World Health Organization statistics indicate that more than 1.5 billion people are overweight, and 500 million of them are obese. Globally, overweight and obesity make up the fifth leading cause of death. These physical conditions are also a huge financial burden to society. They are typically accompanied by worsening comorbidities that lead to an increasing number of disabilities and decreased productivity in the work place.
Overweight and obese employees tend to have a higher number of absences from work, sick leave, and disability, as well as higher risks of work-related injuries. The comorbidities associated with obesity and overweight include asthma, coronary artery disease, diabetes mellitus, gallstones, gastrointestinal reflux disease, hernias, hypertension, osteoarthritis, and sleep apnea. Diabetes mellitus—the focus of the present article—is responsible for approximately 44% of the financial burden related to obesity. 

Cardiovascular disease is also prevalent today, with men having a 42% risk and women a 25% risk, of coronary heart disease. In patients with diabetes mellitus, this risk increases. A study that evaluated the prevalence of heart disease among individuals with and without diabetes mellitus and obesity found that the lifetime risk of diabetes in the obese population is about 74%. The study further found that the risk of cardiovascular disease in the obese population with diabetes rises to 50% in women and 90% in men.

Diabetes mellitus is prevalent in 44% of the overweight and obese population. Obese patients with diabetes mellitus not only suffer from complications of the disease, but they also must endure the high costs of medications and of such weight-loss efforts as special diets, gym memberships, and counseling. Conventional efforts to lose weight, such as behavioral changes, tend to have the most long-term benefits, but surgical interventions provide the most durable and effective method of reversing obesity. An estimated $174 billion was spent in 2007 in the United States as a result of diabetes mellitus, and about 1 in 10 US health care dollars goes to the care of patients with diabetes.

Obesity and overweight are caused essentially by an imbalance of energy consumed and energy expended. Obese and overweight individuals typically consume foods that are high in fats and sugars and spend insufficient time exercising because of a sedentary lifestyle. One study that evaluated the effects of dietary content on body composition showed that greater protein intake vs less protein intake did not affect the individual’s body fat content. Although the study suggested that high-protein diets might affect how energy is expended and how lean body mass is stored, body fat storage was not affected. Rather, calories alone accounted for increases in fat, with individuals who ate less protein gaining less weight. Thus, the composition of dietary intake is important to body composition and energy expenditure, but it is simply a mathematical equation of input minus output that equals a net gain of calories and weight.

**Methods of weight loss**

Weight-loss strategies that include diet and exercise are an effective way to decrease weight and maintain a healthy lifestyle. However, such strategies often require major behavioral and lifestyle changes that many individuals find difficult to adhere to. Thus, lifestyle modifications do not always result in long-term change or successful weight management. An individual’s sex and age can affect the success of a weight-loss plan. Men tend to lose weight faster than women, and older individuals have a lower metabolic expenditure than younger individuals.

In a study that evaluated different strategies of diets for their effects on weight loss (eg, low-calorie diets, balanced-deficit diets, low-fat and low-carbohydrate diets), adherence was found to be the most important factor in the success of the diets. Weight-loss effectiveness did not vary significantly with type of diet. Dietary changes combined with behavioral changes, including increased physical activity, proved to be the most effective strategy that produced the greatest weight loss.
Additional investigation showed that weight loss was further increased by an average of almost 9 pounds over a 12-month period with more intense physical activity.4 Weight loss was increased by another 17 pounds with the combination of behavioral therapy and diet.4

Pharmacologic therapy
Two drug therapies—sibutramine hydrochloride and orlistat—are approved by the US Food and Drug Administration (FDA) for medical management of weight loss. The effectiveness of sibutramine and orlistat, however, is limited to static control of obesity rather than long-term reduction of weight.4 Patients often regain weight after discontinuing the medications.8

Sibutramine inhibits reuptake of norepinephrine, serotonin, and dopamine in the neural pathway to stimulate the brain’s satiety center and decrease food intake, resulting in the possible adverse effects of constipation and insomnia.8 Sibutramine can also increase blood pressure and heart rate in some patients. In such cases, the medication must be discontinued. Orlistat inhibits lipases in the gastrointestinal tract, preventing the absorption of fat.8 Adverse effects associated with orlistat include abdominal pain, fecal urgency or incontinence, and liquid or soft stool. A patient typically experiences at least 1 of these gastrointestinal adverse effects.8

Other possible complications of orlistat use include malabsorption of lipophilic medications, such as cyclosporine—in which case the use of orlistat should be suspended until the other medication is no longer used.8

