Obesity: Overview of Prevalence, Etiology, and Treatment

Obesity is a worldwide epidemic[1] that is characterized by excess adipose tissue and that contributes to numerous chronic diseases[2] and early mortality.[3,4] This epidemic has received both national and international attention because of obesity's detrimental impact on health, the enormous economic burden it imposes,[5] and its increasing prevalence. The adverse health consequences associated with obesity include cardiovascular disease[6,7]; stroke; type 2 diabetes mellitus[8]; hypertension; dyslipidemia; cancers of the breast, endometrium, prostate, and colon[9,10]; gallbladder disease; osteoarthritis[11–13] respiratory problems, including asthma[14] and sleep apnea[15]; and perhaps depression.[16,17] Furthermore, aerobic capacity and the ability to perform physical activities may be hindered by obesity,[18,19] and this may have implications for physical therapists' interventions. In addition to the increased morbidity and functional limitations associated with obesity, approximately 325,000 deaths in the United States each year among nonsmokers are attributable to obesity.[20] We will discuss the prevalence of obesity, its etiology in the context of our environment, and the currently available treatment modalities.

Classification

The most commonly used method today for classifying an individual as overweight or obese is based on body mass index (BMI), a value that is determined by dividing body weight (in kilograms) by the square of height (in meters). In adults, overweight is defined by a BMI of $\geq$25.0 kg/m^2, and obesity is defined by a BMI of $\geq$30.0 kg/m^2, regardless of sex. The World Health Organization distinguishes several BMI categories based on increasing health risks (Table).[21] Despite these categorizations, however, the adverse health effects of overweight and obesity occur along a continuum of increasing adiposity. The use of BMI to assess weight-related health risk has gained international acceptance because of the associations between BMI and adiposity,[22] BMI and disease risk,[2] and BMI and mortality.[23] The simplicity of determining BMI, which can be calculated from measurements or self-

[Racette SB, Deusinger SS, Deusinger RH. Obesity: overview of prevalence, etiology, and treatment. *Phys Ther.* 2003;83:276–288.]

Key Words: *Body mass index, Body weight, Obesity, Overweight.*

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reported values of height and weight, enables comparisons of various populations throughout the nation and worldwide. The major limitation of BMI is that it does not differentiate between weight that is fat (ie, fat mass) and weight that is muscle (ie, fat-free mass), and therefore may lead to misclassification of very muscular individuals as overweight. In addition, older adults may appear to have a healthy BMI despite having excess fat and reduced muscle mass.[24]

Waist circumference is another clinically feasible measurement that may be used independently or in addition to BMI[25] to assess weight-related health risk. The World Health Organization has identified sex-specific waist circumference values that signify increased health risk (≥80 cm for women, ≥94 cm for men) and substantially increased health risk (≥88 cm for women, ≥102 cm for men).[21] Waist circumference correlates well with BMI (r=.84-.88),[26] requires only a tape measure, and provides an estimate of abdominal fat.[27,28] Abdominal fat is more strongly associated with health risk than fat stored in other regions of the body.[29]

Although BMI and waist circumference are the recommended[30] and most clinically feasible means of identifying patients who are overweight or obese in clinical practice, numerous body composition assessment techniques are available.[31] The most accurate techniques, including hydrostatic weighing,[32] dual-energy x-ray absorptiometry (DEXA),[33] and isotope dilution,[34] depend on sophisticated equipment generally available only in research settings. A simple, economical, and potentially reliable technique is skinfold thickness examination performed using calipers.[35] The accuracy of this method, however, is compromised in individuals with extreme obesity or altered hydration status, and interobserver variability may be high,[36] particularly when different calipers are used. Bioelectrical impedance analysis (BIA)[37–39] is another method used to estimate adiposity by measuring resistance to a low-frequency electrical current. The premise of this method is that current flows through aqueous compartments, whereas adipose tissue, which is nonaqueous, impedes the flow. The advantages of BIA include its portability, modest cost, noninvasive nature, the brief assessment time required, and its validity and reliability in many populations.[40–43] However, individual variability can be high, and the accuracy of BIA is compromised in situations of altered hydration status[44] and extreme obesity.[45–47]

