

Obesity

Obesity has become a worldwide epidemic. In the United States, weight problems affect more than two-thirds of the adult population and one-third of the population between ages 6 and 19.^[1]

The Framingham study has shown that, in the United States, an individual's current lifetime risk of obesity is 50% and risk of being overweight is 80%.^[2] Weight conditions are typically classified based on body mass index (BMI), calculated with the following formula:

$$\text{BMI} = \frac{\text{weight (kilograms)}}{\text{height}^2 \text{ (meters)}}$$

Overweight is defined as a BMI between 25 and 29.9 kg/m², and obesity is defined as a BMI of 30 kg/m² or greater. Morbid obesity is defined as a BMI \geq 40 kg/m² or \geq 35 kg/m² when obesity-related comorbidities are present.

In Asian populations, the risk for weight-related diseases begins to increase at lower BMI ranges, compared with other populations, so overweight among Asians is commonly defined as a BMI of 23 to 24.9, and obesity is defined as BMI \geq 25.^[3]

While genetics may predispose to elevated body weight, diet and lifestyle are the major modifiable contributors to obesity. The number of overweight and obese people in the United States increased by one-third between 1990 and 2000, and the rise in incidence of obesity since the 1970s has been attributed to larger portion sizes and increased availability of high-calorie foods such as meat, cheese, and soft drinks.^[4]

Changes in eating habits have been sufficient to explain the recent U.S. obesity epidemic. Perhaps surprisingly, changes in physical activity have played very little role according to large population studies, suggesting that the solution to obesity needs to focus on eating habits, rather than on exercise.^{[5], [6]}

Obesity is a strong risk factor for several chronic diseases, including dyslipidemia, cardiovascular and cerebrovascular disease, venous thromboembolism, hypertension, type 2 diabetes, cholelithiasis, gout, many types of cancer (particularly those arising in the breast, prostate, and colon), dementia, sleep apnea, polycystic ovarian syndrome, osteoarthritis of the hip and knee, and infertility. Abdominal (visceral) fat, compared with other fat distributions, is generally a stronger indicator of health-problem risk.^[7]

Risk Factors

In addition to the contributions of increased caloric intake and decreased physical activity, genetic factors play an important role in predisposition to obesity. Specifically, genes involving the hypothalamic regulation of energy may play a significant role for some individuals.^[8]

Depression, anxiety, major life events, fast-food consumption,^[9] and eating disorders may also contribute to unhealthy weight gain. The use of certain medications has been commonly associated with weight gain, among the most common are glucocorticosteroids, antipsychotics, and some antidepressants, as well as some medications (notably insulin) used in the treatment of diabetes mellitus.^[7]

Certain demographic groups are disproportionately affected by weight problems. The highest incidence is seen in non-Hispanic blacks (47.8%), while non-Hispanic Asians have the lowest prevalence (10.8%).^[10]

A history of childhood obesity and having obese parents are both risk factors for obesity in adulthood.^[11]

Diagnosis

An evaluation of obesity requires a complete history and physical examination, with special attention to medications, herbal remedies, nutritional and exercise history, risk factors for coronary artery disease, and family history of thyroid and cardiac diseases. Underlying medical conditions, psychosocial stressors, depression, and emotional eating should be assessed. Rare genetic disorders may contribute to obesity, and patients should be referred to a geneticist if such conditions are suspected.^[12] Abnormal sleep patterns should be assessed, typically by screening for obstructive sleep apnea or by addressing adequate sleep in the context of shift work.

BMI calculation is commonly used to estimate the severity of overweight, but can be misleading in very muscular people.

Anthropometric measures include waist circumference, waist-to-hip circumference ratio, and body-fat determination, which is usually based on skin-fold thickness or bioimpedance. More accurate determinations such as DEXA scans, CT, and MRI are generally limited to research settings.^[13]

Laboratory testing may include evaluation for diabetes, Cushing syndrome, and thyroid abnormalities. It may also be appropriate to assess renal function, plasma lipid concentrations, a blood count (CBC), and liver enzymes to screen for hepatic steatosis. Female patients may warrant evaluation for polycystic ovarian syndrome.

Treatment

Any underlying medical or psychiatric condition contributing to obesity should be addressed, and therapeutic interventions should be included in the plan of action for treating obesity. Diet changes are essential to weight loss.

