Position of the American Dietetic Association: Weight Management

This paper endorsed by the American College of Sports Medicine

ABSTRACT

It is the position of the American Dietetic Association that successful weight management to improve overall health for adults requires a lifelong commitment to healthful lifestyle behaviors emphasizing sustainable and enjoyable eating practices and daily physical activity. Given the increasing incidence of overweight and obesity along with the escalating health care costs associated with weight-related illnesses, health care providers must discover how to effectively treat this complex condition. Food and nutrition professionals should stay current and skilled in weight management to assist clients in preventing weight gain, optimizing individual weight loss interventions, and achieving long-term weight loss maintenance. Using the American Dietetic Association's Evidence Analysis Process and Evidence Analysis Library, this position paper presents the current data and recommendations for weight management. The evidence supporting the value of portion control, eating frequency, meal replacements, and very-low-energy diets are discussed as well as physical activity, behavior therapy, pharmacotherapy, and surgery. Public policy changes to create environments that can assist all populations to achieve and sustain healthful lifestyle behaviors are also reviewed.

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This Position of the American Dietetic Association (ADA) uses ADA's Evidence Analysis Process and information from ADA's Evidence Analysis Library. The use of an evidence-based approach provides important added benefits to earlier review methods. The major advantage of the approach is the more rigorous standardization of review criteria, which minimizes the likelihood of reviewer bias and increases the ease with which disparate articles may be compared. For a detailed description of the methods used in the evidence analysis process, access the ADA's Evidence Analysis Process at http://adaeal.com/eaprocess/.

Conclusion statements are assigned a grade by an expert work group based on the systematic analysis and evaluation of the supporting research evidence. Grade I=Good; Grade II=Fair; Grade III=Limited; Grade IV=Expert Opinion Only; and Grade V=Grade is Not Assignable (because there is no evidence to support or refute the conclusion).

Recommendations are also assigned a rating by an expert work group based on the grade of the supporting evidence and the balance of benefit vs harm. Recommendation ratings are Strong, Fair, Weak, Consensus, or Insufficient Evidence. Recommendations can be worded as *conditional* or *imperative* statements. Conditional statements clearly define a specific situation and most often are stated as an "if, then" statement, whereas imperative statements are broadly applicable to the target population without restraints on their pertinence. Evidence-based information for this and other topics can be found at www.adaevidencelibrary.com and subscriptions for nonmembers are purchasable at www.adaevidencelibrary.com/store.cfm.

POSITION STATEMENT

It is the position of the American Dietetic Association that successful weight management to improve overall health for adults requires a lifelong commitment to healthful lifestyle behaviors emphasizing sustainable and enjoyable eating practices and daily physical activity.

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Obesity is a condition characterized by excess accumulation of adipose tissue (ie, fat stores). Fat stores can only be changed by a whole body energy imbalance brought on by a change in energy intake, energy output, efficiency of energy use, or a combination of any of these components (1). The underlying genetic and physiologic mechanisms governing these three energy-balance components have been intensely studied (although still far from being completely understood) (2,3). This research has greatly expanded since the discovery of leptin in the early 1990s and has revealed a physiology designed to primarily protect against starvation (4). Despite the volume of research, there have been only a limited number of obesity cases identified as being directly caused by a single gene mutation (5).

On a population level, changes in obesity prevalence can also be viewed as an aberration of energy balance but on a larger scale. Agricultural advances, changes in economy and technology (6), as well as societal changes influencing expectations and value systems (7), have lead to a world where the energy of the food supply most frequently exceeds that of the opportunities for energy expenditure through physical activity. The complexity of the causal factors at the individual level combined with the complexity of causal factors affecting

the environment within which individuals live leads to a high prevalence of a condition that is often described as chronic and refractory with a high recidivism rate for its treatment (8).

Given the biological tendency to protect against starvation and the societal tendency to protect against underconsumption and volitional physical activity, there are clear pathways for action. First, the one in three adults (9) who can currently maintain a healthful body mass index (BMI) are not likely to continue to be able to do so if no action is taken. Curbing the weight gain trajectory at both the individual and population levels is vitally important. Next, it is crucial that we find ways to optimize individualized treatments appropriately. Finally, with the most rapidly growing population category being those who are severely obese (10), it is necessary to understand and effectively treat that portion of the population whose health is most greatly compromised by this condition.

The purpose of this position paper is to outline the evidence supporting The American Dietetic Association's (ADA's) adult weight management position statement. Since 2000, ADA has used an evidence-based approach for the development of clinical practice guidelines for nutrition care. The evidence analysis work for the adult weight management guidelines form the basis of the information provided in this position paper (11). The recommendation statement from the adult weight management guidelines is included in this position paper in all sections where there is a corresponding major recommendation from the guidelines. A brief description of the evidence analysis process, an explanation of the conclusion statement grading, and the recommendation rating scales is provided in the Sidebar.

GOALS OF WEIGHT MANAGEMENT

The goals of weight management go well beyond numbers on a scale, whether or not weight change is one of the management objectives. The development of healthful lifestyles with behavior modification is important for overall fitness and health. Realistic expectations should be defined during an intake interview in terms of a more healthful weight vs the normal BMI range. In addition, it is important to set realistic expectations about the time required to make a sustainable behavior change.

Goals of weight management interventions may include:

- prevention of weight gain or stopping weight gain in an individual who has been seeing a steady increase in his or her weight;
- varying degrees of improvements in physical and emotional health;
- small maintainable weight losses or more extensive weight losses achieved through modified eating and exercise behaviors; and
- improvements in eating, exercise, and other behaviors.

Health can be improved with relatively minor weight losses. A weight loss of 10% may ameliorate health risks associated with excessive body weight (12). Health care providers must help patients to accept a modest, sustainable weight change that can be realistically achieved. Appearance, in many patients, will be an important motivator; however, it is critical that health care providers emphasize the goal of achieving a more healthful weight and lifestyle while de-emphasizing cosmetic goals.

The goals of weight management go well beyond numbers on a scale, whether or not weight change is one of the management objectives.

ADA's Nutrition Care Process includes nutrition assessment, nutrition diagnosis, nutrition intervention, and nutrition monitoring and evaluation. It is essential to include each of these steps into weight management care plans. ADA's Evidence Analysis Library (EAL) contains evidence-based adult weight management guidelines, including the recommendations upon which this position paper is based (11). Food and nutrition professionals should incorporate these fundamental concepts for managing obesity into their patients' individualized care plans.

ASSESSMENT OF OBESITY

Assessment, the first step of the Nutrition Care Process (13,14), involves gathering the necessary information to formulate a diagnosis and develop a care plan. Baseline weight and health indexes should guide weight management goals and are necessary to document outcomes. Clinically useful measures of body weight status are noninvasive, easy to use, inexpensive, reliable, capable of reflecting short- and long-term changes in body fat, and must be correlated to health risk.

The standard measurement for weight status is BMI, calculated as kg/m^2. Overweight is defined as a BMI of 25 to 29, whereas higher BMI values reflect more excessive amounts of body fat (12). There are differences even in the community of experts as to the BMI at which an individual is at greater health risk. Some advocate weight loss by individuals with a BMI of 25 to 29 but debate continues on how much weight reduction should be recommended (15). The National Heart, Lung, and Blood Institute (NHLBI) guidelines (16) recommend intervention for overweight individuals who have two or more risk factors associated with their weight status. The *Dietary Guidelines for Americans 2005* (17) recommend individuals work toward weight reduction if they are even mildly overweight.

Multiple sources of information are available, but for most evaluations a patient-centered interview with supporting records from primary care providers and/or referring physicians remain the most important. A physician's evaluation of weight status, including height, weight, and waist circumference, provides the information indicating that a referral to a registered dietitian (RD) is appropriate. A medical examination should rule out physiologic causes of increased body weight and assess health risks and/or the presence of weight-related comorbidities. Cardiorespiratory fitness and screening for musculoskeletal problems may need to be reviewed before making physical activity recommendations or referring on to an exercise professional. In addition to a

medical assessment, a psychological evaluation may be indicated. Screening for barriers to successful weight loss such as depression, post-traumatic stress disorder, anxiety, bipolar disorder, addictions, binge eating disorder, and bulimia is necessary. Studies have shown a high frequency of these disorders in those with excessive weight problems (18-20). Appropriate treatment should be implemented before beginning a nutritional intervention.

With this information from the health care team, an RD can effectively begin evaluation.

EAL Recommendation "BMI and waist circumference should be used to classify overweight and obesity, estimate risk for disease, and to identify treatment options. BMI and waist circumference are highly correlated to obesity or fat mass and risk of other diseases" (**Rating: Fair, Imperative**) (11). Data is accumulating regarding differences in aboriginal and Asian racial groups that may indicate a downward shift of BMI to define a healthful weight is indicated (21-23).

Functional and behavioral issues (eg, social and cognitive function, psychological and emotional factors, and quality-of-life measures) are important to address to optimize a weight management intervention. Factors related to food access, food selection, functional capacity for food preparation, and other physical activity are significant for treatment planning.

During an intake interview it is important to observe nonverbal and verbal cues. These cues can guide and prompt the interviewing process and help determine what information should be prioritized and evaluated further. In many dietetic referrals the only information available is from the referring physician; therefore the depth and exploration required to adequately assess nutritional status and related factors will be an issue of professional judgment and may extend to subsequent consultations. Nutritional adequacy established from dietary history and food intake records coupled with anthropometric and biochemical measures provide baseline data. The possible multiple components of a comprehensive interview are summarized in the Figure.

The ADA adult weight management guidelines advise resting energy expenditure measurement as part of an assessment. However, metabolic carts are rarely available in clinical practice and another scheduled visit may be required to provide standard conditions for cart measurement. There is controversy regarding the applicability of predictive equations of resting energy expenditure; however, such information can make a valuable contribution to goal setting and intervention strategies (24-26).

EAL Recommendation "Estimated energy needs should be based on [resting metabolic rate]. If possible, [resting metabolic rate] should be measured (eg, indirect calorimetry). If [resting metabolic rate] cannot be measured, then the Mifflin-St Jeor equation using actual weight is the most accurate for estimating [resting metabolic rate] for overweight and obese individuals" (**Rating: Strong, Conditional**) (11). The Mifflin-St Jeor equations are:

Man: Basal Metabolic Rate (BMR)=(10×weight in kilograms)+(6.25×height in centimeters)–(5×age in years)+5.

Woman: Basal Metabolic Rate (BMR)=(10×weight in kilograms)+(6.25×height in centimeters)–(5×age in years)–161.

Determining when a problem requires consultation with or referral to another provider may be appropriate. For effective weight management intervention, a patient ideally would be assessed by a multidisciplinary team, including a physician, RD, exercise physiologist, and a behavior therapist. Through the team approach, issues such as nutrition, physical activity, and change in eating behavior can be coordinated. Although this approach may be a gold standard, there are many barriers such as the increased cost of a multidisciplinary team, the lack of third-party reimbursement, and the absence of experienced weight management health care professionals. However, once a primary care physician has determined that a client would benefit

A. Anthropometrics
- Height
- Weight
- Body mass index
- Waist circumference

B. Medical
- *Identify potential causes:* endocrine, neurological; medications; genetics (age of onset, family history).
- *Identify obesity-associated disorders (current complications and risk of future complications):* metabolic, anatomic, degenerative, and/or neoplastic complications.
- *Evaluate obesity severity and extent of physical disability.*

C. Psychological
- *Identify psychological etiology:* psychotropic medications, depression, post-traumatic stress disorder, addictive behavior.
- *Eating disorders:* binge eating, bulimia.
- *Assess risk for potential barriers to treatments:* psychiatric history—suicidal ideation, untreated psychological disorders.

