



Obesity in adults: Dietary therapy

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INTRODUCTION

The management of all patients considered overweight or who have obesity requires a combination of diet (ie, a reduction in caloric intake), exercise, and behavioral modification. In addition, some patients may eventually require pharmacologic therapy and/or bariatric surgery. The health risk posed by excess adiposity should be evaluated before beginning any treatment program for each individual patient. Selection of treatment can then be made using a risk-benefit assessment ([algorithm 1](#)). The choice of therapy is dependent on several factors, including the degree of overweight or obesity, comorbidities, and patient preference.

This topic will review the dietary therapy of obesity. Other aspects of treatment are discussed separately:

- (See "[Overweight and obesity in adults: Health consequences](#)".)
- (See "[Obesity in adults: Overview of management](#)".)
- (See "[Obesity in adults: Behavioral therapy](#)".)
- (See "[Obesity in adults: Role of physical activity and exercise](#)".)
- (See "[Obesity in adults: Drug therapy](#)".)
- (See "[Bariatric operations for management of obesity: Indications and preoperative preparation](#)".)

GOALS OF WEIGHT LOSS

It is important to set goals when discussing a dietary weight loss program with an individual patient. The clinician should review with the patient the importance of weight loss on physical, mental, and functional health; assist the patient with developing a plan of action; and provide support with each stage of the process [1].

- Weight loss of 5 to 7 percent of body weight carries numerous health benefits and should be sought as an initial weight loss goal.
- Weight loss of more than 5 percent can reduce risk factors for cardiovascular disease, such as dyslipidemia, hypertension, and diabetes mellitus.

As an example, in the Diabetes Prevention Program (DPP), a multicenter trial in patients with impaired glucose tolerance, intensive lifestyle modification aimed at a weight loss of 7 percent reduced the rate of progression from impaired glucose tolerance to diabetes by 58 percent [2]. (See ["Prevention of type 2 diabetes mellitus", section on 'Diabetes Prevention Program'](#).)

In Look AHEAD (**A**ction for **H**ealth in **D**iabetes), a multicenter trial in patients with type 2 diabetes and body mass index (BMI) >25 kg/m², an intensive lifestyle intervention aimed at achieving and maintaining a loss of at least 7 percent of initial body weight led to more weight loss and improved glycemic control compared with usual care [3,4]. Other benefits of the intervention included: reduced use of antihypertensive medications, statins, and insulin; reduction in urinary incontinence [5,6], sleep apnea [7,8], fatty liver [9], kidney disease [10], depression [11], and body image dissatisfaction; and improvements in quality of life [11,12], physical functioning [13,14], sexual functioning [15,16], and mobility [17,18]. There was no reduction in cardiovascular events. However, among all study participants (including both the intervention and control group), weight loss of at least 10 percent within the first year was associated with a reduced risk of fatal and nonfatal cardiovascular events at 10 years (hazard ratio [HR] 0.79; 95% CI 0.64-0.98) [19]. This suggests that although 5 percent weight loss has some health benefits, 10 percent or more weight loss is needed for cardiovascular benefit. (See ["Initial management of hyperglycemia in adults with type 2 diabetes mellitus", section on 'Intensive lifestyle modification'](#).)

RATE OF WEIGHT LOSS

The rate of weight loss is directly related to the difference between the individual's energy intake and energy expenditure. Reducing caloric intake below expenditure should result in a predictable initial rate of weight loss that is related to the energy deficit [20,21]. However, prediction of weight loss for an individual can be difficult because there is a range of weight

loss that varies between individuals and diets. Factors that predict response to a diet include dietary adherence and genetic factors influencing body composition and energy expenditure [22]. As examples:

- Men lose more weight than women of similar height and weight when they comply with a given diet because men generally have more lean body mass, less percent body fat, and, therefore, higher energy expenditure.
- Older individuals have a lower energy expenditure and, therefore, lose weight more slowly than younger individuals; metabolic rate declines by approximately 2 percent per decade [23].

Initial rate of weight loss may be a marker of longer-term success. In the Look AHEAD (**A**ction for **H**ealth in **D**iabetes) trial, individuals in the highest compared with the lowest tertile of weight loss after one and two months were more likely to achieve and/or maintain ≥ 5 percent weight loss at year 8 [24].

There are several methods of formally estimating energy expenditure; we suggest using the World Health Organization (WHO) criteria ([table 1](#)). This method allows a direct estimate of resting metabolic rate (RMR) and calculation of daily energy requirement. The low activity level (1.3 x RMR) includes individuals who lead a sedentary life. The high activity level (1.7 x RMR) applies to those in jobs requiring manual labor or patients with regular daily physical exercise programs [25].

Approximately 22 kcal/kg is required to maintain a kilogram of body weight in a normal-weight adult. Thus, the expected or calculated energy expenditure for a woman weighing 100 kg is approximately 2200 kcal/day. The variability of ± 20 percent could give energy needs as high as 2620 kcal/day or as low as 1860 kcal/day. An average deficit of 500 kcal/day should result in an initial weight loss of approximately 0.5 kg/week (1 lb/week). However, after three to six months of weight loss, loss of lean mass slows the body weight response to the initial change in energy intake, thereby diminishing ongoing weight loss [26]. For weight loss to continue, further caloric restriction or increased caloric expenditure (for example, through increased activity levels) must ensue following weight plateau.

OUR APPROACH

General advice — Reducing total energy (caloric) intake should be the main component of any weight loss intervention [27]. To implement a successful dietary intervention, we typically

perform a brief 24-hour dietary recall during the office visit. We counsel patients on the importance of:

- Elimination of all caloric beverages, which are often the source of unwanted calories, and processed foods
- Portion control
- Self-monitoring
- Adopting a healthy, long-term approach to eating

Self-monitoring, often involving the use of food diaries, activity records, and self-weighing, is one of the elements of a successful behavioral weight loss program. (See ["Obesity in adults: Behavioral therapy", section on 'Elements of behavior change'](#).)