Exercise alone without improved dietary habits is typically not sufficient for significant weight loss, but adding exercise to a healthy diet has been shown to be more effective at attaining and maintaining a healthy weight.^[14] Physical activity helps to increase and retain lean body mass and may better prepare patients to keep weight off after the initial loss.^[15]

A reasonable goal for most obese patients is to lose one pound per week until they have lost 5-10% of body weight. Patients will typically have health improvements even before they have achieved a healthy BMI.^[16] A loss of 2.5% of original body weight can yield a 60% decreased risk of the development of diabetes over the course of 6 years.^[17]

Pharmacotherapy

Several medical therapies are available, and more are under study. Recent evidence suggests that a combination of pharmacotherapy and behavior therapy achieves better results than either modality used alone.^[18] However, results of pharmacotherapy are generally modest, and weight is often regained once the medication is discontinued.^[19] Evidence of long-term benefits is scarce and inability to tolerate side effects may prohibit use. Since most medications are sympathomimetics, common side effects include constipation, dry mouth, and insomnia, as well as elevated heart rate and blood pressure.

Medications that are commonly used (but not necessarily recommended) include:

Appetite suppressants (sympathomimetics). Examples are sibutramine, phentermine, benzphetamine, phendimetrazine, and diethylpropion.

Orlistat. This pancreatic lipase inhibitor decreases the absorption of dietary fat. However, when using this medicine, it is necessary to supplement diet with fat-soluble vitamins and phytonutrients. The most common side effects include fecal incontinence, bloating, and anal leakage.

Other medications may be useful in certain patients with diabetes, depression, or seizure disorders

Surgery

Bariatric surgery has been used successfully in morbidly obese patients (BMI > 40) and in patients with BMI > 35 with comorbid conditions. Gastric bypass and banding are the most frequently used surgeries. Complications such as nutrient malabsorption and infection are common and lead to the 1%-2% mortality risk associated with these procedures. Surgery is not recommended until failure of lifestyle interventions has been established.

Lifestyle Modification

Certain personality and behavioral factors are characteristic of those who succeed at maintaining weight loss. These factors include developing coping skills that prevent using food for comfort; increasing self-efficacy with respect to weight control;^[20] engaging in high levels of physical activity (approximately 1 hour per day); choosing a low-calorie, low-fat diet; eating breakfast regularly; self-monitoring weight; and maintaining a consistent eating pattern through the 7-day week.^[21] The characteristic behaviors of those who keep weight off are documented and updated through the National Weight Control Registry, available at: <http://www.nwcr.ws>.^[21]

Dietary Supplements

Patients should be advised to avoid dietary supplements promoting weight loss. Reviews of their effectiveness indicate a lack of efficacy for chitosan, chromium picolinate, Garcinia cambogia, glucomannan, guar gum, hydroxymethylbutyrate, Plantago psyllium, pyruvate, yerba mate, and yohimbe.^[22] Ephedra-containing formulas have been found effective for weight control, particularly when combined with aspirin. However, the risk-to-benefit ratio of this combination is prohibitively high due to potential adverse cardiovascular effects of ephedra, as well as potential gastrointestinal damage caused by aspirin.

Nutritional Considerations

Although genetic factors contribute to obesity, the increased prevalence of this condition during the last century (particularly in the last three decades) confirms that environmental factors play a major role.^[23] The Western diet, which provides highly palatable, energy-dense foods rich in fat and sugar, is conducive to weight gain.^[24] These foods activate reward systems in the brain, up-regulate the expression of hunger signals, and blunt the response to satiety signals, promoting overconsumption.^[25]

Common short-term restrictive diets that focus on limiting portion sizes or calories rarely produce long-term weight loss^[26],^[27] and may have deleterious health effects.^[28],^[29] A better approach is a permanent change in the type of foods individuals select and in the physical activity they include in their routines. Individuals who consume foods lower in energy density and higher in water and fiber (e.g., salads, soups, vegetables, and fruits), instead of foods high in energy density, experience early satiety and spontaneously decrease food intake. This strategy has produced weight loss in several clinical studies.^[30] By allowing for the intake of larger portions that provide satiety,^[31],^[32] it fosters continued adherence.

The following steps reduce the energy density of the diet and promote weight control:

Reducing dietary fat. Dietary fat has more than twice as many calories per gram as protein and carbohydrate (9 compared with 4), and promotes passive overconsumption of energy. These factors may explain why the prevalence of overweight worldwide is directly related to the percentage of fat in the diet, and why low-fat diets have been consistently shown to promote moderate weight loss.^[33] Common sources of fat are meats, dairy products, fried foods, and added oils.