Bariatric surgery
In 1991, the National Institutes of Health (NIH) developed general guidelines for better assessing the need for bariatric surgical procedures. According to the guidelines, bariatric surgery should be performed only if the patient has a body mass index (BMI) of 40 or greater, is well informed and motivated, has acceptable risk for surgery, and has previously undergone unsuccessful nonsurgical weight-loss attempts.9 Other indications for bariatric surgery, according to the NIH, are a BMI of 35 or greater with severe comorbidities, such as diabetes mellitus or sleep apnea.9 The NIH notes that gastric bypass is an effective type of bariatric surgery for losing weight and decreasing BMI. Patients can lose as much as 60% of excess body weight with the gastric bypass Roux-en-Y procedure and as much as 50% of excess body weight with the adjustable laparoscopic banding procedure.9

Bariatric surgery can be life-changing for individuals battling diabetes mellitus. This article will focus on the reduction of risk factors for type 2 diabetes. The American Diabetes Association (ADA) has defined diabetes remission after bariatric surgery as a glycosylated hemoglobin (HbA1c) level of less than 6% without the use of hypoglycemic medications for at least 1 year after surgery.10 In an analysis of diabetes remission rates (based on this ADA definition) following any of 3 types of bariatric surgery, remission was achieved in 34.4% of the patients studied.10 Remission rates varied among types of bariatric surgery, with a rate of 41% after gastric bypass surgery, 26% after sleeve gastrectomy, and 7% after gastric banding.10

Types of bariatric surgery
Bariatric surgery induces 2 main types of mechanisms of weight loss—restriction or malabsorption—or a combination of both mechanisms may occur.9 Restrictive surgical procedures decrease the amount of space available for the stomach to hold food intake, such as by removing part of the stomach, decreasing the rate at which the stomach can empty, or narrowing the outlet through gastric banding.9 Commonly performed restrictive procedures include vertical gastric banding and laparoscopic adjustable gastric banding. These procedures limit the amount of space in the stomach, preventing the individual from overeating and prolonging the time it
skin. The FDA approved this technique in banding, a band is placed tightly around the stomach to create a restrictive weight-loss mechanism. This band can be adjusted (making it smaller or larger, as needed by the patient) through a port that is placed in an easily accessible location just under the skin. The FDA approved this technique in 2011 for patients who have a BMI greater than 35 and with clinically significant comorbidities (per previously mentioned NIH guidelines). These comorbidities include T2DM and previous failures of medication therapy for obesity. To be covered, the surgeries must be performed at centers that meet CMS requirements.

The cost of bariatric surgery without insurance varies according to procedure, medical center, and geographic region. The average cost for gastric bypass surgery ranges from $18,000 to $35,000, including imaging, preprocedure visit, preoperative laboratory tests, anesthesia, and facility and/or surgeon fees. This cost does not include behavioral counseling before and after surgery, nor the use of supplemental vitamins. The cost of adjustable band procedures ranges from $17,000 to $30,000, including anesthesia and hospital and surgeon fees, as well as radiography radiology, and laboratory test fees. These costs usually also include postsurgical visits related to band adjustments for 1 year. After 1 year, the cost for band adjustments is typically $100 to $175 per visit. Obesity has resulted in estimated medical expenditures of $147 billion each year in the United States, with diabetes mellitus adding costs of more than $150 billion each year.

Can bariatric surgery decrease the health care costs and overall medical expenses of patients? A study published in January 2012 analyzed the preprocedure and postprocedure costs to the individual patient with type 2 diabetes mellitus undergoing bariatric surgery. Costs were analyzed in 1-year increments and included office visits, hospital visits, medications, and other health care expenses. Among patients receiving bariatric surgery, the total health care costs were higher after surgery than before the procedure. In addition, inpatient and hospitalization costs after surgery increased over time and were highest 2 to 6 years after the procedure.

Cost and cost-effectiveness
Studies have evaluated the safety and cost-effectiveness of bariatric surgery, as well as the effects of this surgery on diabetes mellitus. In 2006, the Centers for Medicare & Medicaid Services (CMS) issued a National Coverage Decision stating that laparoscopic adjustable gastric banding would be reimbursed in addition to other approved bariatric procedures, though these reimbursed procedures had to be performed at accredited centers. The CMS coverage decision resulted in a decrease in mortality and morbidity after bariatric procedures, as well as an increase in the use of laparoscopic adjustable gastric banding and decreases in the other bariatric procedures.

In laparoscopic adjustable gastric banding, a band is placed tightly around the stomach to create a restrictive weight-loss mechanism. This band can be adjusted (making it smaller or larger, as needed by the patient) through a port that is placed in an easily accessible location just under the skin. The FDA approved this technique in 2011 for patients who have a BMI greater than 35 with clinically significant comorbidities (per previously mentioned NIH guidelines). These comorbidities include T2DM and previous failures of medication therapy for obesity. To be covered, the surgeries must be performed at centers that meet CMS requirements.