TYPES OF DIETS

Conventional diets are defined as those with energy requirements above 800 kcal/day [28]. These diets fall into the following groups:

- Balanced low-calorie diets and low-calorie versions of healthy diets (eg, Mediterranean and Dietary Approaches to Stop Hypertension [DASH] diets)
- Low-fat diets
- Low-carbohydrate and low glycemic index diets
- High-protein diets
- Very low calorie diets

Fad diets (diets involving unusual combinations of foods or eating sequences) are extremely popular but only for a short period of time. Most fad diets are not sustainable in the long term [29].

Commercial weight loss programs and internet-based programs are discussed elsewhere. (See ["Obesity in adults: Behavioral therapy"](#).)

There is tremendous interest in the possibility that highly processed foods, nonnutritive sweeteners, and other artificial additives may impact body weight beyond the calories they contain either directly or indirectly through modification of the gut microbiome [30]. This is an area of intense research with no definitive results that would change current recommendations. (See ["Overview of non-nutritive sweeteners", section on 'Specific health outcomes'](#).)

Balanced low-calorie diets — Planning a diet requires the selection of a caloric intake and then selection of foods to meet this intake. It is desirable to eat foods with adequate nutrients in

addition to protein, carbohydrate, and essential fatty acids. Thus, weight-reducing diets should minimize or eliminate alcohol, sugar-containing beverages, and most highly concentrated sweets because they may not contain adequate amounts of other nutrients besides energy.

- **Portion-controlled meals** – One simple approach to providing a calorie-controlled diet is to use individually packaged foods, such as formula diet drinks using powdered or liquid formula diets, nutrition bars, frozen food, and prepackaged meals that can be stored at room temperature as the main source of nutrients.

Frozen, low-calorie meals containing 250 to 350 kcal/package can be a convenient and nutritious way to do this. We have often recommended the use of formula diets or breakfast bars for breakfast; formula diets or a frozen lunch entree for lunch; and a frozen, calorie-controlled entree with additional vegetables for dinner. In this way, it is possible to obtain a calorie-controlled 1000 to 1500 kcal/day diet. In one randomized four-year study, replacement of two meals and two snacks with energy-controlled, vitamin- and mineral-supplemented prepared foods resulted in greater initial and maintained weight loss when compared with an isocaloric diet (-8.4 ± 5.0 percent versus -3.2 ± 4.9 percent) [31].

For patients, this approach has several advantages: it simplifies meal planning; reduces the number of food decisions and time spent cooking and shopping; and promotes more accurate self-monitoring of calorie intake. In our clinical experience, the successful use of this approach is largely dependent on factors related to patient preference, including willingness to try portion-controlled meals, satisfaction with the taste and variety of food options, and perceived sustainability of this type of eating routine.

- **Low-calorie versions of healthy diets**

- The term Mediterranean diet refers to a dietary pattern that is common in olive-growing areas of the Mediterranean. Although there is some variation in Mediterranean diets, there are some common components, which include a high level of monounsaturated fat relative to saturated fat; moderate consumption of alcohol, mainly as wine; a high consumption of vegetables, fruits, legumes, nuts, and grains; a moderate consumption of milk and dairy products, mostly in the form of cheese; and a relatively low intake of meat products.

The Mediterranean diet appears to be associated with several health benefits, including cardiovascular risk reduction and diabetes prevention [32,33]. The effects of the Mediterranean diet on cardiovascular disease and type 2 diabetes are reviewed in detail separately. (See "[Healthy diet in adults](#)" and "[Nutritional considerations in type 2 diabetes mellitus](#)", section on 'Macronutrient composition' and "[Prevention of type 2](#)

[diabetes mellitus", section on 'Diet'](#) and ["Overview of the prevention of cardiovascular disease events in those with established disease \(secondary prevention\) or at very high risk", section on 'Diet'.](#))

- The DASH diet is comprised of four to five servings of fruit, four to five servings of vegetables, and two to three servings of low-fat dairy per day, and <25 percent dietary intake from fat. The DASH diet has been studied in both normo- and hypertensive populations and found to lower systolic and diastolic pressure more than a diet rich in fruits and vegetables alone [34]. Combining a calorically restricted DASH diet with approximately 25 minutes of physical activity per day has been shown to result in an average 5.8 kg weight loss over 26 weeks [35]. The DASH diet is reviewed in more detail separately. (See ["Diet in the treatment and prevention of hypertension", section on 'Dietary Approaches to Stop Hypertension trial'](#).)

Low-fat diets — Low-fat diets are another standard strategy to help patients reduce adiposity and lose weight [36], and almost all dietary guidelines recommend a reduction in the daily intake of fat to <30 percent of energy intake [37]. In a meta-analysis of 32 controlled feeding studies with isocaloric substitution of carbohydrate for fat, energy expenditure and fat loss were greater with lower-fat diets [38]. In addition, one report noted that people who successfully kept their weight reduced adopt several strategies, one of which was eating a lower-fat diet [39]. (See ["Dietary fat"](#).)

A low-fat dietary pattern with healthy carbohydrates (eg, fruits, vegetables, and whole grains) is not associated with weight gain. This was illustrated by the Women's Health Initiative Dietary Modification Trial of 48,835 postmenopausal women over age 50 years, who were randomly assigned to a dietary intervention that included group and individual sessions to promote a decrease in fat intake and increases in fruit, vegetable, and whole grains but did not include weight loss or caloric restriction goals, or to a control group that received only dietary educational materials [40]. After an average of 7.5 years of follow-up, the following results were seen:

- Individuals in the intervention group lost weight in the first year (mean of 2.2 kg) and maintained lower weight than the control group at 7.5 years (difference of 1.9 kg at one year, and 0.4 kg at 7.5 years).
- No tendency toward weight gain was seen in the intervention group overall or when stratified by age, ethnicity, or body mass index (BMI).
- Weight loss was related to the level of fat intake and was greatest in those who decreased their percentage of energy from fat the most. A similar, but lesser, trend was seen with

increased vegetable and fruit intake.

