 diabetes.⁷ A follow-up trial, Action for Health in Diabetes (i.e., Look AHEAD), is now investigating whether modest weight loss (≥7%) and increased physical activity (≥175 minutes per week) will reduce the incidence of fatal and nonfatal heart attack and stroke in overweight individuals who already have type 2 diabetes. This is the first randomized, prospective trial to examine this issue.

There are numerous options for the treatment of obesity. A collaboration between the National Heart, Lung, and Blood Institute (NHLBI) and the North American Association for the Study of

Obesity (NAASO) produced the *Practical Guide to the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults*.⁸ The NHLBI/NAASO guide contains an algorithm for selecting appropriate treatments for overweight and obese individuals based on BMI and estimated disease risk. The present article provides an overview of the treatment algorithm (Table 1) and briefly reviews the empirical literature for each level of treatment. Weight loss issues specific to patients with diabetes are then discussed, as are suggestions to reduce the prevalence of obesity.

TREATMENT OF OBESITY

Lifestyle Modification

The NHLBI/NAASO algorithm⁸ recommends that individuals with a BMI ≥30 kg/m², as well as those with a BMI of 25.0–29.9 kg/m² plus two or more disease risk factors, attempt to lose weight by adhering to a program of diet, exercise, and behavior therapy. These three components are frequently referred to as lifestyle modification and are the cornerstone of obesity treatment. Lifestyle modification is distinct from dieting. Dieting implies adhering to a particular regimen for a discrete period of time, whereas lifestyle modification involves implementing dietary and behavioral changes that can be sustained indefinitely to promote health.

Dietary interventions

Dietary interventions for obesity are designed to create a negative energy balance (i.e., calories ingested < calories expended) by reducing daily energy

IN BRIEF

Obesity and type 2 diabetes commonly co-occur. Weight loss is associated with significant health benefits, including improved glycemic control and reduced blood pressure. This article reviews approaches to the treatment of obesity, considers special issues relevant to obese patients with type 2 diabetes, and presents suggestions for the prevention of obesity.

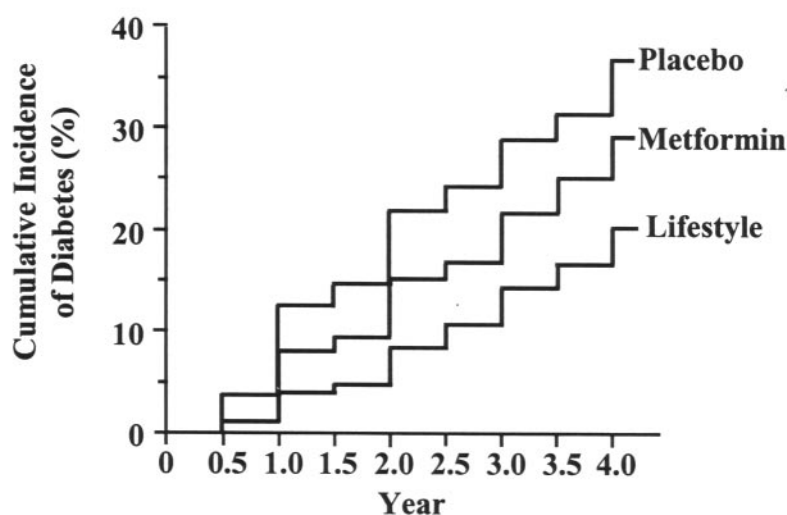


Figure 1. Cumulative incidence of diabetes for participants in the Diabetes Prevention Program. The diagnosis of diabetes was based on the criteria of the American Diabetes Association. The incidence of diabetes differed significantly among the three groups ($P \leq 0.001$ for each comparison). Reprinted with permission from Ref. 7.

intake below energy requirements. Energy requirements vary by sex, weight, and level of physical activity such that men, heavier individuals, and more active individuals have greater energy needs.⁹ Uniformly, however, greater energy deficits result in greater weight losses. Two levels of reducing diets are described below.