Although these 2 procedures, laparoscopic adjustable gastric banding and Roux-en-Y, are the most commonly performed weight-loss surgeries, other forms of bariatric surgery, such as sleeve gastrectomy and biliopancreatic diversion, are also performed. However, these less common procedures are not discussed in the present article.

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An example of a surgical procedure that takes to empty the stomach. By contrast, malabsorption surgical procedures decrease the amount of nutrients absorbed, mainly by decreasing the time available to do so. Although malabsorption procedures can cause effective weight loss, they may also cause such metabolic complications as nutrient deficiencies and alteration in protein metabolism.

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Overall, the health care costs of these patients did not decrease after bariatric surgery. The study further showed that there is a decrease in medication costs after bariatric surgery, inferring that patients have a decreased requirement for diabetic medications after surgery. In regard to cost variation depending on type of surgery, costs were lower in patients undergoing laparoscopic surgery than in those who elected or required open surgical procedures.

Although research suggests that costs of patient visits and overall health care expenditures may increase after bariatric surgery, the economic value of increased productivity and mobility of patients has not been measured after these surgical procedures. Increased productivity and mobility are invaluable outcomes that can lead to decreased comorbidities and improved quality of life.

**Long-term effects of obesity**

Obesity affects the endocrine system and can cause a “domino effect” of complications. Adipose tissue releases inflammatory substances that act on various other tissues, potentially disrupting the endothelial lining of the vasculature, leading to atherosclerosis. Some of these inflammatory substances can also act on the liver and on skeletal muscle, creating insulin resistance and, ultimately, diabetes mellitus. This development is of special concern in the growing pediatric obese population, in whom the incidences of diabetes mellitus and cardiovascular complications are increasing.

Diabetes mellitus is a known risk factor for cardiovascular complications and can increase a patient’s risks for coronary artery disease, stroke, myocardial infarction, and other vascular complications. As many as 80% of patients with diabetes mellitus die of cardiovascular complications, and individuals with diabetes have a 5-times greater risk of mortality than patients without diabetes. Therefore, if resolution of diabetes mellitus can be achieved through bariatric surgery, cardiovascular improvements can be expected to follow. Bariatric surgery may also induce improvements in glucose tolerance, lipid control, and hypertension.

Obesity causes increased strain on the heart, doubling the risk of heart failure compared to the risk in individuals who are not obese. Many obese people with such a condition are said to have “obesity cardiomyopathy.” However, this term applies only to patients without other causes of cardiomyopathy, such as diabetes mellitus, hypertension, and hyperlipidemia. Cardiovascular risks are also associated with obstructive sleep apnea, which, in turn, is often associated with obesity and can develop into right-sided heart failure and pulmonary hypertension.

A recent study demonstrated that obese patients who underwent bariatric surgery had a statistically significantly reduced cardiovascular risk compared to obese patients who did not undergo bariatric surgery. These patients had decreased incidence of stroke and myocardial infarction and an overall reduction of fatal events. It has also been shown that surgically induced weight loss can alter the metabolic functioning of patients through restrictive and malabsorptive mechanisms. One study demonstrated a statistically significant improvement in insulin sensitivity in individuals both with and without diabetes mellitus after bariatric surgery. That study also found a correlation between decreasing BMI with increasing insulin sensitivity.

**Final notes**

Obesity, diabetes mellitus, and cardiovascular complications are tightly linked. Thus, weight loss and management of coexisting diseases are highly important factors for decreasing the number of
cardiovascular events and future complications related to diabetes mellitus. Although behavioral and lifestyle changes can promote adequate weight loss, the majority of the population is unable to achieve these changes. Pharmacologic agents can help, though they do not produce lifelong effects that result from weight loss through such surgery, but they alter the metabolic function in obese individuals and the majority of population is unable to achieve these medications.

It is apparent that bariatric surgery is beneficial in inducing weight loss and can alter the metabolic function in obese individuals. Patients not only benefit from weight loss through such surgery, but they also benefit from the physical, endocrine, and metabolic effects that result from altering the structure of the gastrointestinal tract.

Studies suggest that bariatric surgery is more cost-effective and beneficial than conservative methods of weight reduction. Unfortunately, to our knowledge there are no lifelong studies comparing costs for patients who received bariatric surgery vs those who did not undergo the surgery. Nevertheless, one might assume that the lifelong costs of cardiovascular complications associated with obesity and diabetes mellitus would be more than costs after weight reduction from surgery. Bariatric surgery also has the potential to lengthen the patient’s lifespan. It is important to keep in mind that insurance companies and the Medicare program cover bariatric surgery through guidelines they have established for beneficiaries.

Most obese patients will be unable to achieve the lifestyle and behavioral changes necessary to reduce their cardiometabolic risks. If the obese patient is mentally, physically, and financially able to proceed, bariatric surgery can offer an effective and satisfying outcome.

References