A low-fat diet can be implemented in two ways. First, the registered dietitian can provide the patient with specific menu plans that emphasize the use of reduced-fat foods. As one guideline, if a food "melts" in your mouth, it probably has fat in it. Second, individuals can be instructed in counting fat grams as an alternative to counting calories. Fat has 9.4 kcal/g. It is thus very easy to calculate the number of grams of fat an individual can eat for any given level of energy intake.

Many experts recommend keeping calories from fat to below 30 percent of total calories. In practical terms, this means eating approximately 33 g of fat for each 1000 calories in the diet. For simplicity, we use 30 g of fat or less for each 1000 kcal. For a 1500-calorie diet, this would mean approximately 45 g or less of fat, which can be counted using the nutrition information labels on food packages.

Low-carbohydrate diets — Proponents of low-carbohydrate diets have argued that the increasing obesity epidemic may be, in part, due to low-fat, high-carbohydrate diets. But this may be dependent upon the type of carbohydrates that are eaten, such as energy-dense snacks and sugar- or high fructose-containing beverages. If a low-carbohydrate diet is chosen, healthy choices for fat (mono- and polyunsaturated fats) and protein (fish, nuts, legumes, and poultry) should be encouraged because of the association between saturated fat intake and risk of coronary heart disease. (See '[Choosing a diet](#)' below.)

Low-carbohydrate (60 to 130 grams) and very low carbohydrate (0 to <60 grams) diets are more effective for short-term weight loss than low-fat diets, although probably not for long-term weight loss. A meta-analysis of five trials found that the difference in weight loss at six months, favoring the low-carbohydrate over low-fat diet, was not sustained at 12 months [41]. Restriction of carbohydrates leads to glycogen mobilization and, if carbohydrate intake is less than 50 g/day, ketosis will develop. Rapid weight loss occurs, primarily due to glycogen breakdown and fluid loss rather than fat loss. In addition, very-low-carbohydrate, ketogenic diets are associated with a small increase in energy expenditure that wanes over time [42].

A low-carbohydrate diet can be implemented in two ways, either by reducing the total amount of carbohydrate or by consuming foods with a lower glycemic index or glycemic load ([table 2](#)). However, the latter approach is of uncertain benefit. In a meta-analysis of trials comparing low and high glycemic index diets, there was no significant difference in weight loss, lipids, anthropometric measures, glycated hemoglobin (A1C), and fasting glucose [43]. Glycemic index and load are reviewed in more detail separately. (See "[Dietary carbohydrates](#)", [section on 'Glycemic index'](#).)

Low-carbohydrate diets with healthy choices for fat and protein may have some other beneficial effects with regard to risk of developing type 2 diabetes mellitus, coronary heart disease, and some cancers, particularly if attention is paid to the type as well as the quantity of carbohydrate. During 26 years of follow-up of women in the Nurses' Health Study and 20 years of follow-up of men in the Health Professionals' Follow-up Study, low-carbohydrate diets in the highest versus lowest decile for vegetable proteins and fat were associated with lower all-cause mortality (hazard ratio [HR] 0.80, 95% CI 0.75-0.85) and cardiovascular mortality (HR 0.77, 95% CI 0.68-0.87) [44]. By contrast, low-carbohydrate diets in the highest versus lowest decile for animal protein and fat were associated with higher all-cause (HR 1.23, 95% CI 1.11-1.37) and cardiovascular (HR 1.14, 95% CI 1.01-1.29) mortality. (See "[Dietary fat](#)" and "[Overview of primary prevention of cardiovascular disease](#)", section on 'Healthy diet'.)

Very low carbohydrate diets may be associated with more frequent side effects than low-fat diets. In one of the trials noted above, a number of symptoms occurred significantly more frequently in the low-carbohydrate compared with the low-fat diet group [45]. These included constipation (68 versus 35 percent), headache (60 versus 40 percent), halitosis (38 versus 8 percent), muscle cramps (35 versus 7 percent), diarrhea (23 versus 7 percent), general weakness (25 versus 8 percent), and rash (13 versus 0 percent) [45]. Despite the higher rate of symptoms, dropout rates in clinical trials have been similar for low-carbohydrate and low-fat diets [46-48].

High-protein diets — High-protein diets, in which at least 20 percent of daily calories come from protein, have been recommended for the treatment of obesity because they are more satiating and stimulate thermogenesis [49]. In one meta-analysis of trials comparing the long-term effects of low-fat diets with either high or low protein content, there were no significant differences in weight loss, waist circumference, lipids, and blood pressure [50]. In another meta-analysis of trials evaluating short-term effects (mean trial duration 12 weeks), there were modest reductions in weight, fat mass, and triglycerides with a high compared with standard protein diet [51]. If dietary fat is held constant, energy from carbohydrate sources increases as energy from dietary protein decreases. Thus, patients randomly assigned to the low-fat, high-protein diet had lower carbohydrate intake than those assigned to the low-fat, low-protein diet (typically 40 versus 55 to 65 percent of daily caloric intake). (See "[Low-carbohydrate diets](#)" above.)

Higher-protein diets may improve weight maintenance. (See "[Maintaining weight loss](#)" below.)

Very low calorie diets — Diets with energy levels between 200 and 800 kcal/day are called "very low calorie diets," while those below 200 kcal/day can be termed starvation diets. The basis for these diets was the notion that the lower the calorie intake, the more rapid the weight loss, because the energy withdrawn from body fat stores is a function of the energy deficit.

Starvation is the ultimate very low calorie diet and results in the most rapid weight loss. Although once popular, starvation diets are not recommended for treatment of obesity.

Very low calorie diets have not been shown to be superior to conventional diets for long-term weight loss. In a meta-analysis of six trials comparing very low calorie diets with conventional low-calorie diets, short-term weight loss was greater with very low calorie diets (16.1 versus 9.7 percent of initial weight), but there was no difference in long-term weight loss (6.3 versus 5.0 percent at one to five years) [52].