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Prevalence

Obesity is a global problem, affecting an estimated 300 million people worldwide.[48] Its prevalence is increasing in both developed and developing countries throughout the world. In the United States, the prevalence of obesity is greater than it has ever been, with striking increases observed during the past 2 decades.[49,50] Five large-scale,

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Table.
World Health Organization's Body Mass Index (BMI) Categories Based on Increasing Health Risks[21]

Weight Category	BMI (kg/m^2)
Underweight	<18.5
Normal weight	18.5–24.9
Overweight	≥25.0
Pre-obese	25.0–29.9
Obese	≥30.0
Obese class 1	30.0–34.9
Obese class 2	35.0–39.9
Obese class 3	≥40.0

national surveys conducted in the United States between 1960 and 2000 provided estimates of the extent of overweight and obesity in our nation. These surveys were the National Health Examination Survey (NHES I, 1960–1962); the first 3 National Health and Nutrition Examination Surveys (NHANES I, 1971–1974; NHANES II, 1976–1980; NHANES III, 1988–1994); and the ongoing NHANES, which began in 1999.[51,52] In contrast to other surveillance studies, the NHES and NHANES involved measured heights and weights, from which BMI was calculated. The prevalence of overweight (including obesity) among adults 20 years of age and older in the United States changed relatively little between 1960 and 1980, whereas dramatic increases were observed after 1980. As shown in Figure 1, 64.5% of the adult population currently is estimated to be overweight based on data from NHANES 1999–2000,[51] as compared with 46% during NHANES II (1976–1980).[52] Most of this increase is attributable to a dramatic rise in the prevalence of obesity (ie, BMI of ≥30.0 kg/m^2) from 15% during NHANES II to the recent estimate of nearly 31% during NHANES 1999–2000.[51] Because overweight and obesity are common health problems, present among nearly 65% of adults in the United States, physical therapists will continue to encounter these individuals in clinical practice for many years to come.

Obesity is pervasive, affecting people of all ages and at all socioeconomic levels. Results of the Behavioral Risk Factor Surveillance System, a cross-sectional telephone survey of adults, suggest that the prevalence of obesity among young adults 18 to 29 years of age increased 70% between 1991 and 1998.[53] Consistent with the data for adults, the prevalence of overweight and obesity among children and adolescents changed very little between the 1960s and early 1980s, whereas dramatic increases were observed during the 1980s and 1990s.[54] It has been estimated, using age- and sex-specific BMI criteria, that 10.4% of children 2 to 5 years of age, 15.3% of children 6 to 11 years of age, and 15.5% of adolescents 12 to 19 years of age are overweight.[55] This phenomenon among children and adolescents has contributed to unprecedented rates of type 2 diabetes,[56,57] a disease formerly

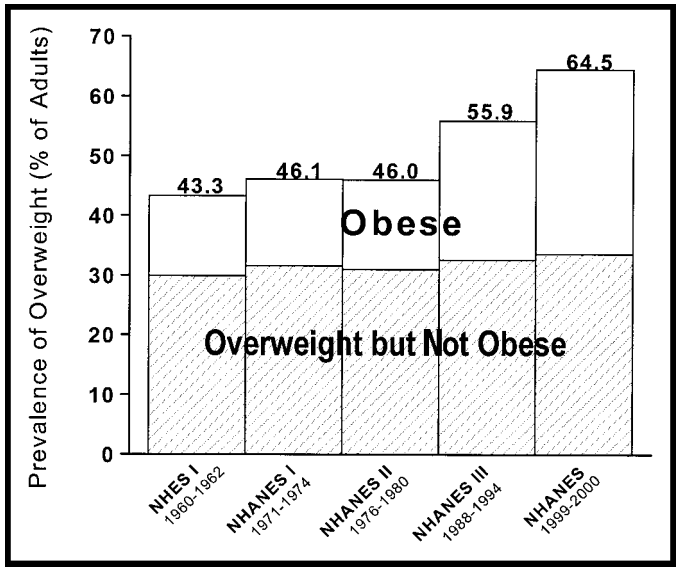

Figure 1.
Percentage of adults (20–74 years of age) classified as overweight but not obese (hatched bars, body mass index=25.0–29.9 kg/m^2) and obese (open bars, body mass index of ≥30.0 kg/m^2) in the National Health Examination Survey I (NHES I) and 4 National Health and Nutrition Examination Surveys (NHANES).[51,52] The numbers above the bars represent the total percentages of individuals classified as overweight.

referred to as "adult-onset diabetes" because it rarely affected youth.