Low-calorie diets (LCDs). An LCD is designed to create an energy deficit of 500–1,000 kcal/day and induce a weight loss of 0.5–1 kg/week. The NHLBI/

NAASO guide recommends LCDs of 1,000–1,200 kcal/day for most overweight women and 1,200–1,600 kcal/day for overweight men (and for women who exercise regularly or weigh ≥ 75 kg).⁸ The recommended macronutrient composition of these diets is shown in Table 2.

Careful self-monitoring of calorie intake is crucial to the success of LCDs. Obese individuals underestimate their intake by ~30–50%.¹⁰ Thus, patients must be instructed in reading food

labels, measuring portion sizes, and recording their food intake as soon as possible after eating. The more self-monitoring records patients complete each week, the more weight they lose.¹¹

There are several options for facilitating adherence to an LCD, including the use of structured meal plans. Wing et al.¹² randomized women to one of four weight loss groups, with varying levels of structure: 1) behavior therapy alone with a self-selected diet of conventional foods; 2) behavior therapy plus a prescribed menu for five breakfasts and five dinners per week; 3) behavior therapy plus the prescribed foods at a decreased price; and 4) behavior therapy plus the prescribed foods at no cost. Participants in groups 2, 3, and 4 lost significantly more weight after 6 months of treatment and maintained greater losses at 18 months' follow-up than did those in group 1. This finding suggests that the provision of structure induces greater weight loss than does behavior therapy alone with a self-selected diet. There were no differences in weight loss among groups 2, 3, and 4 at the end of treatment or at follow-up. This finding indicates that providing detailed menus is sufficient to structure patients' dietary adherence. Jeffery et al.¹³ have reported similar findings concerning the benefits of structured meal plans.

Table 1. A Guide to Selecting Treatment

Treatment	BMI Category (kg/m ²)				
	25–26.9	27–29.9	30–34.9	35–39.9	≥ 40
Diet, physical activity, and behavior therapy	With comorbidities	With comorbidities	+	+	+
Pharmacotherapy		With comorbidities	+	+	+
Surgery					With comorbidities

Note. Prevention of weight gain with lifestyle therapy is indicated in any patient with a BMI ≥ 25 kg/m², even without comorbidities, whereas weight loss is not necessarily recommended for those with a BMI of 25–29.9 kg/m² or a high waist circumference unless they have two or more comorbidities. Combined therapy with a low-calorie diet, increased physical activity, and behavior therapy provide the most successful intervention for weight loss and weight maintenance. Consider pharmacotherapy only if a patient has not lost 1 lb/week after 6 months of combined lifestyle therapy. The + represents the use of indicated treatment regardless of comorbidities. Reprinted from Ref. 8.

Table 2. Low-Calorie Step I Diet

Nutrient	Recommended Intake
Calories	~500–1,000 kcal/day reduction from usual intake
Total fat	30% or less of total calories
Saturated fatty acids	8–10% of total calories
Monounsaturated fatty acids	Up to 15% of total calories
Polyunsaturated fatty acids	Up to 10% of total calories
Cholesterol	<300 mg/day
Protein	~15% of total calories
Carbohydrate	55% or more of total calories
Sodium chloride	No more than 100 mmol/day (~2.4 g of sodium or ~6 g of sodium chloride)
Calcium	1,000–5,000 mg/day
Fiber	20–30 g/day

Reprinted from Ref. 8.

Liquid meal replacements provide another method of facilitating adherence to an LCD. Ditschuneit et al.¹⁴ showed that patients who replaced two meals a day with a shake lost 8% of initial weight during 3 months of treatment, whereas those who were prescribed the same number of calories (i.e., 1,200–1,500 kcal/day) but consumed a self-selected diet of conventional foods lost only 1.5% of initial weight. Ashley et al.¹⁵ similarly found that a liquid meal replacement produced significantly larger losses than a conventional diet with the same calorie goal.