D. Nutritional
- *Weight history:* age of onset, highest/lowest adult weights, patterns of weight gain and loss, environmental triggers to weight gain, triggers to excessive or disordered eating.
- *Dieting history:* number and types of diets, weight loss medications, complementary and alternative approaches for weight loss, success of previous weight loss efforts.
- *Current eating patterns:* meal patterns (skipped meals, largest meal, snacks/grazing), 24-hour recall/food frequency.
- *Nutritional intake:* nutrient density, nutrition supplements, vitamin/mineral supplements.
- *Environmental factors:* meals eaten away from home, fast-food meals, restaurant meals, ethnic foods, lifestyle factors (eg, time and/or financial constraints).
- *Exercise history:* activities of daily living, current structured exercise, past exercise, barriers to exercise.
- *Readiness to change:* reasons to lose weight at this time, weight loss goals, readiness for making changes, current life stressors, support systems.

Figure. Factors to assess during weight management intake interviews.

from the expertise of a team approach, the appropriate referrals can be made. Most commonly, RDs assume a leadership role to design and activate the intervention strategy developed by the multidisciplinary team or in collaboration with the referring medical provider. The active role ADA is now taking in establishing evidence-based guidelines will continue to modify assessment practices.

Nutrition assessment is an ongoing, dynamic process that involves not only initial data collection, but also continual reassessment and analysis. Assessment provides the foundation for the nutrition diagnosis, which is the next step of the Nutrition Care Process.

REGULATION OF FOOD INTAKE

A negative energy balance is the most important factor affecting weight loss amount and rate. The first recommendation in obesity treatment is usually a reduction in energy intake: A reduction of 500 to 1,000 kcal/day is advised to achieve a 1 to 2 lb weight loss per week (11,12). Dietary energy reduction strategies may vary from a focus solely on energy (ie, "calorie counting"), macronutrient composition and/or energy density, or a combination of energy and macronutrient composition along with form considerations such as consistency (eg, meal replacements, very-low-energy diets). In addition, strategies have included changes to meal frequency, meal timing (eg, breakfast) and guidance on food portions. To evaluate the evidence supporting these proposed strategies, it is necessary to first review what is known about the regulation of eating behavior in human beings.

Eating is a behavior that links the external physical environment with an individual's internal physiologic processes (27). Two distinct internal systems govern food intake: the homeostatic system and the hedonic system. Although both systems are regulated centrally, they do not appear to be integrated. Reduced appetite control may be due to either disturbance in homeostatic pathways or to inappropriate sensitization of the hedonic system. The homeostatic system comprises both long-term signaling from the adipose tissue and episodic signaling primarily from the gut. The long-term signaling uses hormones such as leptin and insulin to act as key drivers for initiating food intake. Generated in response to an eating episode, the episodic signaling system is activated from the gastrointestinal tract and uses hormones such as ghrelin, cholescystokinin, glucagon-like peptide, and peptide YY, among others. These episodic signals rise and fall in harmony with eating patterns. The interaction between these two sets of homeostatic signals reflects the brain's recognition of the current dynamic state of energy stores and the changing nutrient flow derived from eating. This central regulation of energy balance tunes hunger and fullness sensations that accompany eating behaviors.

Unlike the central nervous regulation of the homeostatic system (located primarily in the arcuate nucleus of the hypothalamus), a cortico-limbic neural network regulates the hedonic governance of food intake. This neural network (involving signals such as endocannabinoids, serotonin, and dopamine) deals with the cognitive, motivational, and emotional aspects of food intake (eg, perceived pleasantness, liking, and wanting). This system represents the main interface with the external environment as, in the absence of a depletion signal, the initiation of an eating episode often starts as a cognitive decision from the cortex (28). Palatability, via this system, is a very powerful determinant of food intake and inappropriate sensitization of the hedonic network likely leads to weight gain. However, the hedonic system is less well-studied than its homeostatic counterpart and much more research is required to fully understand the interactions of these two systems.

The complexity of eating behavior makes it difficult to completely elucidate the role of any one of the energy reduction strategies. Whereas a randomized study with high dietary control helps to evaluate affects of energy reduction on weight loss per se, longitudinal studies in free-living individuals (albeit with less dietary control) are also required to evaluate the other system components. Unfortunately, studies in free-living individuals (either longitudinal or cross-sectional) often have to rely on self-reported food intake, which, in of itself, presents confounding factors. For example, under-reporting of energy intake is persistently prevalent in dietary surveys and appears to be greater in overweight vs normal-weight people (29). In addition, little is understood regarding the physiology of eating behaviors in people with severe obesity, people following a recent weight loss, or the influence of physical activity on the eating behavior systems.

Diet Composition

A low-fat, reduced-energy diet is the best studied weight-loss dietary strategy and is most frequently recommended by governing health authorities (11,17,30). Fat is the most energy-dense macronutrient but is known to have a weak effect on both satiation and satiety (31). These attributes make fat a useful target for reducing energy intake. Because diabetes and cardiovascular disease are frequent comorbidities of obesity, reducing the dietary saturated and *trans*-fatty acid content is also recommended (30). The effectiveness of low-fat, low-energy diets in combination with lifestyle counseling and activity has been demonstrated in recent multicenter clinical trials where, in addition to 5% to 10% weight loss, the reduction or prevention of comorbidities such as diabetes and/or hypertension has also occurred (32-35).

Frequently, individuals reduce the carbohydrate content of their diet as a weight loss strategy. As glycogen stores are depleted in response to low-carbohydrate intake, the resultant diuresis produces an initial dramatic weight loss. On very-low-carbohydrate diets (eg, $<$20 g/day) the body produces ketones to sustain fuel utilization in the brain, which may in turn help with diet adherence by decreasing hunger (36). Individuals assigned to the ad libitum low-carbohydrate diet in recent randomized controlled trials lost more weight at 6 months than individuals assigned to the low-fat, reduced-energy diet, but this difference was no longer significant at 12 months (11,37,38). Concerns regarding an increase in cardiovascular risks with low-carbohydrate diets do not appear to be as problematic as first thought (37).

EAL Recommendation "An individualized reduced calorie diet is the

basis of the dietary component of a comprehensive weight management program. Reducing dietary fat and/or carbohydrates is a practical way to create a caloric deficit of 500 to 1,000 kcal below estimated energy needs and should result in a weight loss of 1 to 2 lb per week" (**Rating: Strong, Imperative**) (11).

EAL Recommendation "Having patients focus on reducing carbohydrates rather than reducing calories and/or fat may be a short-term strategy for some individuals. Research indicates that focusing on reducing carbohydrate intake (<35% of kcal from carbohydrates) results in reduced energy intake. Consumption of a low-carbohydrate diet is associated with a greater weight and fat loss than traditional reduced-calorie diets during the first 6 months, but these differences are not significant after 1 year" (**Rating: Fair, Conditional**) (11).

The EAL also notes that safety has not been evaluated for long-term, extreme restrictions of carbohydrates (<35% of energy from carbohydrates) and specifically recommends that practitioners use caution in suggesting a low-carbohydrate diet for even short-term use in patients with osteoporosis, kidney disease, or in patients with increased low-density lipoprotein cholesterol (11).

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Additional dietary components thought to influence weight (ie, low glycemic index diets and diets high in calcium) were evaluated. In both instances, low glycemic index foods and low-fat dairy foods can be incorporated but are not essential for diets appropriate for weight management.

EAL Recommendation "A low glycemic index diet is not recommended for weight loss or weight maintenance as part of a comprehensive weight management program, since it is has not been shown to be effective in these areas" (**Rating: Strong, Imperative**) (11).

EAL Recommendation "In order to meet current nutritional recommendations, incorporate 3-4 servings of low-fat dairy foods a day as part of the diet component of a comprehensive weight management program. Research suggests that calcium intake lower than the recommended level is associated with increased body weight. However, the effect of dairy and/or calcium at or above recommended levels on weight management is unclear" (**Rating: Fair, Imperative**) (11).

The debate regarding the optimal macronutrient content of a reduced-energy diet has emphasized the difficulty individuals have in following any weight loss regimen. Whether randomized to a low-fat or a low-carbohydrate diet, study completion rates at 1 year are typically low for both interventions (37). It is likely that factors from both the homeostatic as well as the hedonic systems influence an individual's ability to adhere to any type of weight loss diet. We need to better understand the factors that influence individual adherence as well as study attrition rates in general, because these two parameters affect interpretation of trial outcomes.

Portion Control

RDs typically recommend portion control to weight loss clients with the goal of reducing the energy load of consumed foods. Strategies may include providing information on the energy content of regularly consumed foods (eg, energy content of ½ c vs one bowl of ice cream), use of premeasured foods (eg, frozen entrees, 100-kcal snack packs), replacing higher energy-density foods with lower energy-density foods (eg, cereal with milk for an evening snack), and/or reducing the energy density of foods (eg, increasing vegetable content of entrée items). These strategies may affect either the homeostatic system (eg, reduced portions may be more or less satiating depending on the strategy used) and/or hedonic system (eg, cognitive decisions to choose one food over another possibly more palatable food) that govern eating behavior. Effectively reducing portion sizes appears to be an important weight gain prevention strategy for everybody (regardless of weight) as marketplace food and drink portions now exceed standard serving sizes by a factor of at least twofold (39). *Portion distortion* is a new term created to describe this perception of large portions as appropriate amounts to eat at a single eating occasion. This distortion is reinforced by packaging, dinnerware, and serving utensils that have also increased in size (40).

Most of the evidence supporting the value of portion control comes from studies in normal-weight and/or overweight subjects using experimental paradigms such as differences in serving containers, self-refilling bowls, and self-service vs preserved food items (11). These studies show that by increasing portion sizes, energy intake during an eating occasion is increased but is not compensated for by a decrease in intake later in the day. Three randomized controlled trials showed weight loss in participants using specific portion control strategies of frozen entrees (vs self-selected diet based on the Food Guide Pyramid) (11), use of cereal to replace usual evening snacks (11), and a plate-method education tool (41). Although the concept of portion control is universal in most weight management programs, the overall strength of the evidence for portion control to reduce energy intake and produce weight loss is graded as fair (11). More research is needed to determine the effectiveness of specific portion control strategies on body weight regulation especially for people in different physiological states (eg, post-weight loss [ie, to prevent a weight regain] or people with severe obesity).

EAL Recommendation "Portion control should be included as part of a comprehensive weight management program. Portion control at meals and snacks results in reduced energy intake and weight loss" (**Rating: Fair, Imperative**) (11).

Eating Frequency

Many RDs encourage weight loss clients to avoid skipping breakfast and to have a regular meal pattern. This advice is prompted by a concern for compromised nutrient intake if breakfast is not consumed (eg, decreased calcium and fiber intake),

that an erratic schedule leads to poor food choices from available foods that are energy dense but nutrient poor (eg, vending machines, office candy jars, and fast-food restaurants), as well as concern that evening energy consumption is more likely to lead to weight gain. Generically prescribing a certain meal frequency or advocating the inclusion of breakfast as a specific weight loss (or prevention of weight gain) strategy must be based on an understanding of the evidence of whether the pattern of meal consumption affects energy intake and thereby weight loss. Unfortunately the evidence is inconsistent as the research on eating frequency patterns is not extensive with no randomized controlled studies. A number of cross-sectional studies show equivocal findings on the association of eating frequency to body weight regulation (11). Limitations in study design or inconsistency in methodology may be the reason for this lack of clarity and fair evidence grade (11). These studies have relied on self-reported intake but as yet it is not clear where the under-reporting of energy intake (especially prevalent among obese participants) comes from (ie, misperception and/or misreporting of meal portions, omission of eating occasions, or a combination of both). The definition of an eating occasion is often inconsistent between studies (eg, one study used 50 kcal separated from another eating episode by 15 minutes whereas another study used main meal, beverage meal, light meal, or snack categories) (11). Finally, the characteristics of people who routinely have a regular vs irregular meal pattern are still unknown, making it difficult to understand the influence of eating frequency per se vs other personal attributes (eg, insulin levels, ghrelin levels, age, daily work schedule, and routine exercise habits).