Choosing foods high in complex carbohydrates and fiber. Populations in Asia, Africa, and elsewhere with diets high in complex carbohydrates tend to have a low incidence of obesity. The whole grains and legumes in these diets also provide fiber. Fiber is filling but contributes little to overall calorie intake. Studies show that fiber intake is inversely associated with body weight and body fat.^[34]

Following low-fat, vegetarian diets. Several studies have found that vegetarians tend to be slimmer than omnivores, which is not surprising given that grains, legumes, vegetables, and fruits are low in fat and high in

complex carbohydrates and fiber.^[35] Randomized trials show that low-fat vegan diets promote greater weight loss than typical low-fat diets and that they also improve plasma lipids, insulin sensitivity, and other measures.^{[30],[36]} A study of a vegetarian diet in heart patients, used in combination with exercise and stress management, showed sustained weight loss over a 5-year period.^[37]

Minimizing sugars. Sucrose, high-fructose corn syrup, and other sugars add calories without producing satiety. A systematic review of epidemiological and clinical studies found positive associations between intake of sugar-sweetened beverages and both weight gain and obesity in children and adults.^[38]

Low-carbohydrate diets have been popular, but they have not been found superior to either low-fat, high-carbohydrate, or calorie-controlled diets over a 12-month period.^[39]

A controlled feeding study in a metabolic ward using isocaloric diets found that a low-fat diet resulted in more body fat loss than a low-carbohydrate diet.^[40] Low-carbohydrate diets may increase plasma low-density lipoprotein concentrations, sometimes severely, in approximately one-third of users. They also cause a sustained increase in urinary calcium losses.^[41] In the Women's Health Initiative Dietary Modification Trial, weight loss was greatest in women who both decreased fat intake and consumed more fruit, vegetables, and fibrous carbohydrate.^[42]

Steps for preventing obesity should begin in earliest childhood—including pregnancy. It is important to select foods that help maintain healthy weight gain during pregnancy and to breastfeed newborns. Parents should role-model healthful eating habits and physical activity, and encourage these behaviors in their children.^[43] (see Life Cycle chapter)

Orders

Vegetarian diet, nondairy, low-fat.

What to Tell the Family

Obesity contributes to many chronic illnesses, but it may be prevented and successfully treated in most individuals through a diet low in fat and simple sugar and high in fiber, along with regular physical activity. Well-planned, low-fat vegan and vegetarian diets are particularly healthful and effective.

The family plays an essential role in supporting the diet and lifestyle changes that can prevent and treat weight problems. Family members are likely to benefit from these same changes.

References

1. Overweight and Obesity Statistics. National Institute of Diabetes and Digestive and Kidney Diseases website. Available at: <http://www.niddk.nih.gov/health-information/health-statistics/Pages/overweight-obesity-statistics.aspx> . Updated October 2012. Accessed October 16, 2015.
2. Vasan RS et al: Estimated risks for developing obesity in the Framingham Heart Study. *Ann Intern Med* 143:473, 2005
3. WHO Expert Consultation: Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* 363:157, 2004
4. Vandevijvere S et al: Increased food energy supply as a major driver of the obesity epidemic: a global analysis.

Bull World Health Organ 93:446, 2015

5. Swinburn BA et al: Estimating the changes in energy flux that characterize the rise in obesity prevalence. *Am J Clin Nutr* 89:1723, 2009
6. Swinburn B, Sacks G, Ravussin E: Increased food energy supply is more than sufficient to explain the US epidemic of obesity. *Am J Clin Nutr* 90:1453, 2009
7. Bray GA, Wilson JF. In the clinic. Obesity. *Ann Intern Med* . 2008;149:ITC4-1-15;quiz ITC4-16.
8. Speliotes EK, Willer CJ, Berndt SI, et al. Association analyses of 249,796 individuals reveal 18 new loci associated with body mass index. *Nat Gen* . 2010;42:937-948.
9. Rosenheck R: Fast food consumption and increased caloric intake: a systematic review of a trajectory towards weight gain and obesity risk. *Obes Rev* 9:535, 2008
10. Ogden CL et al: Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA* 311:806, 2014
11. Whitaker RC et al: Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med* 337:869, 1997
12. Farooqi IS, O'Rahilly S: Genetic factors in human obesity. *Obes Rev* 8 Suppl 1:37, 2007
13. Hu F. Measurements of Adiposity and Body Composition. In: Hu F. Obesity Epidemiology . Oxford: Oxford University Press; 2008:53-83.
14. Miller WC, Koceja DM, Hamilton EJ: A meta-analysis of the past 25 years of weight loss research using diet, exercise or diet plus exercise intervention. *Int J Obes Relat Metab Disord* 21:941, 1997
15. Hill JO , Wyatt HR . Role of physical activity in preventing and treating obesity. *J Appl Physiol* (1985). 2005;99:765-770.
16. Kushner RF, Ryan DH: Assessment and lifestyle management of patients with obesity: clinical recommendations from systematic reviews. *JAMA* 312:943, 2014
17. Balk EM et al: Combined Diet and Physical Activity Promotion Programs to Prevent Type 2 Diabetes Among Persons at Increased Risk: A Systematic Review for the Community Preventive Services Task Force. *Ann Intern Med* 163:437, 2015
18. Wadden TA et al: Randomized trial of lifestyle modification and pharmacotherapy for obesity. *N Engl J Med* 353:2111, 2005
19. Padwal R, Li SK, Lau DC: Long-term pharmacotherapy for obesity and overweight. *Cochrane Database Syst Rev*
20. Byrne SM: Psychological aspects of weight maintenance and relapse in obesity. *J Psychosom Res* 53:1029, 2002
21. Wing RR, Phelan S: Long-term weight loss maintenance. *Am J Clin Nutr* 82:222S, 2005
22. Pittler MH, Ernst E: Dietary supplements for body-weight reduction: a systematic review. *Am J Clin Nutr* 79:529, 2004
23. Tremblay A, Pérusse L, Bouchard C: Energy balance and body-weight stability: impact of gene-environment