Meal replacements may also facilitate the maintenance of weight loss. Patients in the Ditschuneit study who continued to replace one meal and one snack a day with shakes or snack bars maintained an 8% weight loss at 51 months.¹⁴ In another study,¹⁶ men who were given meal replacement products for 5 years achieved and maintained a loss of 5.8 kg at the end of that time, while women achieved and maintained a loss of 4.2 kg. Male and female controls in this nonrandomized study gained an average of 6.7 and 6.5 kg, respectively, during the same 5-year period.

Very-low-calorie diets (VLCDs). VLCDs are typically recommended for

patients with a BMI ≥ 30 kg/m² who have failed to lose weight using an LCD.¹⁷ VLCDs provide 200–800 kcal/day, with large amounts of protein (70–100 g/day) to preserve lean body mass. Liquid formula diets are supplemented with vitamins and minerals that also must be taken if a diet of lean meat, fish, or fowl is consumed. VLCDs should only be used under appropriate medical supervision.

These diets produce weight losses of 15–25% in 8–16 weeks,¹⁷ but are not as widely used today as a decade ago. This can be attributed to their cost (i.e., approximately \$3,000 for a 6-month program) and to findings of significant weight regain. Several randomized trials found VLCDs to be no more effective than LCDs 1 year after treatment.^{18–21} These findings led an expert panel convened by NHLBI not to recommend the use of VLCDs.²²

Physical activity

Physical activity is the second component of lifestyle modification. The benefits of physical activity include inducing negative energy balance (by increasing calorie expenditure), sparing fat-free mass during weight loss, and improving cardiovascular fitness. Physical activity, however, produces minimal weight loss

in the absence of caloric restriction. To illustrate: a program of walking 45–60 minutes 4 days a week will create a deficit of approximately 1,000 kcal over the course of a week, with the resulting loss of 0.15 kg. By contrast, LCDs are designed to induce weekly deficits of 3,500–7,000 kcal, with weight losses of 0.5–1 kg per week.

The greatest benefit of physical activity is in facilitating the maintenance of weight loss.²³ Case studies have shown that people who exercise regularly are more successful in maintaining weight losses than are those who do not exercise.^{24,25} Additional evidence comes from randomized trials. Participants who receive diet plus exercise maintain greater weight losses 1 year after treatment than do those who receive diet alone, although the differences are not always statistically significant.²⁶

Physical activity can be divided into two types: programmed and lifestyle. Programmed activity is typically planned, aerobic, and completed in a single bout (e.g., walking, biking, aerobics classes). Lifestyle activity involves increasing energy expenditure throughout the day by methods such as using stairs rather than escalators or choosing a distant parking spot. Andersen et al.²⁷ found that the two types of activity, when combined with diet, both produced a loss of ~8 kg in 16 weeks. There was, however, a trend ($P = 0.06$) for lifestyle activity to be associated with less weight regain than was programmed activity 1 year after treatment (0.08 vs. 1.6 kg, respectively). Given these favorable findings, lifestyle activity would appear to be ideal for obese individuals who say they hate to exercise.

Behavior therapy

Behavior therapy provides patients a set of principles and techniques to facilitate their adherence to the diet and activity goals described above. The behavioral approach has been described at length in other publications to which readers are referred.^{28,29} Common techniques include self-monitoring (of food and

activity), stimulus control, slowing eating, cognitive restructuring, problem solving, and relapse prevention.

Behavior therapy typically is delivered to groups of 10–20 participants in 60- to 90-minute sessions for 20–26 weeks. Several reviews have shown that patients lose 9–10% of their starting weight^{28–30} but regain approximately one-third of the lost weight in the year following treatment.³¹ Perri et al.^{32,33} have shown that continued patient-provider contact following treatment, in person or by mail, significantly improves the maintenance of weight loss. Long-term treatment recognizes that obesity is a chronic condition similar to hypertension or diabetes.