Breakfast consumption possibly plays a role in weight management through an influence on appetite control, dietary quality, and metabolism (42). Like the research on eating frequency, the research on the affect of breakfast consumption on body weight regulation is primarily focused on cross-sectional studies and is confounded by the same factors of reliance on self-report, definition of what constitutes a breakfast, and lack of characterization of breakfast vs nonbreakfast consumers. Three cross-sectional studies show an association between skipping breakfast and an increased prevalence or risk of obesity (11). However, the association may vary depending on the breakfast content (eg, high-fat breakfast consumers are associated with higher BMIs than high-fiber breakfast consumers) and sex (eg, the association between breakfast consumption and a BMI <25 is significant for women but not for men) (11). In one randomized controlled trial, the habitual breakfast-eating habits of the study participants interacted with treatment assignment (breakfast vs no-breakfast treatment) to influence the measured weight change (11). Further research on the relationship between breakfast and body weight regulation is needed.

Although the research does not yet support making absolute meal frequency or breakfast recommendations for optimizing body weight control, it is important that clinical judgment is used when guiding clients. Helping a client to find a meal pattern that prevents the times when high hunger coincides with an environment of high-energy food choices seems pertinent.

EAL Recommendation "Total caloric intake should be distributed throughout the day, with the consumption of four to five meals/snacks per day including breakfast. Consumption of greater energy intake during the day may be preferable to evening consumption" (**Rating: Fair, Imperative**) (11).

Meal Replacements

Choosing a low-energy, nutritious diet in an environment that provides a surplus of palatable, energy-dense, nutrient-poor food choices can easily overwhelm anyone trying to lose weight. Meal replacements, containing a known energy and macronutrient content, are a useful strategy to eliminate problematic food choices or complex meal planning while trying to attain a 500 to 1,000 kcal/day energy deficit. Several studies comparing isocaloric diets have shown equivalent or greater weight loss efficacy with structured meal replacement plans compared to reduced-energy diet treatments (11). Three of these randomized controlled trials included a weight maintenance phase of their evaluation and reported a greater effect of one meal replacement per day over conventional diet for maintenance of a weight loss (11). Individuals adhering to structured meal replacement plans lose more weight at both 12 weeks (~7% vs 4% of initial body weight) and 1 year (~7% to 8% vs 3% to 7%) than individuals following a conventional diet plan, with 1-year dropout rates for the structured meal replacement plan significantly less than the conventional diet plan (47% vs 64%; $P< 0.001$) (11). To date, structured meal replacement plans and weight loss efficacy in severely obese individuals or as a weight gain prevention strategy have not been sufficiently studied.

There is concern that this strategy may mean an over-reliance on artificial nutrients and may prevent clients from learning how to select appropriately from typical conventional food choices. These specific concerns have not been systematically studied. However, RDs have a role in advising clients utilizing meal replacements on how to optimize the overall nutrient content of their diet by careful selection of the conventional foods that make up the non–meal-replacement portion of the weight loss plan.

EAL Recommendation "For people who have difficulty with self selection and/or portion control, meal replacements (eg, liquid meals, meal bars, or calorie-controlled packaged meals) may be used as part of the diet component of a comprehensive weight management program. Substituting one or two daily meals or snacks with meal replacements is a successful weight loss and weight maintenance strategy" (**Rating: Strong, Conditional**) (11).

Very-Low-Energy Diets

Unlike meal replacements, which are designed to replace only one or two meals per day, a very-low-energy diet is designed to be the only food source during active weight loss. A very-low-energy diet is typically a liquid formulation that supplies about 800 kcal (or 6 to 10 kcal/kg) or less per day, is enriched with high biologic value protein and provides at least 100% of the Daily Value of essential vitamins and minerals. The purpose of using a very-low-energy diet is to quickly

achieve a large weight loss while providing adequate nutrition and preserving lean body mass as much as possible. Medical monitoring is necessary during the rapid weight loss phase and the medical risk makes a very-low-energy diet inappropriate for individuals with a BMI <30. Although there is good evidence that adherence to a very-low-energy diet results in significant weight loss of 15 to 5% of initial body weight over 12 to 16 weeks, maintenance of that weight loss is problematic (11,43). In 1998, the NHLBI expert panel recommended against the use of very-low-energy diets. The decision was based on studies showing no differences in long-term weight losses between very-low-energy diets and low-energy diets primarily because of greater weight regain with very-low-energy diets (12). Although there have been many studies evaluating the long-term maintenance of weight loss following very-low-energy diets, the majority have been case-series with no direct comparison with a low-energy diet culminating in equivocal results (11). A recent meta-analysis was conducted evaluating six randomized controlled trials that each included very-low-energy diet and low-energy diet comparisons for short-term and long-term (at least 1 year follow-up) weight loss (43). Despite significantly greater short-term weight loss with very-low-energy diets (16.1%±1.6% vs 9.7%±2.4%; $P=0.0001$), the weight loss was similar between very-low-energy diets and low-energy diets for long-term weight loss (6.3%±3.2% vs 5.0%±4.0%; $P>0.2$) (43). Overall attrition in the six studies was not different between the very-low-energy diet and low-energy diet groups.

The use of very-low-energy diets has been increasingly prescribed before bariatric surgery to reduce overall surgical risk in patients with severe obesity. There is indication that the use of very-low-energy diets for at least 2 weeks reduces liver size although up to 6 weeks may be more ideal for clinically significant decreases in abdominal adiposity (44). Further research is necessary to evaluate the efficacy of this strategy for surgery candidates with severe obesity.

EAL Conclusion "Adherence to a very-low-calorie diet, defined as 800 kcal or 6 to 10 kcal/kg or less, results in significant weight loss" (**Grade I=Good**) (11).

EAL Conclusion "Adherence to a very-low-calorie results in lower calorie intakes and therefore significantly greater initial weight loss than reduced-calorie diets" (**Grade I=Good**) (11).

EAL Conclusion "While adherence to a very-low-calorie results in significant initial weight loss, studies report varying levels of weight regain based on differences in weight maintenance strategies" (**Grade I=Good**) (11).

Physical Activity

An energy deficit of 500 to 1,000 kcal/d is necessary to achieve a 1- to 2-lb weight loss per week (11). Producing this energy deficit through physical activity alone is extremely difficult for most adults. Few studies have used a large enough physical activity "dose" to achieve a 5% weight loss using a physical activity intervention alone (45). Weight-loss studies have shown only small reductions in body weight with physical activity treatment compared to no-treatment control groups (45). However, the magnitude of weight change due to physical activity is additive to that associated with a dietary intervention achieving energy restriction (45). The influence of physical activity on weight loss depends on the ability of an individual to engage in adequate levels of exercise such that the energy cost of exercise is greater than typical fluctuations or compensatory changes in energy intake. Depending on body size, fitness level, and exercise intensity, an individual may burn an additional 1,000 kcal per week by exercising 30 minutes 5 days a week. In comparison, an extra 1,000 kcal could easily be consumed by miscalculating portion sizes and/or a couple of extra snacks or beverages. However, despite its modest impact on weight loss, physical activity is important for improving health-related outcomes related to many obesity comorbidities (eg, heart disease, cancer, and diabetes) (45,46) although additional research is required to understand this relationship in individuals with BMI >40. Regular physical activity is also associated with a lower risk of death regardless of BMI (47). Therefore, it is important that physical activity is included in obesity treatment programs.

Although its influence on weight loss may be minimal, physical activity appears to be crucial in the prevention of weight regain. Many correlation studies show a strong association between physical activity at follow-up and maintenance of a weight loss (45,48,49). Doubly-labeled water studies indicate that physical activity in the range of 11 to 12 kcal/kg/day maybe necessary to prevent weight regain following a weight loss (50). Data from the National Weight Control Registry also indicate that a high level of daily physical activity may be necessary to prevent weight regain (51). The National Weight Control Registry is a registry of more than 3,000 individuals who have successfully maintained at least a 30-lb weight loss for a minimum of 1 year. These individuals report using a variety of methods to lose weight initially, but more than 90% report exercise as crucial to their long-term weight-loss maintenance. They report expending, on average, 2,682 kcal per week in exercise, an energy equivalent of walking 4 miles 7 days a week (51). It has been proposed that high levels of physical activity allows for a post-reduced individual to sustain a lowered energy-balance level without overly restricting food intake (52).

Specific physical activity recommendations were included for the first time in the 2005 Dietary Guidelines (17). These recommendations included three categories related to weight management goals. The first recommendation, to reduce the risk of chronic disease in adulthood, is for 30 minutes of moderate-intensity physical activity on most days of the week. The second recommendation, to help manage body weight and prevent weight gain in adulthood, is to engage in 60 minutes of moderate- to vigorous-intensity activity on most days of the week. Finally, to prevent weight regain after weight loss, engage in 60 to 90 minutes of daily moderate-intensity physical activity while not exceeding energy requirements. The first Federal Physical Activity Guidelines for Americans were issued in late 2008 (45). These guidelines provided a comprehensive summary of the scientific evidence for the health benefits of physical activity and have similar recommendations to the 2005

Dietary Guidelines—all adults should avoid inactivity and health benefits (including weight control benefits) increase as physical activity increases (45). Unlike the recommendations in the 2005 Dietary Guidelines (17), the Physical Activity Guidelines make recommendations in weekly vs daily doses: at least the equivalent of 150 minutes/week of moderate-intensity aerobic physical activity for substantial health benefits and 300 minutes/week of moderate-intensity physical activity for more extensive health benefits (45). Acknowledging the great interindividual variability that exists with physical activity and achieving/maintaining a healthful weight, these guidelines suggested that many people may need more than the equivalent of 150 minutes/week of moderate-intensity physical activity to maintain their weight and more than 300 minutes/week to meet weight-control goals (45). RDs have a role in reinforcing these recommendations that will help clients achieve appropriate physical activity goals through the different phases of weight management (ie, prevention of weight gain, weight loss, and sustaining a weight loss).

Pedometers and step counters are frequently used to promote daily physical activity. These small, relatively inexpensive devices are worn at the hip and track the number of steps taken per day. Individuals wearing these devices can track their daily variability in steps and/or compare daily steps against a prescribed step goal (both behaviors that may promote problem-solving to prevent unnecessarily low step days). 10,000 steps per day is an appropriate daily step goal consistent with the 30 minutes of moderate-intensity physical activity recommendation of the 2005 Dietary Guidelines (53); however, a higher step goal would be necessary to either produce weight loss by physical activity alone or to maintain a weight loss. A recent meta-analysis of 26 studies (eight randomized controlled trials and 18 observational studies) evaluating pedometer use showed that physical activity in pedometer users increased 26.9% over baseline (54). Having a step goal, such as 10,000 steps per day, was an important predictor of increased physical activity ($P=0.001$) (54). Noted limitations of this meta-analysis were the lack of long-term follow up, small study sizes, as well as inability to account for the influence of additional study components such as step diaries and physical activity counseling. In addition, as the mean preintervention BMI of study participants was 30 ± 3.4, the efficacy of pedometer use in people with severe obesity (BMI >40) was not evaluated. Use of pedometers in severely obese individuals deserves further research.

Behavioral Interventions

Historically, cognitive behavioral treatment of obesity developed from the belief that obesity was the result of maladaptive eating and exercise habits, which could be corrected by the application of learning principles (55). Today, it is understood that body weight is affected by factors other than behavior, including genetic, metabolic, and hormonal influences (56,57). Although behavior modification is only one piece of the puzzle, behavior therapy can help individuals develop a set of skills to achieve a more healthful weight (34,58,59).