The side effects of very low calorie diets include hair loss, thinning of the skin, and coldness. These diets are contraindicated in individuals who are lactating or pregnant, and in children who require protein for linear growth. As with all diets, there is increased cholesterol mobilization from peripheral fat stores, thus increasing the risk of gallstones.

Very low calorie diets should be reserved for individuals who require rapid weight loss for a specific purpose, such as surgery. The weight regain when the diet is stopped is often rapid, and it is better to take a more sustainable approach than to use a method that cannot be sustained.

Intermittent fasting — Intermittent fasting strategies, including alternate-day fasting and time-restricted feeding, have been used as approaches to weight loss, although evidence for their efficacy is mixed. As examples, in a 12-week trial including 32 individuals, alternate-day fasting (25 percent of energy consumed on "fast" days alternating with ad libitum "feast" days) resulted in a weight loss of -5.2 kg compared with a control (no caloric restriction) group [53]. In another trial, however, weight loss was not increased with intermittent fasting. In a one-year trial including 100 individuals with obesity, alternate-day fasting (25 percent of total energy consumed on "fast" days and 125 percent consumed on "feast" days) was compared with calorie restriction (75 percent of total energy needs consumed daily) or a no-intervention control [54]. At 6 and 12 months, compared with controls, mean weight loss was similar for individuals in the alternate-day fasting group and in the daily calorie restriction group.

Time-restricted feeding (TRF) is a type of intermittent fasting in which the cessation of eating by a certain time each day (eg, in the early afternoon) results in a prolonged period of fasting which persists until the next day. Short-term TRF trials have shown that the alignment of the feeding period with circadian rhythms may result in weight loss and improve metabolic parameters [55,56]. The mechanisms by which intermittent fasting (including TRF) affect health are incompletely understood but may include improved insulin sensitivity and antiinflammatory effects.

CHOOSING A DIET

The general consensus is that excess intake of calories from any source, associated with a sedentary lifestyle, causes weight gain and obesity. The goal of dietary therapy, therefore, is to reduce the total number of calories consumed. We suggest choosing a dietary pattern of healthful foods, such as the Dietary Approaches to Stop Hypertension (DASH) or Mediterranean-style diet, rather than focusing on a specific nutrient. (See ['Balanced low-calorie diets'](#) above.)

Direct comparison of low-fat, low-carbohydrate, and low-protein diets has yielded mixed evidence, with some studies showing greater weight loss with low-carbohydrate diets [\[57-60\]](#), while others have shown no difference [\[61-64\]](#). In most patients, the macronutrient composition of meals appears to have less impact on weight loss than adherence rates; in certain patient populations, however, modifying macronutrient compositions may optimize adherence, eating patterns, weight loss, metabolic profiles, risk factor reduction, and/or clinical outcomes [\[27\]](#).

In general, diets which emphasize reductions in refined carbohydrates, processed meats, and foods high in sodium and trans fat; moderation in unprocessed red meats, poultry, eggs, and milk; and high intakes of fruits, nuts, fish, vegetables, vegetable oils, minimally processed whole grains, legumes, and yogurt are preferred [\[65\]](#). This approach allows greater flexibility and personal preference in diet and may improve long-term adherence.

Very low carbohydrate diets (eg, Atkins) appear more effective than other diets (eg, low glycemic load [eg, Zone], very low fat [eg, Ornish], or low-fat [eg, LEARN diets]) for up to 12 months [\[66\]](#). However, the optimal mix of macronutrients for longer-term weight loss or weight loss maintenance is unknown and likely depends upon individual factors. These factors may include gene-diet interactions and baseline insulin secretion [\[67\]](#). However, in a trial of 609 overweight adults who were randomly assigned to a healthy low-fat diet or a healthy low-carbohydrate diet, there was no interaction between weight loss and genotype pattern (low-fat sensitive or low-carbohydrate sensitive) or baseline insulin secretion levels [\[68\]](#). A principal determinant of weight loss appears to be the degree of adherence to the diet, irrespective of the particular macronutrient composition [\[57,66,69-73\]](#). However, in one randomized trial, the opportunity to choose rather than be assigned to a diet did not improve adherence or weight loss [\[74\]](#). Thus, in addition to patient choice, we suggest behavioral modification to improve dietary compliance with any type of diet. Behavioral modification may have the greatest impact on long-term weight loss. (See ["Obesity in adults: Behavioral therapy"](#).)

Role of macronutrient composition — The impact of specific dietary composition on weight change remains uncertain. When energy from dietary carbohydrates decreases, energy from fat or protein sources must increase. The reverse is also true; when energy from dietary fats decreases, energy from carbohydrate or protein sources increases. The debate has mainly centered on whether low-fat or low-carbohydrate diets can better induce weight loss and sustain it over the long term. However, the success of such diets may be dependent upon the type of carbohydrates or the types of fat that are consumed.

In a meta-analysis of 48 randomized trials (7286 individuals) comparing different dietary programs (predominantly low-carbohydrate, moderate macronutrient, or low-fat) with a comparator (no diet or competing dietary program), all diet programs resulted in significant weight loss (approximately 6 to 8 kg at six months) compared with no diet [75]. At 12-month follow-up, the average weight losses of all diet programs were 1 to 2 kg less than at six-month follow-up. Weight loss differences between individual diets were minimal.

Individual trials and meta-analyses specifically comparing low-fat with low-carbohydrate or very low carbohydrate diets have conflicting results with regard to the impact of macronutrient composition on weight loss [68,76-81]. In a systematic review of five trials with follow-up ≥ 12 months, a Mediterranean diet resulted in similar weight loss (-4.1 to -10.1 kg) as a low-carbohydrate diet (-4.7 to -7.7 kg) and greater weight loss than a low-fat diet (2.9 to -5 kg) [82]. There was wide variation in weight loss across trials, within individual diets, and between people for individual diets.