Increasing age is associated with an increase in obesity. Body weights of men and women in the United States increase approximately 9.1 kg between the ages of 25 and 55 years.[58,59] These increases in body weight generally are not explained by increases in fat-free mass, because bone mass peaks around 30 years of age and muscle mass plateaus and later declines unless the individual engages in strengthening activities. These changes in body weight and body composition are attributable, in part, to the natural declines in growth hormone, dehydroepiandrosterone, and testosterone with aging. In addition, reductions in resting metabolism alter energy balance and contribute to weight gain.

The question has been raised as to whether obesity remains a health risk among older adults. There is evidence suggesting that the optimal BMI range for adults 65 years of age and older is higher than the range for younger adults.[60–62] However, a mortality follow-up study of men who participated in NHANES I and NHANES II revealed that indicators of fat mass were positively associated with mortality, whereas indicators of fat-free mass were inversely associated with mortality.[63] These findings highlight the importance of body composition assessment and the potential limitation of BMI among older individuals. Excess body fat appears to continue to have adverse health effects into old age,

although the relative contribution to ill health may be different than for younger individuals. Additional research is needed to enable us to better understand the relationships among obesity, morbidity, and mortality in older adults.

Sex differences also are apparent in the patterns of weight gain and the development of overweight and obesity. These patterns are partially attributable to hormonal differences between men and women before menopause and to hormonal changes in women during menopause.[64] During the perimenopausal and postmenopausal periods, many women experience alterations in body weight,[65,66] total body fat[67] and body fat distribution.[68] Wing et al[66] reported that premenopausal women between 42 and 50 years of age gained an average of 2.25 kg in 3 years; 20% of these women gained at least 4.5 kg (approximately 10 lb). Based on the NHANES III data set, approximately 70% of women between 45 and 54 years of age is overweight or obese.[69] Although increasing adiposity appears to be common after menopause, a great deal of evidence suggests that this phenomenon is neither desirable nor necessarily inevitable.[70]

In addition to age and sex, race and ethnicity are factors in the prevalence of obesity. Substantial disparities exist among white, black, and Hispanic women, with a higher prevalence of obesity observed among the latter 2 groups.[71–74] Some of this difference appears to be attributable to lower rates of physical activity among black women[75–77] and Hispanic women.[76] Interestingly, however, the health risks associated with obesity also are influenced by race, with black individuals at lower risk and Asians at higher risk compared with whites at the same BMI.[78] Additional factors influencing body weight include income and education level, which are inversely associated with overweight and obesity among adolescents and adults.

The observed trends in body weight in the United States during the past decade are contrary to the Healthy People objectives of reducing the prevalence of overweight and obesity.[79] Healthy People 2000,[80] a national health initiative introduced in 1990 by the US Department of Health and Human Services, contained specific goals to be achieved by the year 2000 that would improve the health of Americans. One of these 10-year goals was to reduce the prevalence of overweight among adults from 26% to 20%. Not only was this goal not achieved, but the prevalence of obesity increased 61% between 1991 and 2000.[50] A new set of health objectives, Healthy People 2010: Understanding and Improving Health,[71] was introduced in 2000, with a greater focus on overweight and obesity. Objectives to be achieved by 2010 include: increasing the proportion of adults who have a healthy body weight to 60% (from approximately 35% in 2000; healthy weight is defined by a BMI between 18.5 and 24.9 kg/m^2), reducing the proportion of adults who are obese to 15% (from 31% in 2000), and reducing the proportion of children and adolescents who are overweight or obese to 5% (from approximately 15% in 2000). These body weight goals have been established based on the public health benefits that are likely to result if our nation achieves these goals. Unfortunately, current body weight trends are leading us farther away from rather than closer to these goals. Heightened awareness and understanding of the obesity epidemic by physical therapists and other health care professionals are important as we strive toward the Healthy People goals.