What Is Cognitive Behavioral Therapy? Cognitive behavioral therapy is based largely on principles of classical conditioning, which assert that eating is often prompted by antecedent events (ie, cues) that become strongly linked to food intake (55). Cognitive behavioral therapy helps patients identify cues that trigger inappropriate eating (and activity) behaviors and learn new responses to them (60). Treatment also seeks to reinforce (or reward) the adoption of positive behaviors. Cognitive behavioral therapy has several distinguishing characteristics (61): it is goal-directed (measurable outcomes), process-oriented (helps people decide how to change), and advocates small rather than large changes. The behavior change process is facilitated through the use of a variety of problem-solving tools and usually includes multiple components such as nutrition education, keeping food and activity records (ie, self-monitoring), controlling cues associated with eating (ie, stimulus control), problem solving, cognitive restructuring, and physical activity (60). These components comprise the behavioral package. ADA's Nutrition Counseling work group is currently reviewing the evidence to determine how effective individual components of the behavioral package (ie, self-monitoring, stimulus control, problem solving, social support, and cognitive restructuring) are in changing behavior and promoting weight loss in adults.

Cognitive Behavioral Therapy and Weight Loss. A limited number of studies have evaluated the intermediate (6 to 12 months) effectiveness of cognitive behavioral therapy on weight loss.

EAL Conclusion "One neutral quality, 6-month randomized controlled trial (86 obese adults) provides evidence that intermediate duration (6-12 months) behavioral therapy and behavioral therapy combined with a personalized system of skill acquisition targeting weight loss is more effective than weight loss education alone in facilitating weight loss, decreasing both total energy intake and percent of calories from fat, and increasing physical activity" (**Grade III=Limited**) (11).

Compared to patients with obesity receiving the weight-loss educational program (ie, 6 monthly education sessions on nutrition, behavioral strategies for changing eating and exercise habits, and guidelines for increasing physical activity), patients with obesity who either received standard behavior therapy (ie, 25 weekly sessions on self-monitoring, goal setting, stimulus control, and cognitive restructuring) or behavior therapy plus personalized skill acquisition (ie, behavior therapy plus reinforcement [monetary rewards] contingent on individual mastery of specific skills related to eating and exercise behaviors) lost significantly more weight at 6 months.

Small randomized trials evaluating the effects of cognitive behavioral therapy on weight loss over 2 years have also shown positive effects on weight control though weight gain is typically observed over time.

EAL Conclusion "One neutral quasi-experimental (84 participants received behavior therapy) and two positive randomized controlled trials (65 participants received behavior therapy and a very-low-calorie diet) evaluated behavior therapy as a component of a weight-loss program of long-term duration ($\geq$12 months). Behavior therapy was not always the variable of randomization. Participants receiving behavior therapy lost weight at the conclusion of treatments. Upon follow-up there was

some weight regain but participants remained at a lower weight than baseline. Studies that included a very-low-calorie diet to initiate rapid initial weight loss, combined with behavior therapy, also appeared to produce long-term weight loss. [*Note*: This is not a statement recommending very-low-energy diets or suggesting that very-low-energy diets are more beneficial than low-energy diets.]" (**Grade II=Fair**) (11).

A number of large randomized studies examined the effects of cognitive behavioral therapy on diabetes and cardiovascular disease risk. Given the beneficial effect of weight reduction on these disease states, weight loss is often an outcome that is evaluated. The typical design of many behavioral studies is group meetings weekly for the initial treatment phase (approximately 3 to 6 months), biweekly (every other week) meetings for the maintenance phase (6 to 12 months), and monthly or bimonthly for the later phases of the study (12 to 24 months) (33,61-64).

The PREMIER, Diabetes Prevention Program, Finnish Diabetes Prevention, and Look AHEAD studies are examples of large, multicenter, randomized studies that demonstrate the influence of behavior modification on weight loss, diabetes, and cardiovascular disease risk (33-35,58,59). Participants in the PREMIER study were randomly assigned to either a control group (single advice-giving session) or one of two behavior modification intervention groups, which differed in diet prescription (35). Significantly greater weight losses were observed in the intervention groups compared to the control group at 6 months. There were no significant differences in weight loss between the intervention groups, suggesting that behavior modification had a stronger influence on weight loss than the prescribed method of energy restriction.

The Diabetes Prevention Program showed that intensive behavior modification is not only more efficacious in producing weight loss and improving health than general recommendations but also more efficacious than pharmacotherapy (33). Participants in the intensive lifestyle group lost significantly more weight and also had a significantly lower incidence of type 2 diabetes than those taking metformin or placebo. Similar findings were observed in the Look AHEAD study, which compared the effectiveness of a behavioral intervention program and enhanced usual care (ie, diabetes support and education) on weight loss and the prevention of cardiovascular disease in individuals with type 2 diabetes (32). Not only did individuals in the behavioral intervention group lose more weight at 1 year, they also observed greater reductions in medication use, fasting glucose, hemoglobin A1c, blood pressure, triglyceride levels, and greater increases in high-density lipoprotein levels.

The Finnish Diabetes Prevention study also compared the efficacy of lifestyle modification and usual care in individuals at high risk for type 2 diabetes (58). This study was ended early due to clear differences in outcomes (ie, body weight, plasma glucose, risk of type 2 diabetes) between intervention and control groups. The extent to which lifestyle changes and risk reduction remained after discontinuation of active counseling was studied in a follow-up to the Finnish Diabetes Prevention study (32). The incidence of diabetes and body weight was examined for a total of 7 years. The relative risk for developing type 2 diabetes remained significantly less in individuals who were in the lifestyle intervention group and was related to the success in maintaining weight loss; eating a low-fat, high-fiber diet; and engaging in physical activity. These findings are encouraging but behavior therapy's effectiveness for long-term weight maintenance has not been shown in the absence of continued behavioral intervention (12). Long-term follow-up of patients undergoing behavior therapy shows a return to baseline weight in the great majority of subjects in the absence of continued behavioral intervention (12).

Although these studies have limitations (ie, participant-clinician contact and instruction was greater in the intervention groups; therefore, these studies do not simulate treatment in the real world because of their high intensity and frequency), these well-designed efficacy studies show that behavioral treatment in combination with low-energy, low-fat diets have positive effects on weight control and, more importantly, on comorbid conditions.

As a means to determine whether the results of lifestyle intervention studies can be replicated in the real world, researchers designed the Good Ageing in Lahti Region Program, a lifestyle implementation study designed for primary health care settings (65). Although the outcomes were less robust than more intensive efficacy studies, favorable lifestyle changes were reported and weight gain was prevented, suggesting on overall positive effect of lifestyle counseling in real-life settings. Additional studies are needed to determine the effectiveness of clinic-based behavioral treatment on weight gain prevention, weight loss, and weight maintenance.

Findings from these studies suggest that cognitive behavioral therapy combined with a healthful diet and physical activity results in significant weight loss in the short-term. Individuals lose approximately 8% to 11% of their initial body weight during the treatment phase (24 to 32 weeks) but slowly regain weight over time (ie, approximately 4% to 8% and 2% to 4% of their initial body weight after 48 and 72 weeks, respectively) (66-69). Five years after treatment, 50% or more of patients have returned to their baseline weight (68); however, there is some evidence to suggest that individuals who participate in maintenance therapy (twice a month for 1 year) after initial treatment maintain most of their weight loss at follow-up (ie, approximately 10% and 8% of their initial body weight after 48 and 72 weeks, respectively) (69-73).

Strategies for Augmenting Outcomes. Although cognitive behavioral treatment provides individuals with a set of skills to handle barriers to eating healthfully and being active, overcoming barriers is a difficult endeavor in a fast-paced environment that encourages overconsumption of energy-dense, palatable, low-cost foods and promotes energy-saving devices (8). A healthful lifestyle requires significant planning, proficiency in making appropriate choices and estimating portion sizes, and diligence in monitoring energy intake and activity, all of which take time to develop and maintain. As such, strategies for simplifying and making this process more practical by providing structure and reducing time spent in meal planning

and decision making (eg, meal replacements as described above) may be useful for some people.

EAL Recommendation "A comprehensive weight management program should make maximum use of the multiple strategies for cognitive behavioral therapy (ie, self-monitoring, stress management, stimulus control, problem solving, contingency management, cognitive restructuring, and social support). Cognitive behavior therapy in addition to diet and physical activity leads to additional weight loss. Continued behavioral interventions may be necessary to prevent a return to baseline weight" (**Rating: Strong, Imperative**) (11).

Further research is needed to identify the most potent components of the behavior modification package, as well as additional interventions (eg, body image therapy) and counseling techniques (eg, motivational interviewing) that might be added to assist patients in making behavior change and to improve efficacy, especially in the long term. It is possible that there is no single behavioral tool that works best. Instead it may be more important to match behavioral tools with each individual's unique set of characteristics. These are the type of questions that need further attention and research.

Pharmacotherapy

Current medications that have been approved by the Food and Drug Administration (FDA) for long-term treatment of "clinically significant" obesity (BMI >30 or BMI 27 to 29 with one or more obesity-related disorders) include sibutramine and orlistat. These two medications have been evaluated in multiple randomized controlled trials (44 for sibutramine, 29 for orlistat). Medication combined with lifestyle modification is more effective than placebo with lifestyle modification in promoting weight loss in adults with overweight and obesity (74). The safety and efficacy of the currently approved drug therapies have not been evaluated in children or older adults and there is limited information on adolescents (75).

Sibutramine. Sibutramine is a centrally acting serotonin and adrenergic reuptake inhibitor. Meta-analysis indicates an average loss of 4.5 kg more per year over placebo (74). Hypertension and increased heart rate are potential complications so it is contraindicated for individuals with known heart disease, uncontrolled hypertension, heart failure, stroke, and arrhythmias. Sibutramine is also contraindicated with monoamine oxidase inhibitors and other serotonin uptake inhibitors, which include medications for depression and migraine (76). The evaluation of the reported cardiovascular effects has determined that the risk-benefit ratio remains favorable (77).

Orlistat. Orlistat is a pancreatic lipase inhibitor that inhibits the absorption of up to 30% of dietary fat (78). In the 22 studies that reported 12-month data, those treated with orlistat lost 2.89 kg more than those on placebo. Steatorrhea, bloating and distension, and anal leakage are potential side effects if dietary fat is not restricted, and one must be alert for possible fat-soluble vitamin deficiencies. With the long-term safety record that has been achieved, orlistat has been approved for over-the-counter sales at a reduced dosage.

Phentermine. Phentermine is a sympathomimetic anorexogenic agent and the most widely prescribed weight loss agent in the United States; however, its use is approved by the FDA for only 3 months (79). In the six placebo-controlled studies available, published between 1975 and 1999, the duration of treatment was between 2 and 24 weeks with an average weight loss of 3.6 kg over placebo. Side effects include insomnia, constipation, and dry mouth. Intermittent dosage in a randomized controlled trial produced greater weight loss than placebo (80).

The continued increase in the prevalence of obesity speaks to the unmet medical needs for safe and effective medications (81). Pharmacotherapy research is currently focusing on: central nervous system agents that affect neurotransmitters, including antidepressants (bupropion), antiseizure agents (topiramate, zonisamide), and some dopamine antagonists; leptin/insulin/central nervous system agents, including leptin analogues or promoters, ciliary neurotropic factor (Axokine, Regeneron Pharmaceuticals, Tarrytown, NY), neuropeptide-Y, and agouti–related peptides, α-melanocyte analogues, and adiponectin; gastrointestinal-neural pathway agents to increase cholecystokin or decrease ghrelin activity; enhancers of energy expenditure, UCP2 and UCP3 uncoupling proteins, and thyroid receptor agonists; and inhibitors of fatty acid synthesis (82).