The following observations illustrate the range of findings in the individual trials:

- In one trial, 322 people with moderate obesity (86 percent men) were randomly assigned to a low-fat (restricted calorie), Mediterranean (moderate-fat, restricted calorie, rich in vegetables, low in red meat), or low-carbohydrate (nonrestricted calorie) diet for two years [58]. Adherence rates were higher than those reported in previous trials (95.4 and 84.6 percent at one and two years, respectively). Weight loss was greater with the Mediterranean and low-carbohydrate diets than the low-fat diet (mean weight loss 4.4, 4.7, and 2.9 kg, respectively).

Among patients with type 2 diabetes, the greatest improvement in glycemic control occurred with the Mediterranean diet. Among all groups, weight loss was greater for those who completed the two-year study than for those who withdrew.

- Another randomized trial compared four different diets in 311 premenopausal women with overweight or obesity: very low carbohydrate (Atkins); macronutrient balance controlling glycemic load (Zone); general calorie restriction, low-fat (LEARN); and very low fat (Ornish)

[66]. In the intention-to-treat analysis at one year, mean weight loss was greater in the Atkins diet group compared with the other groups (4.7, 1.6, 2.2, and 2.6 kg, respectively). Pairwise comparisons showed a significant difference only for Atkins versus Zone.

Dietary adherence rates (77 to 88 percent) were similar among the groups and better than in previous trials. Within each group, adherence was significantly associated with weight loss [70].

- In the largest trial to date, 811 adults with overweight or obesity were randomly assigned to one of four diets based upon macronutrient content: low or high fat (20 to 40 percent), which provided carbohydrate at 35, 45, 55, or 65 percent, and average- or high-protein (15 to 25 percent) [69]. After six months, mean weight loss in each group was 6 kg. By two years, mean weight loss was 3 to 4 kg, and weight losses remained similar in all groups. Many participants had trouble attaining target levels of macronutrients. Individuals who attended the greatest number of group sessions (most adherent) lost the most weight.

Independent of weight loss, however, specific diets may be associated with additional health benefits. As an example, a Mediterranean diet is associated with lower mortality [83]. (See "[Healthy diet in adults](#)".)

Translating research to practice — There is no one single diet that fits all patients; there are a variety of dietary strategies that can be effective in reducing calorie intake and promoting weight loss. Patients often need guidance in choosing the dietary strategy that is the right fit for them based on their usual eating habits and food preferences, preferred learning style and capabilities, and perceived ability to manage hunger, sustain adherence, and maintain the pleasure of eating.

In our experience, some patients prefer to pursue a diet strategy on their own using self-help diet books, mobile applications ("apps"), or internet-based programs. Other patients prefer lifestyle intervention programs that offer education on nutrition, activity, and behavioral topics and include the element of group support and information exchange via in-person meetings or virtual meetings (telephone conference calls or telehealth). (See "[Obesity in adults: Behavioral therapy](#)", section on 'Importance of behavioral therapy'.)

Some patients prefer individual counseling and would benefit from referral to a registered dietitian who can personalize a nutrition plan based upon an individual assessment of usual eating pattern, food preferences, metabolic goals, learning capability, food availability, and socioeconomic factors. A dietitian can tailor the diet implementation strategy for each patient using a shared decision-making approach to help determine whether a counting approach (calories, fat grams, or carbohydrates), a meal pattern/menu approach, use of portion-

controlled foods, or individual guidelines and goals to shape eating over time is best suited for a patient's preferred learning style. Once a plan is established, the dietitian will then coach patients over a series of visits to help integrate the plan into their lifestyle using a variety of cognitive and behavioral strategies [84]. (See ['Role of dietary counseling'](#) below.)

A systematized approach to patient assessment to better predict response and improve selection of the various approaches available, so-called behavioral or psychosocial phenotyping, is a developing area of research [85].

ROLE OF DIETARY COUNSELING

Dietary counseling may produce modest, short-term weight losses. This topic is reviewed in detail elsewhere. (See ["Obesity in adults: Behavioral therapy", section on 'Elements of behavior change'](#) and ["Obesity in adults: Behavioral therapy", section on 'Efficacy'](#).)

MAINTAINING WEIGHT LOSS

- **Adaptations favoring weight gain** – Although many individuals have success losing weight with diet, most subsequently regain much or all of the lost weight, due to the following adaptations:
 - A reduction in energy expenditure induced by weight loss ([figure 1](#)) [86].
 - Changes in peripheral hormonal signals that regulate appetite ([table 3](#)). Ghrelin, which stimulates appetite, and glucose-dependent insulinotropic polypeptide (GIP), which may promote energy storage, increase after diet-induced weight loss. Other circulating mediators that inhibit food intake (eg, leptin, peptide YY, cholecystokinin, amylin) decrease. These hormonal adaptations can persist for at least one year after diet-induced weight loss, collectively conspiring against weight loss maintenance [87]. (See ["Ghrelin", section on 'Obesity'](#) and ["Obesity: Genetic contribution and pathophysiology", section on 'Physiology and pathophysiology of obesity'](#).)

Exercise and behavioral interventions are two important strategies to mitigate these factors. (See ["Obesity in adults: Overview of management", section on 'Maintenance of weight loss'](#) and ["Obesity in adults: Role of physical activity and exercise", section on 'Exercise importance in maintenance of weight loss'](#) and ["Obesity in adults: Behavioral therapy", section on 'Maintenance of weight loss'](#).)

- **Weight-maintaining diets** – Whether the macronutrient composition of a diet, independent of total calorie intake, has any effect on long-term weight maintenance is unknown. Since long-term adherence to a weight-maintaining diet is probably the most important determinant of success, the optimal weight-maintaining diet will depend upon preference and individual factors as described above.