Etiology

Obesity is the result of genetic, behavioral, environmental, physiological, social, and cultural factors that result in energy imbalance and promote excessive fat deposition. The relative contribution of each of these factors has been studied extensively, and although genes play an important role in the regulation of body weight, the World Health Organization Consultation on Obesity[21] concluded that behavioral and environmental factors (ie, sedentary lifestyles combined with excess energy intake) are primarily responsible for the dramatic increase in obesity during the past 2 decades. The genetic contribution to obesity has been elucidated by studies of Stunkard et al[81] involving twins, in which concordance rates for varying degrees of overweight were twice as high among monozygotic than dizygotic male twin pairs at age 20 years. A 25-year follow-up of these individuals further supports the role of genetics in body weight regulation. Another classic study involving adult adoptees[82] revealed a strong correlation between the adoptees' weight and their biological parents' BMI, whereas no such relationship was observed with the adoptive parents' BMI. These results highlight the importance of genes, while signifying little or no environmental contribution. Maes et al[83] estimated that genetic factors account for 50% to 90% of the variability in BMI.

Genotype-environment interactions also have been implicated in the development of obesity.[84] Bouchard et al[85] demonstrated that the amount of body weight and fat gained, as well as the distribution of fat gained in response to overfeeding, had greater similarity within than between twin pairs, further supporting the heritability of the tendency to become overweight or obese. One of the mechanisms by which genotype affects body weight is in the regulation of energy expenditure. It is estimated that approximately 40% of the variance in daily energy expenditure (excluding vigorous physical activity) is attributable to genotype.[86] Thus, there is

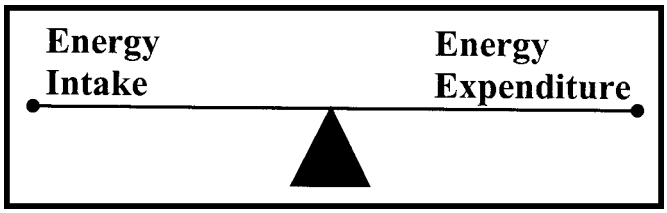

Figure 2.
Energy balance.

substantial evidence implicating the role of genetics in body weight regulation.

Despite the influence of genetics in the regulation of body weight, the rapidity with which obesity has escalated in the United States and other industrialized countries suggests that genetic factors cannot play the predominant role in the current obesity epidemic. Population-wide genetic alterations do not occur in the relatively short period of time during which obesity reached epidemic proportions. Rather, behavioral and environmental factors are largely responsible,[87] and there is recent evidence from studies comparing monozygotic, dizygotic, and virtual twins (ie, siblings who are not biologically related, but who are the same age and were raised together from infancy) that environmental factors have a greater effect on BMI than was appreciated previously.[88] Therefore, the current obesity epidemic appears to be the result of environmental and behavioral factors interacting with genetic susceptibility.

The development of obesity is dependent on an imbalance between energy intake and energy expenditure during an extended period of time. The cause may be viewed as excess energy intake relative to daily energy expenditure, or as low energy expenditure relative to daily energy intake. Figure 2 illustrates that energy balance can be achieved only when energy intake and energy expenditure are equal. In accordance with the first law of thermodynamics (ie, energy cannot be created or destroyed), excess energy is stored as triacylglycerols in adipose tissue. The primary functions of adipocytes are to store energy when calories are in excess and to mobilize energy from this triacylglycerol reservoir when energy needs exceed intake (eg, during dieting and starvation).[89] An imbalance of as little as 10 surplus calories per day will lead to a 0.45-kg (1-lb) weight gain each year, which can become clinically important if continued for decades. Weight gain during adulthood is characterized predominantly by adipocyte hypertrophy, a process by which adipocytes can increase their volume several thousandfold to accommodate large increases in lipid storage. In an evolutionary context, the ability to store excess energy in adipose tissue was essential for survival, because energy could be drawn from this storage depot in times of famine.[89] Paradoxically, this survival characteristic is disadvantageous when food is abundant and palatable.[90]