Pharmacological Interventions

As BMI or disease risk increase, more intensive options are available for the treatment of obesity. Pharmacotherapy is recommended for individuals with a BMI ≥ 30 kg/m² or with a BMI ≥ 27 kg/m² in the presence of two or more obesity-related comorbidities (e.g., coronary heart disease, type 2 diabetes, or sleep apnea) and who cannot lose weight satisfactorily with more conservative approaches.²² Two medications—sibutramine (Meridia) and orlistat (Xenical)—are approved by the Food and Drug Administration for the induction and maintenance of weight loss.³⁴

Sibutramine is a combined serotonin-norepinephrine reuptake inhibitor that is associated with reports of increased satiation (i.e., fullness). When used with an LCD, sibutramine (10–15 mg/day) produced a significantly greater loss of initial weight (7%) than an LCD plus placebo (2%) over the course of 1 year.³⁵ Reductions of 10–15% have been observed in studies that combined sibutramine with intensive lifestyle modification.^{36,37} However, sibutramine is not recommended for patients with uncontrolled hypertension or a history of coronary artery disease, arrhythmias, congestive heart failure, or stroke. It is also not recommended in combination with certain antidepressant agents, such

as monoamine oxidase inhibitors or selective serotonin reuptake inhibitors.³⁸ Unfortunately, obese individuals are at increased risk for conditions that render the use of sibutramine inappropriate.

Orlistat is a gastric lipase inhibitor that blocks the absorption of about one-third of the fat contained in a meal,³⁹ leading to the loss of about 150–180 kcal/day. Patients are negatively reinforced to eat a low-fat diet because the consumption of more than 20 g of fat per meal, or 70 g of fat per day, can induce adverse gastrointestinal events that include oily stools, flatus with discharge, and fecal urgency. In randomized trials, participants who received placebo plus diet lost 6% of their weight in 1 year, compared with 10% for those treated by orlistat plus diet.^{39,40}

The greatest benefit of pharmacotherapy may reside in facilitating the maintenance, rather than the induction, of weight loss. Two-year studies of sibutramine^{36,41} and orlistat^{39,40} showed that participants who remained on medication at the end of this time maintained losses nearly twice as great as those of participants who received placebo. They also maintained significantly greater improvements in lipid values.^{36,39–41} These findings suggest that weight loss medications should be used long term in the same manner as agents for hypertension, diabetes, or hypercholesterolemia. There are several barriers, however, to the long-term use of weight loss medications, including findings that most patients must pay out-of-pocket for anti-obesity agents.⁴² Medication costs typically exceed \$100 per month.

Surgical Interventions

Bariatric surgery, the most intensive treatment for obesity, is appropriate only for those individuals with a BMI ≥ 40 kg/m² or BMI ≥ 35 kg/m² in the presence of comorbidities.²² Typically, people who seek bariatric surgery have exhausted the more conservative weight loss options without satisfactory results.

The two most common surgical procedures for obesity are vertical banded

gastroplasty (VGB) and gastric bypass (GB). Both entail isolating a small (15- to 30-ml) pouch of stomach with a line of staples, thereby drastically limiting food intake. In VGB, the pouch empties into the remaining stomach, where the digestive process continues as normal. GB, however, not only restricts food intake, but also reduces absorption by bypassing the remaining stomach and 45–150 cm of small intestine.⁴³

Bariatric surgery produces average reductions of 25% (VGB) to 30% (GB) of initial weight⁴⁴ and significant improvements in hypertension, asthma, sleep apnea, and diabetes.⁴⁵ Improvements in mood have also been reported, but they appear to wane with time.⁴⁶

Randomized trials have shown that GB is associated with significantly better maintenance of weight loss than is VGB.⁴⁷ This has been attributed to the “dumping syndrome” associated with GB, in which patients experience nausea, cramping, and other gastrointestinal symptoms after eating high-sugar/high-fat foods. Patients learn to avoid these foods, whereas VGB patients can continue to eat them and thus may regain weight. Patients treated by GB maintained a loss of 50% of excess weight as long as 14 years postoperatively.⁴⁸