As with active weight loss, there is little consensus on the optimal mix of macronutrients to maintain weight loss. The satiating effects of high-protein, low glycemic index diets have generated interest in manipulating protein composition and glycemic index in weight-maintenance diets [88,89]. As an example, in a multicenter trial of five ad libitum diets to prevent weight regain over 26 weeks, 773 adults who had successfully lost 8 percent of their body weight on a low-calorie diet (800 to 1000 kcal/day), were randomly assigned in a two-by-two factorial design to a high- or low-protein (25 versus 13 percent of total calories), high or low glycemic index, or control diet (moderate protein content) [88]. In the intention-to-treat analysis, weight regain during the trial was modest but significantly greater in the low- versus high-protein groups (mean difference 0.93 kg) and in the high versus low glycemic index groups (mean difference 0.95 kg). Only individuals in the high-protein, low glycemic index diet group continued to lose weight (mean change -0.38 kg). The trial was limited by the moderate dropout rate (29 percent) and short-term follow-up (six months). (See '[High-protein diets](#)' above and '[Low-carbohydrate diets](#)' above.)

In a small, four-week crossover trial in 21 young adults with overweight or obesity who had achieved a 10 to 15 percent weight loss, a low-fat diet resulted in decreases in resting and total energy expenditure compared with low glycemic index and very low carbohydrate diets [90]. Due to the short-term follow-up in the study, the clinical implications for maintaining weight loss are unknown.

PROLONGED CALORIC RESTRICTION AND LONGEVITY

In some [91,92], but not all [93], studies, prolonged caloric restriction improved longevity in rodents and nonhuman primates, but the impact of calorie restriction on longevity in humans is unknown [94]. It is hypothesized that the antiaging effects of caloric restriction are due to reduced energy expenditure resulting in a reduction in production of reactive oxygen species (and therefore a reduction in oxidative damage). In addition, other metabolic effects associated with caloric restriction, such as improved insulin sensitivity, might also have an antiaging effect. In one trial of 48 sedentary, overweight people, six months of caloric restriction (with or without exercise) resulted in significant weight loss as expected [95]. In addition, calorie restriction-mediated reductions in fasting insulin concentrations, core body temperature, serum

triiodothyronine (T3) levels, and oxidative damage to DNA (as reflected by a reduction in DNA fragmentation) were seen, suggesting a possible antiaging effect of the prolonged caloric restriction.

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See ["Society guideline links: Obesity in adults"](#).)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see ["Patient education: Diet and health \(The Basics\)"](#) and ["Patient education: Weight loss treatments \(The Basics\)"](#))
- Beyond the Basics topics (see ["Patient education: Diet and health \(Beyond the Basics\)"](#) and ["Patient education: Losing weight \(Beyond the Basics\)"](#) and ["Patient education: Weight loss surgery and procedures \(Beyond the Basics\)"](#))

SUMMARY AND RECOMMENDATIONS

- Weight loss of 5 to 7 percent of body weight carries numerous health benefits and should be sought as an initial weight loss goal. (See ["Goals of weight loss"](#) above.)
- Weight loss is directly related to the difference between the individual's energy intake and energy expenditure. Reducing caloric intake below expenditure should result in a

predictable initial rate of weight loss that is related to the energy deficit. There are significant individual differences, and close monitoring of energy intake is essential. Patients should be educated that weight loss itself lowers energy expenditure and weight plateau is expected without further reduction in energy intake. (See ['Rate of weight loss'](#) above.)

- The goal of dietary therapy is to reduce the total number of calories consumed. We suggest choosing a dietary pattern of healthful foods, such as the Dietary Approaches to Stop Hypertension (DASH) or Mediterranean-style diet, rather than focusing on a specific nutrient (**Grade 2B**). Diets which emphasize reductions in refined carbohydrates, processed meats, and foods high in sodium and trans fat; moderation in unprocessed red meats, poultry, eggs, and milk; and high intakes of fruits, nuts, fish, vegetables, vegetable oils, minimally processed whole grains, legumes, and yogurt are preferred. (See ['Choosing a diet'](#) above.)
- There is no one single diet that fits all patients; there are a variety of dietary strategies that can be effective in reducing calorie intake and promoting weight loss. Patients often need guidance in choosing the dietary strategy that is the right fit for them based on their usual eating habits and food preferences, preferred learning style and capabilities, and perceived ability to manage hunger, sustain adherence, and maintain the pleasure of eating.

Dietary adherence is an important predictor of weight loss, irrespective of the type of diet. Behavior modification strategies are important to improve dietary compliance with any type of diet. (See ["Obesity in adults: Behavioral therapy"](#) and ['Translating research to practice'](#) above.)

- If a low-carbohydrate diet is chosen, healthy choices for fat (mono- and polyunsaturated) and protein (fish, nuts, legumes, and poultry) should be encouraged. If a low-fat diet is chosen, the decrease in fat should be accompanied by increases in healthy carbohydrates (fruits, vegetables, whole grains). (See ['Types of diets'](#) above.)
- Although many individuals have success losing weight with diet, most subsequently regain much or all of the lost weight. Since long-term adherence to a weight-maintaining diet is probably the most important determinant of success, the optimal weight-maintaining diet will depend upon preference and individual factors. Exercise and behavioral interventions also may help individuals maintain weight loss. (See ['Maintaining weight loss'](#) above.)