In addition to their storage function, adipocytes serve as endocrine cells by secreting hormones and growth factors that regulate fat metabolism through feedback mechanisms. One of these regulators is leptin, a hormone identified in 1994[91] and secreted by adipocytes in proportion to total fat mass.[92] Because larger adipocytes synthesize more leptin, obesity is associated with high plasma leptin concentrations.[93] Dietary intake also influences leptin secretion; short-term food restriction decreases leptin concentrations,[94] whereas resumption of habitual eating patterns restores them.[95] The physiological functions of leptin in rodents include reducing energy intake and increasing energy expenditure.[96] Because these effects generally would result in weight loss, leptin resistance has been proposed as the mechanism by which humans with high leptin concentrations remain obese.[92] Despite the documented effects of leptin in rodents, and the role of leptin deficiency in rodent models of obesity,[96] leptin does not appear to play a role in the etiology of human obesity except in very rare cases of genetic mutations.[96]

Dietary patterns contribute substantially to the development of obesity. Despite an increased focus on nutrition, a heightened awareness of the energy and fat content of foods, and the availability of various reduced-fat, fat-free, and sugar-free foods and beverages, obesity continues to increase. Modern society facilitates excessive consumption with its abundance of inexpensive, energy-dense foods, numerous conveniently located eating establishments that promote dining away from home,[97] a high variety of foods at mealtime,[98] and unreasonably large portion sizes. Food manufacturers strive to enhance the appearance and flavor of packaged foods and, through effective advertising, promote overeating. Fast-foods and convenience foods, which frequently are high in calories but relatively low in nutrients, are readily available in many neighborhoods, shopping centers, schools, and hospitals. The effects are dramatic, not only in terms of the expanding American waistline and the inevitable adverse health effects, but also because their omnipresence conveys the wrong message about their role in a healthy diet. In addition, behavioral changes common during holidays contribute to seasonal weight gain during the winter months, which although less than 0.5 kg on average,[99] is greater among individuals who are overweight or obese and is responsible for at least half of annual weight gain.

Although it is apparent that average energy consumption has increased over time, there are conflicting opinions regarding the contribution of dietary fat to obesity. Because fat contains more calories per gram than carbo-

hydrate and protein and frequently is found in high-calorie foods, it has been regarded as a major culprit contributing to overeating and obesity.[21,100] In contrast, there is evidence that dietary fat intake as a percentage of total energy intake has declined[101] and that adiposity is not determined by dietary fat.[102] Energy density (ie, the number of calories per gram of food) has been shown to influence short-term consumption patterns to a greater extent than dietary fat.[103,104] These observations help explain why the advent of fat-free and reduced-fat food products, which in many cases have the same energy content as their full-fat counterparts, has failed to ameliorate the obesity problem in the United States. Self-reports of food intake, however, can be quite inaccurate,[105–107] and individuals who are obese generally underreport their food intake,[108] leading to erroneous conclusions about consumption patterns over time. Nevertheless, available evidence from studies of humans and animals indicate that obesity is more likely to develop and to be maintained in the presence of high-fat rather than low-fat diets.[109] Furthermore, obesity experts agree that avoiding weight gain has become a challenge amidst the overabundance of high-calorie commercial foods and fast-foods in our society.

Adverse dietary patterns have been accompanied by sedentary lifestyles, which contribute to the high prevalence of obesity.[110] Engaging in physical activities, whether mild, moderate, or vigorous, has an impact on daily energy expenditure and therefore is a major determinant of energy balance. Industrialization and numerous technological advances have enabled humans to evolve from hunter-gatherers[111,112] to highly sedentary individuals in America and other wealthy nations. In addition to a high reliance on automobiles, elevators, escalators, dishwashers, remote controls, and other labor-saving devices, Americans are using more technology in their work and recreational activities. Changes in our educational systems and family structure have led to reductions in physical education in schools[79] and to increases in the number of latchkey children who must stay indoors after school. Safety concerns in many neighborhoods promote television viewing and use of video games as alternatives to physical activities for youth. All of these trends have contributed to a new generation of children who are sedentary and obese. Many of them will remain obese as adults.[113]

In addition to environmental shifts toward more sedentary lifestyles, decrements in physical activity generally occur at defined times of life, one of which is the passage from adolescence to adulthood. Data from the National Health Interview Survey[114] indicate that participation in vigorous aerobic and strengthening activities declines progressively from 12 to 21 years of age, with the greatest deterioration in physical activity between 15 and 18 years of age, and that a continuous decline is common during early adulthood (18–29 years of age).