- interactions. *Br J Nutr* 92 Suppl 1:S63, 2004
24. Lindberg MA, Dementieva Y, Cavender J: Why Has the BMI gone up so drastically in the last 35 years? *J Addict Med* 5:272, 2011
 25. de Macedo IC, de Freitas JS, da Silva Torres IL. The influence of palatable diets in reward system activation: a mini review. *Adv Pharmacol Sci* . 2016;2016:1-7.
 26. Mann T, Tomiyama AJ, Ward A: Promoting Public Health in the Context of the "Obesity Epidemic": False Starts and Promising New Directions. *Perspect Psychol Sci* 10:706, 2015
 27. Rolls BJ, Roe LS, James BL, Sanchez CE. Does the incorporation of portion-control strategies in a behavioral program improve weight loss in a one-year randomized controlled trial? *Int J Obes (Lond)* . 2017;41:434-442.
 28. Tomiyama AJ et al: Low calorie dieting increases cortisol. *Psychosom Med* 72:357, 2010
 29. Lucan SC, DiNicolantonio JJ: How calorie-focused thinking about obesity and related diseases may mislead and harm public health. An alternative. *Public Health Nutr* 18:571, 2015
 30. Rolls BJ, Ello-Martin JA, Tohill BC: What can intervention studies tell us about the relationship between fruit and vegetable consumption and weight management? *Nutr Rev* 62:1, 2004
 31. Barnard ND et al: The effects of a low-fat, plant-based dietary intervention on body weight, metabolism, and insulin sensitivity. *Am J Med* 118:991, 2005
 32. Ello-Martin JA, Ledikwe JH, Rolls BJ: The influence of food portion size and energy density on energy intake: implications for weight management. *Am J Clin Nutr* 82:236S, 2005
 33. Hooper L et al: Effect of reducing total fat intake on body weight: systematic review and meta-analysis of randomised controlled trials and cohort studies. *BMJ* 345:, 2012
 34. Berkow SE, Barnard N: Vegetarian diets and weight status. *Nutr Rev* 64:175, 2006
 35. Barnard ND, Levin SM, Yokoyama Y: A systematic review and meta-analysis of changes in body weight in clinical trials of vegetarian diets. *J Acad Nutr Diet* 115:954, 2015
 36. Huang R, Huang C, Hu F, Chavarro J. Vegetarian diets and weight reduction: a meta-analysis of randomized controlled trials. *J Gen Intern Med* . 2015;31:109-116.
 37. Ornish D et al: Intensive lifestyle changes for reversal of coronary heart disease. *JAMA* 280:2001, 1998
 38. Malik VS et al: Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. *Am J Clin Nutr* 98:1084, 2013
 39. Astrup A, Meinert Larsen T, Harper A: Atkins and other low-carbohydrate diets: hoax or an effective tool for weight loss? *Lancet* 364:897, 2004 Sep 4-10
 40. Hall KD et al: Calorie for Calorie, Dietary Fat Restriction Results in More Body Fat Loss than Carbohydrate Restriction in People with Obesity. *Cell Metab* 22:427, 2015
 41. Yancy WS Jr, Olsen MK, Guyton JR, Bakst RP, Westman EC. A low-carbohydrate, ketogenic diet versus a low-fat diet to treat obesity and hyperlipidemia: a randomized, controlled trial. *Ann Int Med* . 2004;140:769-777.
 42. Howard BV et al: Low-fat dietary pattern and weight change over 7 years: the Women's Health Initiative Dietary

Modification Trial. *JAMA* 295:39, 2006

43. Mameli C, Mazzantini S, Zuccotti GV: Nutrition in the First 1000 Days: The Origin of Childhood Obesity. *Int J Environ Res Public Health* Aug 23