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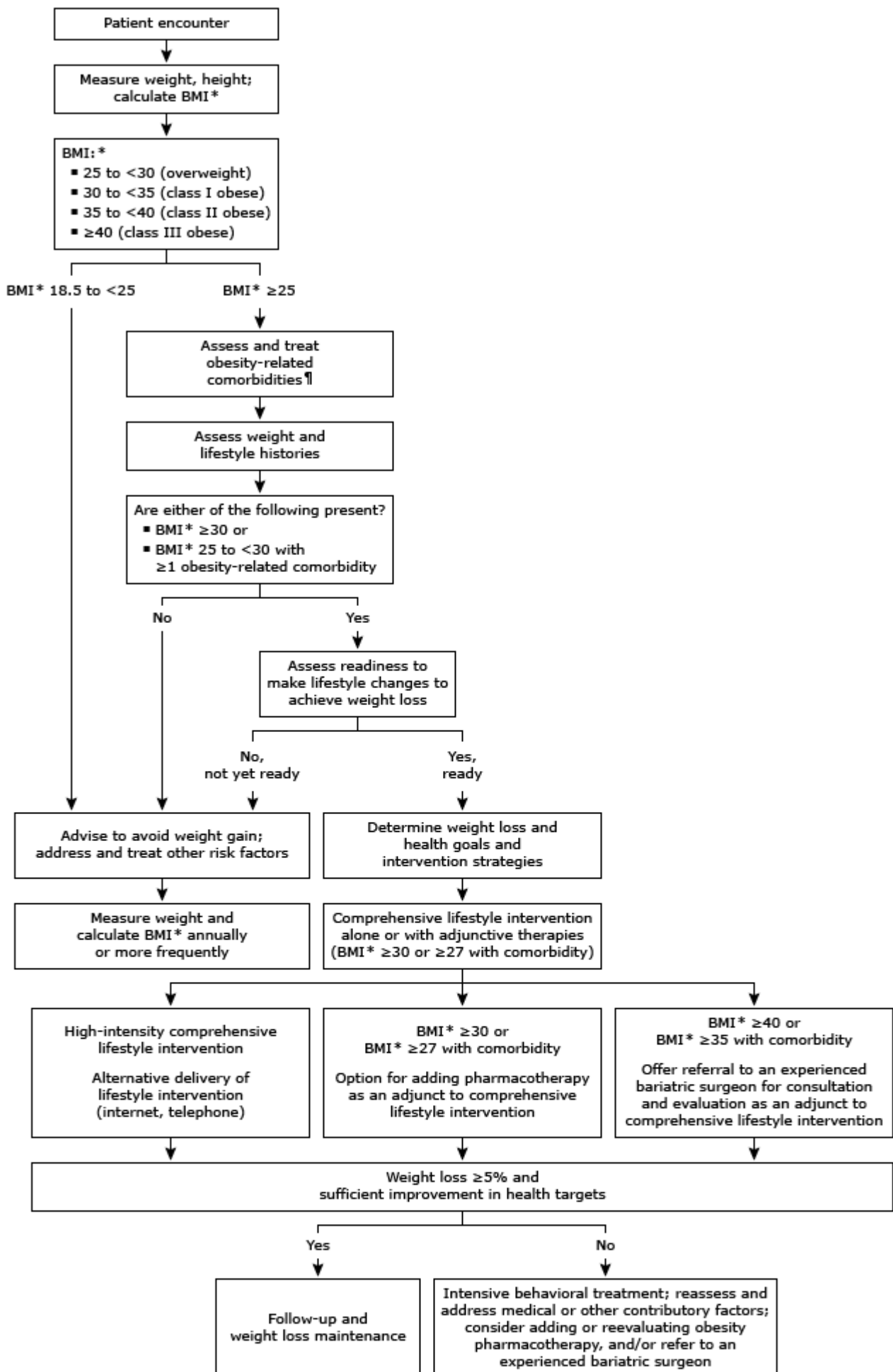
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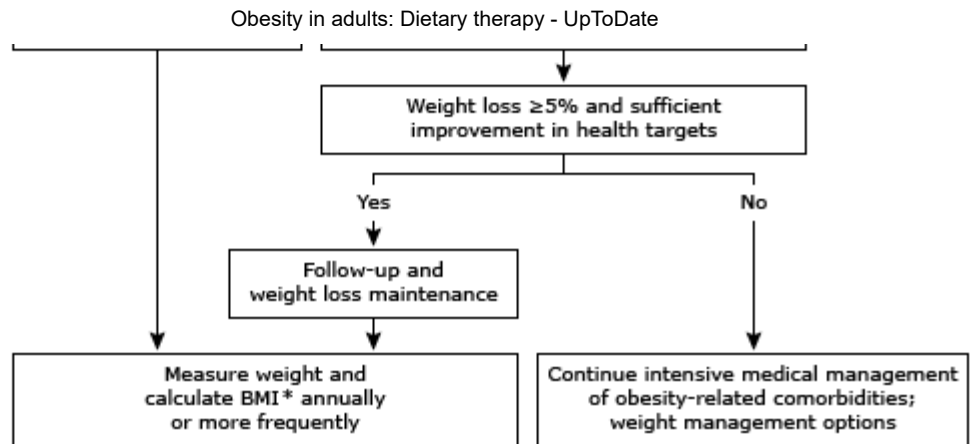
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Topic 5375 Version 47.0

GRAPHICS

Overweight and obesity: Evaluation and treatment algorithm





BMI: body mass index; CVD: cardiovascular disease; BP: blood pressure.

* BMI measured as kg/m^2 .

¶ Assess and treat obesity-related comorbidities:

- Assess risk for presence of obesity-related comorbidities. Risk assessment for CVD and diabetes in a person with overweight or class I to III obesity includes history, physical examination, and clinical and laboratory assessments, including BP, fasting blood glucose, and fasting lipid panel (expert opinion). A waist circumference measurement is recommended for individuals with BMI 25 to $<35 \text{ kg}/\text{m}^2$ to provide additional information on risk. It is not necessary to measure waist circumference in patients with BMI $>35 \text{ kg}/\text{m}^2$, because the waist circumference will likely be elevated and it will add no additional risk information. The Panel recommends, by expert opinion, using the current cutpoints ($>88 \text{ cm}$ or $>35 \text{ in}$ for women and $>102 \text{ cm}$ or $>40 \text{ in}$ for men) as indicative of increased cardiometabolic risk.
- Because obesity is associated with increased risk of hypertension, dyslipidemia, diabetes, and a host of other comorbidities, the clinician should assess for associated conditions. The Panel recommends by expert opinion that intensive management of CVD risk factors (hypertension, dyslipidemia, prediabetes, or diabetes) or other obesity-related medical conditions (eg, sleep apnea) be instituted if they are found, regardless of weight loss efforts.

Original figure modified for this publication. Jensen MD, Ryan DH, Apovian CM, et al. 2013 AHA/ACC/TOS Guideline for the Management of Overweight and Obesity in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. J Am Coll Cardiol 2013 Nov 7. DOI: 10.1016/j.jacc.2013.11.004. Illustration used with the permission of Elsevier Inc. All rights reserved.