Amid the current focus on fitness and health, it may seem paradoxical that physical inactivity is a concern in our society. Health clubs, walking and running paths, and bike trails are abundant, and utilization of these resources appears to be in vogue for people of all ages. The number of work-site fitness centers has increased dramatically during the past decade, and there is greater participation in physical activities (light, moderate, and vigorous) and strengthening exercises.[79] The amount of energy expended in physical activity and exercise, however, often is insufficient to counter the generally sedentary nature of the remainder of our lifestyles and the influence of excessive caloric consumption. Furthermore, those who engage in formal exercise on a regular basis comprise a relatively small portion of our general population,[115] and in many cases also comprise the minority of the population who are neither overweight nor obese. A report of the Surgeon General revealed that only 22% of adults in America engage in physical activity on a regular basis, and more than half of the adult population maintains an almost totally sedentary lifestyle.[115] Physical therapists can play an important role in educating patients and the public about appropriate amounts of physical activity.

Treatment

The goals of obesity treatment are to achieve and then to maintain clinically meaningful weight loss, with the ultimate goal of reducing the risk for or severity of obesity-related diseases, impairments, and functional limitations. Weight losses of 5% to 10% of initial body weight produce health benefits and are deemed by many health care practitioners to represent a clinical success. Long-term success, however, is dependent on maintenance of a 10% weight loss for at least 1 year,[116] a daunting challenge with varying rates of success.[117] Wing and Hill[116] estimated that approximately 21% of adults who are overweight or obese are successful at 1 year, but longer-term success generally is lower.

Effective therapeutic regimens for treating obesity, we believe, should incorporate multiple approaches to encourage behavioral change or modification and creative strategies to facilitate consistent and long-term follow-through. Numerous options are available today,[118,119] including reduced-energy diets, physical activity/exercise, behavior modification,[120] pharmacotherapy,[121,122] and surgery.[123] The treatment choice depends on the degree of obesity, the presence of comorbidities, previous weight loss therapies utilized and the relative success of each, and the myriad characteristics of an individual's personal life.

Dietary approaches form the basis of most weight loss interventions and rely on a reduction in total energy intake. Although many diets focus on dietary fat reductions, the main determinant of weight loss is the total energy content of the diet[124] (relative to total energy expenditure), rather than the composition of macronutrients. Therefore, whether diet therapy is based on a high complex-carbohydrate, low-fat meal plan, as advocated by the American Heart Association[125] and many nutrition professionals,[118,126] or relies primarily on carbohydrate restriction, its success is dependent on a relative energy deficit. Weight-reducing diets may be very-low-calorie diets (VLCDs, <800 kcal/d) or low-calorie diets (LCDs, 800-1500 kcal/d) and may consist of liquid formulas, prepackaged meals, nutritional bars, regular foods, or a combination. Very-low-calorie diets are very effective for weight reduction,[127] and the nutritionally adequate formulas used today have fewer associated health problems (eg, gout, cholelithiasis, hair loss) as compared with the VLCD formulas used in the 1970s.

Despite rapid and clinically meaningful weight loss with VLCDs, however, maintenance of the reduced weight is variable and generally poor. Instead, LCDs are used more commonly because they are safer, have fewer side effects, enable better adherence, and therefore may result in comparable weight loss as VLCD regimens.[128] Diets containing more than 1,200 kcal/d produce slower weight losses, but they are advantageous because they can be incorporated more easily into individual lifestyles and generally can be followed for long periods of time without adverse health effects. Regardless of the prescribed energy level of the diet, it is now evident that dietary adherence and weight loss outcomes may be improved when food and beverage choices are limited and strictly controlled.[129] Therefore, meal replacements (beverages, bars, soups, and prepackaged meals containing approximately 200–400 kcal) constitute an effective strategy both for weight loss[129] and for weight maintenance following weight loss.[130,131] Individualization is important, however, because various dietary strategies have been used to achieve weight loss,[132] and no single treatment approach has been shown to be effective or appropriate for all people who are obese.