These findings undoubtedly have contributed to the recent surge in popularity of bariatric surgery, as has the ability to perform the procedures laparoscopically. Laparoscopy reduces hospital stay time, as well as operative morbidity and mortality.⁴⁹

The screening process for bariatric surgery is rigorous. Candidates must meet weight and medical requirements and also should undergo a comprehensive multidisciplinary assessment to identify behavioral contraindications to surgery (as described by Wadden et al.⁵⁰) Pre-surgical counseling is appropriate to ensure that patients have realistic weight loss expectations and understand the postoperative dietary requirements. In addition, candidates should be fully informed of the risks of bariatric surgery, which include an operative mortality rate of ~1.5%.^{48,51}

SPECIAL CONSIDERATIONS FOR PATIENTS WITH DIABETES

According to the American Diabetes Association (ADA),⁵² type 2 diabetes accounts for 90–95% of all cases of diabetes, and ~90% of patients with type 2 diabetes are overweight. Overweight patients with IGT or diagnosed type 2 diabetes can reap significant health benefits with modest weight reductions.^{6,7} Even before they lose weight, patients may achieve significant short-term reductions in blood glucose as a result of adhering to a hypocaloric diet.⁵³ Patients treated with insulin and sulfonylureas are at increased risk of hypoglycemia and must monitor their blood glucose regularly when attempting weight loss.

Wing et al.^{21,54–56} have provided a wealth of clinical and research findings on the behavioral management of obese individuals with type 2 diabetes. Health providers are referred to this work for practical suggestions.

Liquid Meal Replacements and Diabetes

Yip et al.⁵⁷ recently compared changes in weight and fasting glucose levels in obese individuals with type 2 diabetes who consumed a diet of regular (sugared) meal replacements, sugar-free meal replacements, or an exchange diet plan based on ADA recommendations. After 12 weeks of treatment, patients using meal replacements (regardless of sugar content) lost more weight (6.4–6.7%) than those using the exchange diet plan (4.9%) and had significantly lower fasting glucose levels. These findings should reassure patients who are concerned that popular liquid meal replacements may contain as many as 39 g of sugar per serving. The sugar does not appear to be a problem if patients are in negative energy balance.

Bariatric Surgery and Diabetes

For patients with extreme obesity, bariatric surgery represents a potential cure for type 2 diabetes. Pories et al.⁵¹ followed patients with type 2 diabetes

and IGT for up to 14 years after undergoing gastric bypass surgery and found that 82.9% of the patients with diabetes and 98.7% of the patients with IGT maintained normal levels of blood glucose and hemoglobin A_{1c} long term.

PREVENTION EFFORTS

Obesity and type 2 diabetes are increasing in prevalence, not only among adults, but also among children and adolescents in the United States.^{1,58} These trends, in conjunction with obesity’s medical, psychological, and economic effects, highlight the need for interventions and policy directives aimed at preventing obesity. Efforts to remove soft drinks from public schools have begun in some cities. Additionally, Horgen and Brownell⁵⁹ have offered the following public policy recommendations to reduce the incidence of obesity: regulate food advertising aimed at children, subsidize the sale of healthy foods, tax unhealthy foods, and provide resources for increased physical activity.

Obesity prevention promises to be a formidable task, given that American culture fosters a “toxic environment”⁵⁹ in which less energy is expended and calorie-dense, inexpensive foods are both heavily advertised and readily available. The full efforts of clinicians, researchers, and lawmakers, however, may pay large dividends. If we fail to treat obesity as a public health problem and implement bold prevention and policy initiatives, the incidence of obesity and its related complications can only increase in the years to come.

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ACKNOWLEDGMENT

Preparation of this article was supported, in part, by grant 1-U01-DK57135 from the National Institute of Diabetes and Digestive and Kidney Diseases.

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Note of disclosure: Dr. Wadden has received research support and honoraria for speaking engagements from Abbott Laboratories and Roche Pharmaceuticals, which manufacture drugs for the treatment of obesity.