Leptin has undergone phase two testing, but data at this time do not indicate leptin has the potential to be clinically useful for the modification of weight status (83). Both Axokine (84) and rimonabant (85,86) are in stage three trials. Fenfluramine, alone or in combination with phentermine, produced effective weight loss but serious side effects resulted (87). This voluntary medication withdrawal slowed effort for the use of combined medications. Currently three trials of combined medications are in progress: Qnexa (topiramate+phentermine) (Vivus, Inc, Mountainview, CA), Excalia (bupropion+zonisamide) (Orexigen Therapeutics, La Jolla, CA [now called Empatic]), and Contrave (bupropion+naltrexone) (Orexigen Therapeutics, La Jolla, CA).

Herbal preparations for weight loss do not have standardized amounts of active ingredients and harmful effects have been reported (88,89). Certain over-the-counter preparations containing phenylpropanolamine (and related compounds) have no proven efficacy for short- or long-term weight loss and are recalled because of the incidence of hemorrhagic stroke (90,91). Ephedrine plus caffeine, and fluoxetine have been tested for weight loss, but are not FDA-approved, and over-the-counter and herbal weight loss preparations are currently not recommended (75).

It has been shown that small reductions in body weight (5%) can affect obesity-related comorbidities (92). If such reductions are achieved with medications, data indicate that those medications be continued long-term to maintain the change in weight status (93). For those considering pharmacologic treatment for obesity, it should be noted that medications can lead to modest weight losses at 1 to 2 years, but that data are not available on long-term effectiveness and safety (77).

When weight loss drugs are prescribed they should be only as part of a comprehensive treatment plan in-

cluding behavior therapy, diet, and physical exercise (12).

EAL Recommendation "FDA-approved weight loss medications may be part of a comprehensive weight management program. RDs should collaborate with other members of the health care team regarding the use of FDA-approved weight loss medications for people who meet the NHLBI criteria. Research indicates that pharmacotherapy may enhance weight loss in some overweight and obese adults" (**Rating: Strong, Imperative**) (11).

Surgery

Surgery, with its inherent structural change, clearly has an advantage in the long-term success of weight maintenance. It is reserved for patients with severe disease who have failed to find less invasive interventions successful and are at high risk for obesity-related morbidity and mortality. It is that group with morbid obesity that has increased 400% from 1983 to 2000 (94). The patient selection criterion established by the National Institutes of Health for surgery is currently a BMI of 40. If weight-related comorbidities like diabetes, hypertension, and sleep apnea are present, a BMI between 35 and 40 may be considered for a surgical procedure (12). Extending bariatric surgery to patients with BMIs of 30 to 34.9 who have comorbid conditions that could be cured or markedly improved by substantial weight loss is under review at this time (95).

All data indicate that for the morbidly obese, bariatric surgery is the most effective therapy available for weight management and can result in improvement or resolution of the obesity-related comorbidities and improved quality of life (96). Therefore, it is important that RDs working in weight management are knowledgeable about the common surgical procedures, their mechanisms of producing weight loss, as well as the complications and concerns. It is of note that surgical procedures to promote weight loss are continually evolving. At the current time there are four commonly used procedures to assist weight loss by restricting food intake and/or a combination of restricting intake and producing malabsorption. Food intake may be reduced by the placement of an adjustable band that allows only a small amount of food to enter the stomach or by the removal of part of the stomach to produce a gastric sleeve. Gastric bypass operations, Roux-en-Y gastric bypass, and the extensive gastric bypass (biliopancreatic diversion, with duodenal switch) create a small pouch by stapling or removal of portions of the stomach, and also bypass the duodenum and other segments of the small intestines, thus producing malabsorption along with restriction. These procedures have acceptable operative risk from 0.5% to 0.6% when performed by skilled surgeons (97-99). A fifth procedure, vertical banded gastroplasty, has decreased in use because weight maintenance has been problematic (100,101).

Surgeon skill and a medical center's bariatric surgery volume are important factors in evaluating surgical outcomes. The American Society of Metabolic and Bariatric Surgery and the American College of Surgeons have established "Centers of Excellence" on the basis of hospital volumes and surgical outcomes. Compared with centers that had <50 cases, high volume centers with >100 cases per year had lower mortality, shorter length of stay, lower overall complications, lower complications of medical care and lower costs (102). A nationwide, population-based sample reported 21.9% complications during the initial hospitalization, which increased to 39.6% during the first 180 days (103). The definition of a complication from the insurance records varied from an outpatient visit to a hospital readmission. Such data with a broad interpretation of what is a complication contrast sharply with data from the centers of excellence. A Canadian group has established that weight-loss surgery significantly decreases mortality, 0.68% compared with 6.17% in the nonoperated controls as well as the development of new health-related conditions in persons with morbid obesity (104). Swedish investigators have recently published their 10.9-year follow-up of operated vs nonoperated controls, which clearly shows long-term weight loss maintenance and decreased overall mortality in those having a bariatric surgical procedure. Mortality from cardiovascular disease and cancer were reduced (105). In the United States, a 7.1-year follow-up of patients with gastric bypass showed the group receiving surgery had long-term mortality reduced by 40% compared with the control population (106). Vogel and colleagues reported a reduction in predicted coronary heart disease after bariatric surgery (107). Their report emphasized the importance of significant and sustained weight loss as a powerful intervention to reduce future rates of myocardial infarction and death in the morbidly obese. Data from the Canadian health care system showed that long-term health care costs were reduced after a bariatric procedure and the initial costs of surgery were amortized over 3.5 years (108). Data are now available that with laparoscopic vs open procedures, the duration of hospitalization has been decreased, wound complications are lower, post operative patient pain is reduced, and bowel function normalizes more quickly (102, 108,109).

The effectiveness of different surgical procedures comparing both open and laparoscopically performed procedures on diverse populations by surgeons with different levels of expertise is difficult to interpret. For purposes of comparison, a range of weight loss defined as percentage of excessive weight loss (change in BMI/original BMI-24) is commonly used (97). The effectiveness of the surgical procedures for weight loss range from 47.5% excessive weight loss for the adjustable gastric band, 61.6% for the gastric bypass, 68.2% for gastroplasty, and 70% for the biliopancreatic diversion with or without the duodenal switch. As noted above, gastroplasty is no longer frequently performed because a high rate of weight regain is documented. The sleeve procedure is increasing in use as a primary procedure for high-risk and elderly patients or as an initial procedure for weight reduction to reduce surgical risk before a second stage of a gastric bypass or the duodenal switch procedure. The excess weight loss reported for the sleeve at 1 year approximates 46% (110-113). It is of note that surgery appears to rule over the genetic component of weight status in regard to weight loss responses with surgery and weight maintenance (114).

It is important that RDs working in weight management are knowledgeable about the common surgical procedures, their mechanisms of producing weight loss, as well as the complications and concerns.

Before surgery, patients should be fully evaluated by a multidisciplinary team, including but not limited to a medical doctor, psychiatrist, and an RD. The role of an RD is important during screening to evaluate weight history, efforts to lose weight, food preferences, and food-related behaviors (ie, binge eating) to assist in electing the optimal procedure for the patient. The patient must be informed of the lifestyle changes necessary to decrease postoperative complications and maintain weight loss. Weight loss surgery is more effective when accompanied by pre- and postoperative comprehensive therapy to modify eating, smoking, and exercise behavior. After surgery an RD may play a vital role in promoting lifelong health behavior change and adjustment to postsurgery dietary and supplementation requirements. Such adjunctive therapy increases the likelihood of long-term success and should be a standard component of surgical weight management (115,116). All procedures require lifelong medical follow-up and monitoring to avoid and manage possible complications.

Liposuction is another form of surgery with a focus on adipose tissue. Its purpose generally is cosmetic, to alter body contours, and it usually is not considered as a surgical procedure for weight loss (117). Investigators in this country have studied the effects of high-volume liposuction on insulin action and risk of coronary artery disease. They reported no improvement in metabolic abnormalities (118). This contrasts with the findings of other workers reporting improvements in insulin resistance and inflammatory markers (119,120).

EAL Recommendation "Dietitians should collaborate with other members of the health care team regarding the appropriateness of bariatric surgery for people who have not achieved weight loss goals with less invasive weight loss methods and who meet the NHLBI criteria. Separate ADA evidence-based guidelines are being developed on nutrition care in bariatric surgery" (**Rating: Strong, Imperative**) (11).

WEIGHT MAINTENANCE

As demonstrated in the preceding sections, it is possible to lose weight using a number of different strategies. However, weight loss is only one phase of the weight management continuum. Prevention of weight gain (at any BMI level) and prevention of weight regain (after a weight loss) anchor either end of this continuum. Each phase of the continuum possibly requires a transition to a different set of strategies and/or skill set.

The research on weight-loss maintenance is relatively new and far from conclusive with retrospective studies of successful weight-loss maintainers (121-125) and a small number of prospective studies (126-129). Issues confounding the evaluation of research in this area include consensus on amount of weight loss, weight loss duration, time between weight loss and evaluation of weight maintenance, and minimum length of weight maintenance (130). Successful weight-loss maintenance may be an outcome that is determined by multiple variables, each contributing differently to a successful outcome. Such variables might include factors impacting metabolic as well as behavioral responses such as initial weight loss, comorbid conditions, presence of depression, perception of weight loss success, level of self-monitoring, level of physical activity, type of intervention (including frequency of contact), coping style, and stressful life events among others (123,129-133).

The best studied metabolic compensatory responses occurring with weight loss is the concomitant decline in metabolic rate that results in what has been termed an *energy gap* (134). This energy gap, estimated to be about 8 kcal/lb lost/day, points to a post-weight loss need to chronically maintain a lower energy intake or a combination of lowered energy intake and increased energy expenditure—hence, the lifelong commitment portion of the position statement. However, as critical as it is for food and nutrition professionals to support their clients to prevent weight regain, it is not yet clear which maintenance strategy is best prescribed for all individuals.

Responsibilities of Food and Nutrition Professionals in Weight Management

Many of the ideas expressed below are not evidence-based but are the opinions of this writing group based on experience and knowledge in the field.

An individual's body weight is determined by a combination of genetic, metabolic, behavioral, environmental, cultural, and socioeconomic influences. These diverse influences make treating individuals with overweight and obesity complex. Food and nutrition professionals must understand each of these aspects as they develop a shared decision-making relationship with clients. Food and nutrition professionals should also be aware of their own biases regarding individuals with this condition. In one study of RDs, 87% viewed individuals with obesity as self-indulgent and 32% indicated that individuals with obesity lacked willpower (135). These characterizations could affect the style of counseling for clients with obesity.

Food and nutrition professionals should understand the importance of weight gain prevention and the challenge of weight loss maintenance to effectively help their clients maintain normal weight and sustain long-term weight loss. Increased physical activity also appears to be key in successful weight loss maintenance (36). RDs, with their understanding of energy balance and energy expenditure along with their skills in teaching behavior change, are in key positions to:

- educate physicians and other health care professionals about the importance of weight-loss maintenance;
- help the public, as well as other health care professionals, to understand the difference between weight loss and weight-loss maintenance; and

- assist clients in developing strategies necessary for achieving weight-loss maintenance (13).

As RDs counsel patients, they should be aware of the Scope of Dietetics Practice Framework that helps them define what range of services they can provide within a practice setting. It is the professional responsibility of RDs to ensure that competency is maintained to provide safe and effective services to clients with overweight and obesity (136).

RDs must remain current on topics related to the treatment and management of patients with obesity, including the knowledge and skills that are required to counsel patients about physical activity.

This may involve an understanding of when patients with obesity should be referred to a certified exercise professional or other appropriate health care provider. Guidance on the situations that may require a referral to an exercise professional and appropriate recommendations for physical activity for adults with overweight and obesity are available through the American College of Sports Medicine, with updated guidelines to be released by the American College of Sports Medicine in February 2009 (137). Every opportunity to increase weight management skills should be taken. Attending workshops and symposiums, such as the Certificate of Training in Adult or Pediatric Weight Management sponsored by the ADA Commission on Dietetic Registration, with program content focused on all aspects of obesity, is advised.