Exercise generally does not produce considerable weight loss when used independently, but is a very important adjunct to a weight-reducing diet[133] because it increases energy expenditure, enhances loss of adipose tissue,[134] and improves dietary adherence.[135] Although aerobic exercise has been used most frequently for weight loss and control because of the caloric expenditure required, strength training has numerous benefits and may help to preserve fat-free mass during diet-induced weight loss.[136]

In addition to formal exercise, daily physical activity plays a critical role in energy balance,[137] weight control, disease prevention, and achievement and maintenance of overall health. Prospective studies indicate that physical activity protects against obesity,[138] specifically influencing abdominal obesity,[139] and reduces the incidence of several diseases associated with obesity (eg, cardiovascular disease,[140,141] type 2 diabetes,[142–144] depression[145,146] and premature death.[140,147] Furthermore, exercise adherence and habitual physical activity are the greatest determinants of weight maintenance following weight loss.[133,148–152] The effects of physical activity on fitness and health are dramatic,[141] and there is evidence that physically active individuals who are obese have a lower risk for morbidity and mortality than sedentary individuals of normal weight.[153] These benefits have prompted public health advisors to recommend that Americans participate in a minimum of 30 minutes of modest-intensity physical activity almost every day,[71,154] regardless of body weight. Thus, engaging in exercise and leading physically active lifestyles are especially important for individuals who are obese.

Behavior modification is an important component of all weight loss programs.[120,155] Behavioral strategies frequently are targeted toward identifying stimuli that signal unhealthy behaviors (eg, binge eating), learning about the role of readiness in initiating or continuing positive behaviors,[156] and recognizing barriers that may compromise healthy pursuits. Goal-setting, self-monitoring, frequent contact, feedback, and continuous motivation and support are important components of behavioral programs that can be delivered through individual and group meetings. Although no single theoretical framework for behavioral intervention has been shown to be superior, success in modifying patterns of eating and physical activity generally is dependent on consistency, support, and long-term modification of lifestyle, rather than on one specific diet or exercise program.

Pharmacologic agents may be used in conjunction with diet, exercise, and behavioral strategies when non-pharmacologic approaches alone fail to produce or sustain meaningful weight loss. Several appetite-suppressant drugs are approved for weight loss,[157,158] but the treatment duration for most is limited to twelve weeks or less. The chronic nature of obesity necessitates longer-term therapy, because drug cessation usually leads to weight regain. Two drugs approved for the long-term treatment of obesity include sibutramine (Meridia*), which reduces food intake by inhibiting the reuptake of serotonin and norepinephrine, and orlistat

* Knoll Pharmaceutical Co, 300 Continental Dr N, Mt Olive, NJ 07828.

(Xenical[†]*), which selectively inhibits pancreatic lipase and therefore reduces intestinal digestion and absorption of dietary triglycerides.[157] Both of these agents have been studied extensively and have proven to be effective in facilitating clinically meaningful weight loss and weight maintenance following weight loss.[159,160] The majority of weight loss occurs during the first 3 months of treatment, followed by very gradual weight loss and stabilization.[159] The mechanisms by which these agents act differ from those of the anorectic drugs that were removed from the market in 1997 (ie, fenfluramine-phentermine) following their association with valvular heart disease.[161] Both sibutramine and orlistat currently are considered to be safe for chronic use.