Graphic 93424 Version 3.0

Revised World Health Organization equations for estimating energy expenditure

Step 1: Estimate basal metabolic rate	
Men 18 to 30 years = $(0.0630 \times \text{actual weight in kg} + 2.8957) \times 240 \text{ kcal/day}$	
Men 31 to 60 years = $(0.0484 \times \text{actual weight in kg} + 3.6534) \times 240 \text{ kcal/day}$	
Women 18 to 30 years = $(0.0621 \times \text{actual weight in kg} + 2.0357) \times 240 \text{ kcal/day}$	
Women 31 to 60 years = $(0.0342 \times \text{actual weight in kg} + 3.5377) \times 240 \text{ kcal/day}$	
Step 2: Determine activity factor	
Activity level	Activity factor
Low (sedentary)	1.3
Intermediate (some regular exercise)	1.5
High (regular activity or demanding job)	1.7
Step 3: Estimate total energy expenditure	
Total energy expenditure = Basal metabolic rate x activity factor	

Graphic 63308 Version 1.0

Dietary glycemic indices and glycemic load for the top 20 carbohydrate-contributing foods in the Nurses' Health Study in 1984

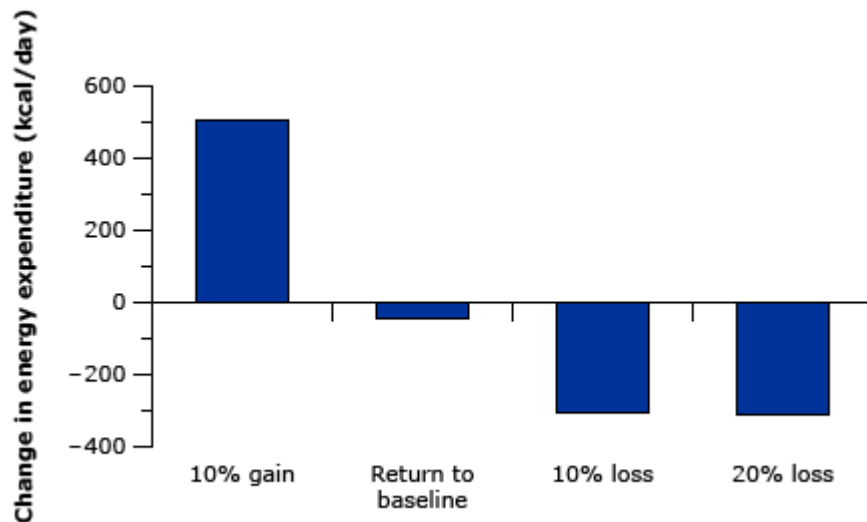
Foods	Glycemic index*, %	Carbohydrate per serving, g	Glycemic load per serving
1. Cooked potatoes (mashed or baked)	102	37	38
2. White bread	100	13	13
3. Cold breakfast cereal	Varies by cereal	Varies by cereal	Varies by cereal
4. Dark bread	102	12	12
5. Orange juice	75	20	15
6. Banana	88	27	24
7. White rice	102	45	46
8. Pizza	86	78	68
9. Pasta	71	40	28
10. English muffins	84	26	22
11. Fruit punch	95	44	42
12. Cola	90	39	35
13. Apple	55	21	12
14. Skim milk	46	11	5
15. Pancake	119	56	67
16. Table sugar	84	4	3
17. Jam	91	13	12
18. Cranberry juice	105	19	20
19. French fries	95	35	33
20. Candy	99	28	28

* Standard reference is white bread, which has a glycemic index of 100%. All other glycemic index values are relative to white bread.

Adapted from: Liu S, Willett WC. Dietary glycemic load and atherothrombotic risk. *Curr Atheroscler Rep* 2002; 4:454.

Graphic 71978 Version 3.0

Impact of diet-induced weight change on energy expenditure



Observed minus predicted energy expenditure in subjects studied during food-induced weight gain and diet-induced weight loss. Changes in weight were associated with parallel changes in total energy expenditure, thereby making further alterations in weight more difficult.

Data from: Leibel RL, Rosenbaum M, Hirsch J. Changes in energy expenditure resulting from altered body weight. *N Engl J Med* 1995; 332:621.

Graphic 63172 Version 4.0

Physiologic changes in active weight loss versus maintenance of reduced weight

	Active weight loss	Maintenance of reduced weight
Current metabolic state	Negative energy balance	Energy balance
Changes compared with weight maintenance at usual body weight		
Energy expenditure	↓↓ REE (approximately 2 times reduced weight maintenance residual) ↓ NREE ↑ Muscle contraction efficiency	↓ REE* ↓ NREE* ↑ Muscle contraction efficiency*
Neuroendocrine axes	↓↓ T3, ↓↓ T4, ↓↓ TSH, ↑ rT3 ↓↓ Leptin/FM by 40 to 50%* ↑ Cortisol ↑ GH	↓ T3*, ↓ T4*, ↓ TSH, ↑ rT3* ↓ Leptin/FM by approximately 10%* Cortisol within normal range No change or small ↑ GH
Autonomics	↑↑ PNS tone and ↓↓ SNS tone	↑ PNS tone and ↓ SNS tone*
Energy intake	↓↓ Satiation ↑↑ Hunger	↓ Satiation* ↑ Hunger*

The arrows represent the direction and magnitude of the physiologic changes that occur to oppose active weight loss and/or maintenance of reduced weight. These illustrate that homeostatic systems functioning to maintain usual body weight are responsive to both energy stores (fat mass) and energy balance (weight loss versus weight maintenance).

REE: resting energy expenditure; NREE: non-resting energy expenditure; FM: fat mass; T3: triiodothyronine; T4: thyroxine; TSH: thyroid-stimulating hormone; rT3: reverse T3 (bioinactive enantiomer of T3); GH: growth hormone; PNS: parasympathetic; SNS: sympathetic nervous system.

* Significant reversal of physiologic changes by leptin repletion.

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Contributor Disclosures

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