Reimbursement for Obesity Treatment. Third-party payers cover treatment conditions caused by obesity and sometimes pay for bariatric surgery, but there is little reimbursement for prevention or treatment of obesity without comorbidities. For obesity to be recognized and covered by third-party payers, health professionals, including RDs, must supply scientific evidence that a treatment works to improve health outcomes of the beneficiary. Insurers and the public must be presented with effective weight management approaches along with proof that they work. RDs should implement the science-based weight management practice guidelines that have been developed for both adults and children. RDs need to demonstrate the cost-effectiveness of the strategies with well-designed studies and should use the medical nutrition therapy reimbursement strategies for diabetes and renal diseases as a model for obesity coverage (138).

Role of RDs in Providing Care

The partnership between RDs and their patients should focus on developing strategies that will enhance opportunities for clients to control their own behaviors related to overweight or obesity. Incorporating various behavioral techniques into weight loss counseling is a recommended approach (14). RDs need to use their skills and knowledge to support and encourage clients with their weight loss efforts.

If RDs work only with physicians or a team that includes a coordinated group of health professionals with a variety of skills, they should work effectively with the team to achieve the best outcome for the patient. Communication with other health care providers on the team is essential to accommodate the different needs of each patient. Understanding when to refer patients to other health care providers is important in managing patients' needs (14).

Within the past several years various committees, foundations, governmental agencies, and professional associations have addressed the increasing prevalence of obesity and overweight in our country. Each of these investigations resulted in a report including action steps or recommendations, many of them related to helping the American public achieve more healthful diets and increasing physical activity. The 2005 Dietary Guidelines addressed the issue by stressing the necessity of energy balance for weight maintenance and for the first time the importance of physical activity (19). In *F as in Fat: How Obesity Policies are Failing in America 2007* (139), there are two recommendations that relate directly to food and nutrition professionals:

- helping all Americans become more physically active, and
- helping Americans choose more healthful foods.

For food and nutrition professionals to have a substantial influence in achieving these goals, we are challenged to develop new innovative and bold approaches for the prevention and treatment of obesity. The future paradigm will involve population-based interventions that will require the full cooperation of the entire health care community. The coordinated integration of expertise from different health care disciplines, encompassing a diversity of skills, is necessary to develop innovative ways to tackle the obesity problem. Because RDs are the primary nutrition practitioners, they should share the leadership role with other health professionals in stemming the tide of this obesity epidemic.

The partnership between RDs and their patients should focus on developing strategies that will enhance opportunities for clients to control their own behaviors related to overweight or obesity.

Much of the literature also stresses the importance of working cooperatively with relevant government agencies, appropriate medical and scientific organizations, employer organizations, unions, educational authorities, and the media. In 2001, the Surgeon General's Call to Action identified a public health approach to halting the obesity epidemic in our country (140). The Call to Action identified key actions, one of which was to encourage partnerships between health care providers, schools, faith-based groups, and other community organizations in prevention efforts targeted at social and environmental causes of overweight and obesity.

RDs are encouraged to participate in nutrition advocacy at the local, state, and national levels to encourage healthful eating and lifestyle behaviors. More importantly they should become involved in action programs that

support healthful eating at the grassroots level. RDs have the necessary skills and broad educational preparation to contribute effectively to partnerships that are focused on stemming the obesity epidemic.

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References

1. Egger G, Swinburn B. An "ecological" approach to the obesity pandemic. *BMJ*. 1997; 315:477-480.
2. Korner J, Aronne LJ. The emerging science of body weight regulation and its impact on obesity treatment. *J Clin Invest*. 2003;111: 565-570.
3. Balthasar N. Genetic dissection of neuronal pathways controlling energy homeostasis. *Obesity*. 2006;14(suppl 5):222-227.
4. Blundell JE. Perspective on the central control of appetite. *Obesity*. 2006;14(suppl 4): 160S-163S.
5. Farooqi IS, Wangensteen T, Collins S, Kimber W, Matatese G, Keogh JM, Lank E, Bottomley B, Lopez-Fernandez J, Ferraz-Amaro I, Dattani MT, Ercan O, Myhre A, Retterstol L, Stanhope R, Edge JA, McKenzie S, Lessan N, Ghodsi M, De Rosa V, Perna F, Fontana S, Barroso I, Undlien DE, O'Rahilly S. Clinical and molecular genetic spectrum of congenital deficiency of the leptin receptor. *N Engl J Med*. 2007;356:237-247.
6. Peters JC. Combating obesity: Challenges and choices. *Obes Res*. 2003;11(suppl):7-11.
7. Mela DJ. Food choice and intake: The human factor. *Proc Nutr Soc*. 1999;58: 513-521.
8. Wadden TA, Brownell KD, Foster GD. Obesity: Responding to the global epidemic. *J Consult Clin Psych*. 2002;70:510-525.
9. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States: 1999-2004. *JAMA*. 2006;295:1549-1555.
10. Sturm R. Increases in morbid obesity in the USA: 2000-2005. *Public Health*. 2007;121: 492-496.
11. Adult weight management evidence-based nutrition practice guideline. American Dietetic Association Evidence Analysis Library Web site. http://www.adaevidencelibrary.com/topic.cfm?cat=2798. Accessed January 2, 2008.
12. *The Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report*. Rockland, MD: US Department of Health and Human Services; 1998. NIH Publication No. 98-4083.
13. *Nutrition Diagnosis and Intervention: Standardized Language for the Nutrition Care Process*. Chicago, IL: American Dietetic Association; 2007.
14. Lacey K, Pritchett E. Nutrition care process and model: ADA adopts road map to quality care and outcomes management. *J Am Diet Assoc*. 2003;103:1061-1072.
15. Willett WC, Dietz WH, Colditz GA. Primary care: Guidelines for healthy weight. *N Engl J Med*. 1999;341:427-434.
16. Kuczmarski RJ, Flegal KM, Criteria for definition of overweight in transition: Background and recommendations for the United States. *Am J Clin Nutr*. 2000;72: 1074-1081.
17. *Nutrition and Your Health: Dietary Guidelines for Americans, 2005*. 6th ed. Washington, DC: US Government Printing Office; 2005:1-19.
18. Yanovski SZ, Nelson JE, Dubbert BK, Spitzer RL. Association of binge eating disorder and psychiatric comorbidity in obese subjects. *Am J Psychiatry*. 1993;150: 1472-1479.
19. Pickering RP, Grant BF, Chou SP, Compton WM. Are overweight, obese, and extreme obesity associated with psychopathology? Results from the national epidemiological survey on alcohol and related conditions. *J Clin Psychiatry*. 2007; 68:998-1009.
20. Kalarchian MA, Marcus MD, Levine MD, Courcoulas AP, Pilkonis PA, Ringham RM, Soulakova JN, Weissfeld LA, Rofey DL. Psychiatric disorders among bariatric surgery candidates: Relationship to obesity and functional health status. *Am J Psychiatry*. 2007;164:328-334.
21. Wildman RP, Gu D, Reynolds K, Duan X, He J. Appropriate body mass index and waist circumference cutoffs for categorization of overweight and central adiposity among Chinese adults. *Am J Clin Nutr*. 2004;80:1129-1136.
22. Jenkins K, Johnson N, Ofstedal M. Patterns and associations of body weight among older adults in two Asian societies. *J Cross Cult Geront*. 2007;22:83-99.
23. Razak F, Anand SS, Shanon H, Vuksan V, Davis B, Jacobs R, Teo KK, McQueen M, Yusuf S. Defining obesity cut points in a multiethnic population. *Circulation*. 2007; 115:2111-2118.
24. Compher C, Frankenfield D, Keim N, Roth-Yousey L. Best practice methods to apply to measurement of resting metabolic rate in adults: A systematic review. *J Am Diet Assoc*. 2006;106:881-903.
25. Heshka S, Feld K, Yang MU, Allison DB, Heymsfield SB. Resting energy expenditure in the obese: A cross-validation and comparison of prediction equations. *J Am Diet Assoc*. 1993;93:1031-1036.
26. Frankenfield DC, Rowe WA, Smith JS, Cooney RN. Validation of several established equations for resting metabolic rate in obese and non-obese people. *J Am Diet Assoc*. 2003;103:1152-1159.
27. Blundell JE. Perspective on the central control of appetite. *Obesity*. 2006;14(suppl 4): 160S-163S.
28. Berthoud HR. Mind versus metabolism in the control of food intake and energy balance. *Physiol Behav*. 2004;81:781-793.
29. Blundell JE. What foods do people habitually eat? A dilemma for nutrition, an enigma for psychology. *Am J Clin Nutr*. 2000;71:3-5.
30. Lichtenstein AH, Appel LJ, Brands M, Carnetho M, Daniels S, Franch HA, Franklin B, Kris-Etherton P, Harris WS, Howard B, Karanja N, Lefevre M, Rudel L, Sacks F, Van Horn L, Winston M, Wylie-Rosett J. Diet and lifestyle recommendations revision 2006: A scientific statement from the American Heart Association Nutrition Committee. *Circulation*. 2006;114:82-96.
31. Blundell JE, Stubbs RJ. High and low carbohydrate and fat intakes: Limits imposed by appetite and palatability and their implications for energy balance. *Eur J Clin Nutr*. 1999;53(suppl 1):S148-S165.
32. Lindström J, Ilanne-Parikka P, Peltonen M, Aunola S, Eriksson JG, Hemiö K, Hämäläinen H, Härkönen P, Keinänen-Kiukaanniemi S, Laakso M, Louheranta A, Mannelin M, Paturi M, Sundvall J, Valle TT, Uusitupa M, Tuomilehto J. Sustained reduction in the incidence of type 2 diabetes by lifestyle intervention: Follow-up of the Finnish Diabetes Prevention Study. *Lancet*. 2006;368:1673-1679.
33. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346:393-403.
34. Look AHEAD Research Group, Pi-Sunyer X, Blackburn G, Brancati FL, Bray GA, Bright R, Clark JM, Curtis JM, Espeland MA, Foreyt JP, Graves K, Haffner SM, Harrison B, Hill JO, Horton ES, Jakicic J, Jeffery RW, Johnson KC, Kahn S, Kelley DE, Kitabchi AE, Knowler WC, Lewis CE, Maschak-Carey BJ, Montgomery B, Nathan DM, Patricio J, Peters A, Redmon JB, Reeves RS, Ryan DH, Safford M, Van Dorsten B, Wadden TA, Wagenknecht L, Wesche-Thobaben J, Wing RR, Yanovski SZ. Reduction in weight and cardiovascular disease risk factors in individuals with type 2 diabetes: One-year results of the look AHEAD trial. *Diabetes Care*. 2007;30:1374-1383.
35. Appel LJ, Champagne CM, Harsha DW, Cooper LS, Obarzanek E, Elmer PJ, Stevens VJ, Vollmer WM, Lin PH, Svetkey LP, Stedman SW, Young DR; Writing Group of the PREMIER Collaborative Research Group. Effects of comprehensive lifestyle modification on blood pressure control: Main results of the PREMIER clinical trial. *JAMA*. 2003;289:2083-2093.
36. Johnstone AM, Horgan GW, Murison SD, Bremner DM, Lobley GE. Effects of a high-protein ketogenic diet on hunger, appetite, and weight loss in obese men feeding ad libitum. *Am J Clin Nutr*. 2008;87:44-55.
37. Nordmann AJ, Nordmann A, Briel M, Keller U, Yancy WS, Brehm BJ, Bucher HC. Effects of low-carbohydrate vs low-fat diets on weight loss and cardiovascular risk factors: A meta-analysis of randomized controlled trials. *Arch Intern Med*. 2006;166: 285-293.
38. Gardner CD, Kiazand A, Alhassan S, Kim S, Stafford RS, Balise RR, Kraemer HC, King A. Comparison of the Atkins, Zone, Ornish, and LEARN diet for change in weight and related risk factors among overweight premenopausal women. *JAMA*. 2007;297:969-977.
39. Young LR, Nestle M. Expanding portion sizes in the US marketplace: Implications for nutrition counseling. *J Am Diet Assoc*. 2003;103:231-234.
40. Wansink B, Van Ittersum K. Portion size me: Downsizing our consumption norms. *J Am Diet Assoc*. 2007;107:1103-1106.
41. Pedersen SD, Kang J, GA Kline. Portion control plate for weight loss in obese patients with type 2 diabetes mellitus: A controlled clinical trial. *Arch Intern Med*. 2007; 167:1277-1283.
42. Timlin MT, Pereira MA. Breakfast fre-