Surgery is reserved for cases of extreme obesity (BMI of $\geq$40 kg/m^2) or for more moderate obesity (BMI of $\geq$35 kg/m^2) when obesity-related comorbidities are present.[123] The most commonly performed surgical procedure in this country today is the gastric bypass, in which the upper portion of the stomach is stapled to create a small (10–30 mL) reservoir that attaches directly to the jejunum via a Roux-en-Y limb.[162] The restricted capacity of the gastric pouch severely limits food intake, while bypassing the stomach and upper portions of the small intestine inhibits the absorption of some nutrients. The net result is substantial weight loss within 6 months. Weight losses of approximately 45 kg (100 lb),[163] or 60% to 70% of excess body weight,[164–166] have been observed 1 year after gastric bypass, and large losses have been maintained for up to 15 years.[163,167] Gastric bypass may be performed laparoscopically[166] or using an open technique. Vertical banded gastroplasty is another, less commonly used surgical procedure in which a band constricts the upper portion of the stomach, effectively reducing its capacity. Long-term success following these surgical procedures is dependent on drastic dietary modifications to prevent complications associated with bingeing, which may include vomiting, diarrhea, or rupture of the staple line. In contrast to the surgical procedures used in past decades, the current techniques have low mortality rates of approximately 1.3%[168] to 1.5%.[163] However, morbidity associated with wound infections, incisional hernia, and anastomotic leak with peritonitis may be higher, particularly when additional surgery is necessary. Additional risks of surgical treatment for obesity include steatorrhea, vitamin and mineral deficiencies, and osteoporosis,[169] all of which necessitate lifelong supplementation and medical follow-up.

Despite the established short-term successes achievable using these available interventions, the treatment of obesity remains a major challenge. Many people who are obese never seek treatment. Physical therapists and other health care providers can play an important role by identifying individuals whose body weight places them at increased health risk. A discussion of the health risks associated with being overweight and the health benefits of losing weight can then ensue. In addition, many people who begin treatment for obesity are unable to adhere to their treatment regimen for the duration needed to produce sufficient weight loss. An interdisciplinary support system involving physical therapists and other health care professionals may be helpful in this regard. Consistent messages regarding the importance of the patients' weight loss efforts and recognition of their achievements before they accomplish their long-term weight loss goal may facilitate longer-term adherence.

A relatively small percentage of people who lose weight are able to prevent substantial weight regain. Therefore, greater assistance and support by physical therapists could provide one more avenue by which people can be reminded of the health importance of maintaining a reduced body weight. The difficulties of losing weight and achieving long-term weight control have stimulated interest in studying strategies to prevent weight gain as well as to promote and maintain weight loss. This is reflected by allocation of federal funds for obesity prevention research as well as for obesity treatment research.

Obesity apparently will continue to plague our society for many years. As providers of health care, physical therapists should be able to recognize individuals who are obese, and they should address obesity-related issues with their patients. Because obesity can have an adverse impact on movement-related conditions and a patient's ability to perform therapy, an assessment of obesity-related limitations could reveal whether it is necessary to alter therapy. Adherence to therapy and the outcomes of therapy may be dependent to some extent on whether therapists can tailor therapeutic regimens to meet the needs of individuals who are obese.

Summary

Obesity is a chronic and dangerous condition that predisposes people to numerous serious health disorders and premature death. Body mass index is the most commonly used indicator of obesity today. Although influenced by genetics, the current obesity epidemic appears to be driven principally by behavioral and environmental factors. Lifestyle factors, including high-energy diets and lack of physical activity, are the greatest contributors to the energy imbalance that causes overweight and obesity. Although the relative contributions of increased food intake and decreased energy expendi-

[†] Roche Pharmaceuticals, Roche Laboratories Inc, 340 Kingsland St, Nutley, NJ 07110.

ture to America's expanding waistline are uncertain, it is evident that our environment promotes overindulgence and at the same time facilitates sedentary behaviors.

Efforts to curb the escalating incidence of obesity in order to reduce morbidity and mortality are critical, and substantial resources have been devoted to these efforts both nationally and internationally. There is a consensus that a multidimensional approach, with individualized treatment options, is important for successful obesity treatment. However, despite numerous treatment methods, prevention strategies, and the billions of dollars spent on weight control efforts each year, eradication of obesity does not appear to be in the foreseeable future. In light of much evidence that reversal of obesity generally is difficult and long-term success rates are low, strategies to prevent obesity are essential and potentially more effective than obesity treatment regimens for controlling the current obesity epidemic. A multidisciplinary approach involving physical therapists and other health care providers can be an important step toward combating the obesity epidemic.

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