quency and quality in the etiology of adult obesity and chronic diseases. *Nutr Rev*. 2007;65:268-281.
43. Tsai AG, Wadden TA. The evolution of very–low-calorie diets: An update and meta-analysis. *Obes Res*. 2006;14:1283-1293.
44. Colles SL, Dixon JB, Marks P, Strauss BJ, O'Brien PE. Preoperative weight loss with a very–low-energy diet: Quantification of changes in liver and abdominal fat by serial imaging. *Am J Clin Nutr*. 2006;84:304-311.
45. Physical activity guidelines advisory committee report to the Secretary of Health and Human Services, 2008. US Department of Health and Human Services Web site. http://www.health.gov/PAGuidelines/committeereport.aspx. Accessed November 15, 2008.
46. Physical activity and health: A report of the Surgeon General. Centers for Disease Control and Prevention Web site. http://www.cdc.gov/nccdphp/sgr/contents.htm. Accessed September 28, 2008.
47. Leitzmann MF, Park Y, Blair A, Ballard-Barbash R, Mouw T, Hollenbeck AR, Schatzkin A. Physical activity recommendations and decreased risk of mortality. *Arch Intern Med*. 2007;167:2453-2460.
48. Jeffery RW, Wing RR, Sherwood NE, Tate DF. Physical activity and weight loss: Does prescribing higher physical activity goals improve outcome? *Am J Clin Nutr*. 2003; 78:684-689.
49. Jakicic JM, Marcus BH, Lang W, Janney C. Effect of exercise on 24-month weight loss maintenance in overweight women. *Arch Intern Med*. 2008;168:1550-1559.
50. Schoeller DA, Shay K, Kushner RF. How much physical activity is needed to minimize weight gain in previously obese women? *Am J Clin Nutr*. 1997;66:551-556.
51. Klem ML, Wing RR, McGuire MT, Seagle HM, Hill JO. A descriptive study of individuals successful at long-term maintenance of substantial weight loss. *Am J Clin Nutr*. 1997;66:239-246.
52. Hill JO, Wyatt HR, Reed GW, Peters JC. Obesity and the environment: Where do we go from here? *Science*. 2003;299:853-855.
53. Tudor-Locke C, Bassett DR. How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Med*. 2004;34:1-8.
54. Bravata DM, Smith-Spangler C, Sundaram V, Gienger AL, Lin N, Lewis R, Stave CD, Olkin I, Sirard JR. Using pedometers to increase physical activity and improve health: a systematic review. *JAMA*. 2007; 298:2296-2304.
55. Stuart RB. Behavioral control of overeating. *Behav Ther*. 1967;5:357-365.
56. Stunkard AJ, Harris JR, Pederson NL, McClearn GE. The body-mass index of twins who have been reared apart. *N Engl J Med*. 1990;322:1483-1487.
57. Ravussin E, Lillioja S, Knowler WC, Christin L, Freymond D, Abbott WG, Boyce V, Howard BV, Bogardus C. Reduced rate of energy expenditure as a risk factor for body weight gain. *N Engl J Med*. 1988;318:467-472.
58. Lindström J, Eriksson JG, Valle TT, Aunola S, Cepaitis Z, Hakumäki M, Hämäläinen H, Ilanne-Parikka P, Keinänen-Kiukaanniemi S, Laakso M, Louheranta A, Mannelin M, Martikkala V, Moltchanov V, Rastas M, Salminen V, Sundvall J, Uusitupa M, Tuomilehto J. Prevention of diabetes mellitus in subjects with impaired glucose tolerance in the Finnish Diabetes Prevention Study: Results from a randomized clinical trial. *J Am Soc Nephrol*. 2003;14:S108-113.
59. Elmer PJ, Obarzanek E, Vollmer WM, Simons-Morton D, Stevens VJ, Young DR, Lin PH, Champagne C, Harsha DW, Svetkey LP, Ard J, Brantley PJ, Proschan MA, Erlinger TP, Appel LJ. Effects of comprehensive lifestyle modification on diet, weight, physical fitness, and blood pressure control: 18-month results of a randomized trial. *Ann Intern Med*. 2006;144:485-495.
60. Wing RR. Behavioral weight control. In: Wadden TA, Stunkard AJ, eds. *Handbook of Obesity Treatment*. New York, NY: Guilford Press; 2002:301-316.
61. Wadden TA, Foster GD. Behavioral treatment of obesity. *Med Clin North Am*. 2000; 84:441-461.
62. Ryan DH, Espeland MA, Foster GD, Hafner SM, Hubbard VS, Johnson KC, Kahn SE, Knowler WC, Yanovski SZ. Look AHEAD (Action for Health in Diabetes): Design and methods for a clinical trial of weight loss for the prevention of cardiovascular disease in type 2 diabetics. *Control Clin Trials*. 2003;24:610-628.
63. Svetkey LP, Harsha DW, Vollmer WM, Stevens VJ, Obarzanek E, Elmer PJ, Lin PH, Champagne C, Simons-Morton DG, Aickin M, Proschan MA, Appel LJ. Premier: A clinical trial of comprehensive lifestyle modification for blood pressure control: Rationale, design and baseline characteristics. *Ann Epidemiol*. 2003;13:462-471.
64. Eriksson J, Lindström J, Valle T, Aunola S, Hämäläinen H, Ilanne-Parikka P, Keinänen-Kiukaanniemi S, Laakso M, Lauhkonen M, Lehto P, Lehtonen A, Louheranta A, Mannelin M, Martikkala V, Rastas M, Sundvall J, Turpeinen A, Viljanen T, Uusitupa M, Tuomilehto J. Prevention of type II diabetes in subjects with impaired glucose tolerance: The Diabetes Prevention Study (DPS) in Finland. Study design and 1-year interim report on the feasibility of the lifestyle intervention programme. *Diabetologia*. 1999;42:793-801.
65. Absetz P, Valve R, Oldenburg B, Heinonen H, Nissinen A, Fogelholm M, Ilvesmäki V, Talja M, Uutela A. Type 2 diabetes prevention in the "real world": One-year results of the GOAL Implementation Trial. *Diabetes Care*. 2007;30:2465-2470.
66. Wadden TA, Berkowitz RI, Womble LG, Sarwer DB, Phelan S, Cato RK, Hesson LA, Osei SY, Kaplan R, Stunkard AJ. Randomized trial of lifestyle modification and pharmacotherapy for obesity. *N Engl J Med*. 2005;353:2111-2120.
67. Wadden TA, Crerand CE, Brock J. Behavioral treatment of obesity. *Psychiatr Clin North Am*. 2005;28:151-170.
68. Jones LR, Wilson CI, Wadden TA. Lifestyle modification in the treatment of obesity: An educational challenge and opportunity. *Clin Pharmacol Ther*. 2007;81:776-779.
69. Wadden TA, Butryn ML, Wilson C. Lifestyle modification for the management of obesity. *Gastroenterology*. 2007;132:2226-2238.
70. Perri MG, Nezu AM, McKelvey WF, Shermer RL, Renjilian DA, Viegener BJ. Relapse prevention training and problem-solving therapy in the long-term management of obesity. *J Consult Clin Psychol*. 2001;69:722-726.
71. Perri MG, Corsica JA. Improving the maintenance of weight lost in behavioral treatment of obesity. In: Wadden TA, Stunkard AJ, eds. *Handbook of Obesity Treatment*. New York, NY: Guilford Press; 2002:357-379.
72. Perri MG, McAllister DA, Gange JJ, Jordan RC, McAdoo G, Nezu AM. Effects of four maintenance programs on the long-term management of obesity. *J Consult Clin Psychol*. 1988;56:529-34.
73. Perri MG, McAdoo WG, McAllister DA, Lauer JB, Yancey DZ. Enhancing the efficacy of behavior therapy for obesity: Effects of aerobic exercise and a multicomponent maintenance program. *J Consult Clin Psychol*. 1986;54:670-675.
74. Li Z , Magione M, Tu W, Mojica W, Arterburn D, Shugarman LR, Hilton L, Suttorp M, Soloman V, Shekelle PG, Morton S. Meta-analysis: Pharmacologic treatment of obesity. *Ann Intern Med*. 2005;142:532-546.
75. Ioannides-Demos LL, Proietto J, Tonkin AM, McNeil JJ. Safety of drug therapies used for weight loss and treatment of obesity. *Drug Saf*. 2006;29:277-302.
76. Bray GA, Ryan DH, Gordon D, Heidingsfelder S, Cerise F, Wilson K. A double-blind randomized placebo-controlled trial of sibutramine. *Obes Res*. 1996;4:263-270.
77. Padwal R, Li SK, Lau DC. Long-term pharmacotherapy for obesity and overweight. *Cochrane Database Syst Rev*. 2004;3: CD004094.
78. Sjöström L, Rissanen A, Andersen T, Boldrin M, Golay A, Koppeschaar HP, Krempf M. Randomised placebo-controlled trial of orlistat for weight loss and prevention of weight regain in obese patients. European Multicentre Orlistat Study Group. *Lancet*. 1998;352:167-172.
79. Stafford RS, Radley DC. National trends in obesity medication use. *Arch Intern Med*. 2003;163: 1046-1050.
80. Munro JF, MacCuish AC, Wilson EM, Duncan LJP. Comparison of continuous and intermittent anorectic therapy in obesity. *BMJ*. 1968;10:352-354.
81. Arbeeny CM. Addressing the unmet medical need for safe and effective weight loss therapies. *Obes Res*. 2004;12:1191-1196.
82. Bays HE. Current investigational antiobesity agents and obesity therapeutic treatment targets. *Obes Res*. 2004;12:1197-1211.
83. Heymsfield SB, Greenberg AS, Fujioka K, Dixon RM, Kushner R, Hunt T, Lubina JA, Patane J, Hunt P, McCamish M. Recombinant leptin for weight loss in obese and lean adults. A randomized, controlled, dose-escalation trial. *JAMA*. 1999;282: 1568-1575.
84. Ettinger MP, Littlejohn TW, Schwartz SL, Weiss SR, McIlwain HH, Heymsfield SB, Bray GA, Roberts WG, Heyman ER, Stambler N, Heshka S, Vicary C, Guler HP. Recombinant variant of ciliary neurotrophic factor for weight loss in obese adults: A randomized, dose-ranging study. *JAMA*. 2003;289:1826-1832.
85. Van Gaal LF, Rissanen AM, Scheen AJ, Ziegler O, Rossner S, (RIO-European Study Group). Effects of the cannabinoid-1 receptor blocker rimonabant on weight reduction and cardiovascular risk factors in overweight patients: 1-year experience from the RIO-Europe study. *Lancet*. 2005;365:1389-1397.

86. Després J-P, Golay A, Sjöström L. Effects of rimonabant on metabolic risk factors in overweight patients with dyslipidemia. *N Engl J Med*. 2005;353:2121-2134.
87. Centers for Disease Control and Prevention. Cardiac valvulopathy associated with exposure to Fenfluramine or Dexfenfluramine: US Dept of Health and Human Services interim public health recommendation, Nov 1997. *MMWR Morb Mortal Wkly Rep*. 1997;46:1061-1065.
88. Nortier JL, Martinez M-CM, Schmeiser HH, Arlt VM, Bieler CA, Petein M, Depierreux MF, DePauw L, Abramowicz D, Vereerstraeten P, Vanherweghem J-L. Urothelial carcinoma associated with the use of a Chinese herb (Aristolochia Fangchi). *N Engl J Med*. 2000;342:1686-1692.
89. Pittler MH, Schmidt K, Ernst E. Adverse events of herbal food supplements for body weight loss: Systemic review. *Obes Rev*. 2005;6:93-111.
90. Kernan WN, Viscoli CM, Brass LM, Broderick JP, Brott T, Feldman E, Morgenstern LB, Wilterdink JL, Horwitz RL, Phenylpropanolamine and risk of hemorrhagic stroke. *N Engl J Med*. 2000;343:1686-1692.
91. Haller CA, Benowitz NL. Adverse cardiovascular and central nervous system events associated with dietary supplements containing ephedra alkaloids. *N Engl J Med*. 2000;343:1833-1838.
92. Wadden TA, Berkowitz RI, Womble LG, Sarwer DB, Phelan S, Cato RK, Hesson LA, Osei SY, Kaplan R, Stunkard AJ. Randomized trial of lifestyle modification and pharmacotherapy for obesity. *N Engl J Med*. 2005;353:2111-2120.
93. Yanovski S, Yanovski JA. Drug therapy: Obesity. *N Engl J Med*. 2002;346:591-602.
94. Strum R. The effects of obesity, smoking, and drinking on medical problems and costs. *Health Affairs*. 2002;21:245-253.
95. International Conference on Gastrointestinal Surgery to Treat Type 2 Diabetes. Diabetes surgery summit. Studio Congressi Web site. http://www.scstudiocongressi.it/media/dss/dss.pdf. Accessed January 11, 2008.
96. Colquitt J, Clegg A, Lovemen E, Royle P, Sidhu MK. Surgery for morbid obesity. *Cochrane Database System Rev*. 2005;4: CD003641.
97. Buchwald H, Avidor Y, Braunwald E, Jensen MD, Pories W, Fahrbach K, Schoelles K. Bariatric surgery: A systematic review and meta-analysis. *JAMA*. 2004;292: 1724-1737.
98. Jones DB, Provost DA, DeMaria EJ, Smith CD, Morgenstern L, Schirmer B. Optimal management of the morbidly obese patient. SAGES appropriateness conference statement. *Surg Endosc*. 2004;18:1029-1037.
99. Nguyen NT, Silver M, Robinson M, Needleman B, Hartley G, Cooney R, Catalano R, Dostal J, Sama D, Blankenship J, Burg K, Stemmer E, Wilson SE. Result of a national audit of bariatric surgery performed at academic centers: A 2004 University Health System Consortium benchmarking project. *Arch Surg*. 2006;141:445-449.
100. Verselewel de Witt Hamer PC, Hunfeld MA, Tuinebeijer WE. Obesity Surgery: Discouraging long-term results with Mason's vertical banded gastroplasty. *Eur J Surg*. 1999;165:855-860.
101. Balsiger BM , Poggio JL, Mai J, Kelly KA, Sarr MG. Ten and more years after vertical banded gastroplasty as primary operation for morbid obesity. *J Gastrointest Surg*. 2000;4:598-605.
102. Nguyen NT, Paya M, Mavandadi S, Zainabadi K, Wilson SE. The relationship between hospital volume and outcome in bariatric surgery at academic medical centers. *Ann Surgery*. 2004;240:586-593.
103. Encinosa WE, Bernard DM, Chen CC, Steiner CA. Healthcare utilization and outcomes after bariatric surgery. *Med Care*. 2006;44:706-712.
104. Christou NV, Sampalis JS, Liberman M. Surgery decreases long term mortality, morbidity and health care use in morbidly obese patients. *Ann Surgery*. 2004;240:416-423.
105. Sjostrom L, Narbo K, Sjostrom D, Karason K, Larsson B, Wedel H, Lystig T, Sullivan M, Bouchard C, Carlsson B, Bengtsson C, Dahlgren S, Gummesson A, Jacobson P, Karlsson J, Lindroos AK, Lönroth H, Näslund I, Olbers T, Stenlöf K, Torgerson J, Agren G, Carlsson LM. Effects of bariatric surgery on mortality in Swedish obese subjects. *N Engl J Med*. 2007;357:741-752.
106. Adams TD, Gress RE, Smith SC, Halverso RC, Simper SC, Rosamond WD, LaMonte MJ, Stroup AM, Hunt SC. Long-term mortality after gastric bypass surgery. *N Engl J Med*. 2007;357:753-761.
107. Vogel JA, Franklin BA, Zalesin KC, Trivax JE, Krause KR, Chengelis DL, McCullough PA. Reduction in predicted coronary heart disease risk after substantial weight reduction after bariatric surgery. *Am J Cardiol*. 2007;99:222-226.
108. Samplis JS, Liberman M, Auger S, Christou NV. The impact of weight reduction surgery on health-care costs in morbidly obese patients. *Obes Surgery*. 2004;14:939-947.
109. El Shobary H, Christou N, Beckman SB, Gvocdic B, Schricker T. Effect of laparoscopic versus open gastric bypass surgery on postoperative pain and bowel function. *Obes Surgery*. 2006;16:437-442.
110. Maggard MA, Shugarman LR, Suttorp M, Miglione M, Sugarman HJ, Livingston EH, Nuguyen NT, Li Z, Mojica WA. Hilton L, Rhodes S, Morton SC, Shekelle PG. Meta-analysis: Surgical treatment of obesity. *Ann Intern Med*. 2005;142:547-559.
111. Silecchia G, Boru C, Pecchia A, Rizzello M, Caseli G, Leonetti F, Basso N. Effectiveness of laparoscopic sleeve gastrectomy (first stage of biliopancreatic diversion with duodenal switch) on co-morbidities in super obese high risk patients. *Obes Surg*. 2006; 16:1138-1144.
112. Cottam D, Qureshi FG, Mattar SG, Sharma S, Holover S, Bonanomi G, Ramanathan R, Schauer P. Laparoscopic sleeve gastrectomy as an initial weight-loss procedure for high risk patients with morbid obesity. *Surg Endosc*. 2006;20:859-863.
113. Roa PE, Kaidar-Person O, Pinto D, Cho M, Szomstein S, Rosenthal RJ. Laparoscopic sleeve gastrectomy as treatment for morbid obesity: Technique and short-term outcome. *Obes Surg*. 2006;16:1323.
114. MacLean LD, Rhode BM. Does genetic predisposition influence surgical results of operations for obesity? *Obes Surg*. 1996; 6:132-137.
115. Saltzman E, Anderson W, Apovian CM, Boulton H, Chamberlain A, Cullum-Dugan D, Cummings S, Hatchigian E, Hodges B, Keroack CR, Pettus M, Thomason P, Veglia L, Young LS. Criteria for patient selection and multidisciplinary evaluation and treatment for the weight loss surgery patient. *Obes Res*. 2005;13:234-243.
116. Greenberg I, Perna F, Kaplan M, Sullivan MA. Behavioral and psychological factors in the assessment and treatment of obesity surgery patients. *Obes Res*. 2005;13:244-249.
117. Sumall AG. A review of liposuction as a cosmetic surgical procedure. *J Nat Med Assn*. 1987;79:1275-1279.
118. Klein S, Fontana L, Young VL, Coggan AR, Kilo C, Patterson BW, Mohammed BS. Absence of an effect of liposuction on insulin action and risk factors for coronary heart disease. *N Engl J Med*. 2004;350:2549-2557.
119. Rizzo MR, Paolisso G, Grella R, Barbieri M, Grella E, Ragno E, Grella R, Micoletti G, D'Andrea F. Is dermolipectomy effective in improving insulin action and lowering inflammatory markers in obese women? *Clin Endocrinol*. 2005;63:253-258.
120. Giugliano G, Nicoletti G, Grella E, Giugliano F, Esposito K, Scuderi N, D'Andres F. Effect of liposuction on insulin resistance and vascular inflammatory markers in obese women. *Br J Plast Surg*. 2004;57:190-194.
121. Kayman S, Bruvold W, Stern JS. Maintenance and relapse after weight loss in women: Behavioral aspects. *Am J Clin Nutr*. 1990;52:800-807.
122. McGuire MT, Wing RR, Klem ML, Hill JO. Behavioral strategies of individuals who have maintained long-term weight losses. *Obes Res*. 1999;7:334-341.
123. Dohme FA, Beattie JA, Aibel C, Striegel-Moore RH. Factors differentiating women and men who successfully maintain weight loss from women and men who do not. *J Clin Psychol*. 2001;57:105-117.
124. Byrne S, Cooper Z, Fairburn C. Weight maintenance and relapse in obesity: A qualitative study. *Int J Obes*. 2003;27:955-962.
125. Cleanthous X, Noakes M, Keogh JB, Mohr P, Clifton PM. Weight loss maintenance in women 3 years after following a 12-week structured weight loss program. *Obes Res Clin Prac*. 2007;1:195-211.
126. Jeffery RW, French SA. Preventing weight gain in adults: The Pound of Prevention study. *Am J Public Health*. 1999;89:747-751.
127. Jeffery RW, Sherwood NE, Brelje K, Pronkn NP, Boyle R, Boucher JL, Hasen K. Mail and phone interventions for weight loss in a managed-care setting: Weigh-to-Be 1-year outcomes. *Int J Obes*. 2003;27: 1584-1592.
128. Westenhoefer J, von Falck B, Stellfeldt, Fintelmann S. Behavioural correlates of successful weight reduction over 3 y. Results from the Lean Habits Study. *Int J Obes*. 2004;28:334-335.
129. Linde JA, Jeffery RW, French SA, Pronk NP, Boyle G. Self-weighing in weight gain prevention and weight loss trials. *Ann Behav Med*. 2005;30:210-216.
130. Elfhag K, Rossner S. Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obes Rev*. 2005;6:67-85.
131. Peyrot M, Rubin RR. Behavioral and psychosocial interventions in diabetes: A conceptual review. *Diabetes Care*. 2007;30: 2433-2440.

132. Gorin AA, Marinilli Pinto A, Tate DF, Raynor HA, Fava JL, Wing RR. Failure to meet weight loss expectations does not impact maintenance in successful weight losers. *Obesity*. 2007;15:3086-3090.
133. Butryn ML, Phelan S, Hill JO, Wing RR. Consistent self-monitoring of weight: A key component of successful weight loss maintenance. *Obesity*. 2007;15:3091-3096.
134. Hill JO, Thompson H, Wyatt H. Weight maintenance: What's missing? *J Am Diet Assoc*. 2005;105(suppl 1):S63-S66.
135. McArthur LH, Ross JL. Attitudes of registered dietitians toward personal overweight and overweight clients. *J Am Diet Assoc*. 1977;97:63-66.
136. O'Sullivan Malliet J, Skates J, Pritchett E. American Dietetic Association: Scope of dietetics practice framework. *J Am Diet Assoc*. 2005;105:634-640.
137. American College of Sports Medicine. Position stand: Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Med Sci Sports Exerc*. 2009;41:459-471.
138. Stern JS, Kazaks A, Downey M. Future and implications of reimbursement for obesity treatment. *J Am Diet Assoc*. 2005;105(suppl 1):S104-S109.
139. Levi J, Segal LM, Gadola E. *F as in Fat: How Obesity Policies are Failing in America*. Washington, DC: Trust for America's Health; 2007:91-101.
140. *The Surgeon General's call to action to prevent and decrease overweight and obesity*. Rockville, MD: US Department of Health and Human Services, Public Health Service, Office of the Surgeon General; 2001.

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