Weight Loss, Diets, and Supplements: Does Anything Work?

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It is estimated that at least two-thirds of adults are currently trying to lose weight or prevent weight gain.[1] While many are eating less fat to manage weight, few are using the recommended strategies of eating fewer calories and increasing physical activity.[1]

Many individuals trying to lose or maintain weight engage in new behaviors for short periods of time. However, they are typically not able to maintain these new behaviors. In one study, for example, individuals reported using each of the following behaviors at least once in 4 years, but used these behaviors only 20% of the time: decreased fat intake (78.7%), reduced calories (73.2%), and increased exercise (82.2%).[2]

Individuals attempting to lose weight may have unrealistic expectations, and if their expectations are not met, they may give up. Data suggest that people who want to lose weight want to lose, on average, at least 32% of their initial body weight[3] even though health professionals recommend a weight loss of only 5–10% to improve obesity-related complications (e.g., lowering blood pressure or improving lipids).[4] Weight-loss goals set by individuals are based more on appearance and physical comfort than on improved health.[3]

Because weight-loss expectations differ from traditional, recommended programs that encourage small weight losses over time, consumers are turning to other diet gimmicks in hopes of achieving their goals.[5] Americans are spending $33 billion annually for weight-loss products and services[6] for which there may or may not be evidence supporting their effectiveness. This article reviews popular weight-loss diets and supplements. It also discusses prioritization of weight-management goals with diabetes management goals and offers key counseling messages.

Facts About Diets and Supplements Patients Are Trying

Diets. The past 50 years have seen a proliferation of diets. These have ranged from total fasting, to consuming 300–400 calories/day of liquid supplements, to eating 1,200–2,100 calories/day with varying macronutrient distributions (5–60% carbohydrate, 2–70% fat, and ≥20% protein).[6]

Our patients who are concerned about their weight may have tried one, two, or more of these diets in an effort to lose or manage their weight. In the past decade, as Americans have become heavier, the diet industry has exploded. Of the top 50 best-selling diet books, 88% have been published since 1997.[7]

Because of the growing popularity of fad diets, the U.S. Department of Agriculture (USDA) initiated a research program to assess the health and nutrition effects of popular diets. One of its first activities was a comprehensive, evidence-based literature review. In January 2001, the USDA posted an article on its Website[8] summarizing this review, and later published the article in *Obesity Research*.[7]

Although the USDA literature review was not specifically focused on weight loss and diabetes, it did provide information for health care professionals to use when counseling patients with diabetes. Table 1 offers evidence statements and evidence ratings from the review. This literature review confirmed that all low-calorie diets—and calorie reduction is the hidden foundation of most of the popular diets—result in loss of body weight and body fat. However, some diets are more nutritionally adequate than others.

The USDA's second step was to analyze existing data to determine the association between different health and nutrition indicators and popular diets.[9] The USDA reviewed data collected between 1994 and 1996 from more than 10,014 adults aged 19 years and older as part of the Continuing Survey of Food Intake by Individuals (CSFII). The CSFII consists of food consumption and dietary pattern information on a nationally representative sample.

Popular diets were categorized into three prototypes and reviewed for total energy intake, macronutrient distribution, healthy eating index (HEI; range 0–100), fruit score (range 0–10), and variety score (range 0–10). A brief summary of results is shown in Table 2. Although these data do not show cause and effect, they do suggest that people eating low- to moderate-fat diets are more likely to eat fewer calories and a more nutritionally balanced diet (the higher the HEI, fruit, and variety scores, the more nutritionally balanced the diet).

Dietary supplements. In addition to diets, many patients are trying dietary supplements as a means of achieving quick weight loss. Under the Dietary Supplement Health and Education Act (DSHEA), a dietary supplement is defined as a product other than tobacco that contains a "dietary ingredient" and is intended to supplement the diet. Dietary ingredients include vitamins, minerals, herbs or other botanicals, amino acids, and substances such as

Table 1. USDA Weight Management Evidence Statements

Evidence Statement	Evidence Grade[1]
All low-calorie diets result in loss of body weight and body fat. Macronutrient composition does not appear to play a major role.	A
A moderate-fat reduction diet (20–30% calories from fat) is nutritionally adequate.	A
Metabolic profiles are improved with energy restriction and weight loss.	A
Caloric balance is the major determinant of weight loss. Diets that reduce caloric intake result in weight loss. In the absence of physical activity, the optimal diet for weight loss contains 1,400–1,500 kcal/day, regardless of macronutrient composition.	A
Overweight individuals consuming moderate-fat reduction diets lose weight because they consume fewer calories. These diets can produce weight loss when consumed ad libitum.	A
Moderate-fat, balanced-nutrient reduction diets reduce cholesterol, normalize plasma triglycerides, and normalize the ratio of HDL and total cholesterol.	A
Many factors influence hunger, appetite, and subsequent food intake. There does not appear to be an optimal diet for reducing hunger.	B
High-fat, low-carbohydrate diets result in ketosis.	B
Overweight individuals consuming low- and very-low-fat diets lose weight because they consume fewer calories.	B
Long-term compliance is likely a function of psychological issues rather than macronutrient composition per se.	B
Very-low-fat diets are deficient in vitamin E, vitamin B_{12}, and zinc.	B
Low- and very-low-fat diets reduce LDL cholesterol and may also decrease plasma triglyceride levels depending on diet composition.	B
Weight loss on very-low-fat diets may be the result of lifestyle modification, which may include decreased fat and energy intake, increased energy expenditure, or both.	B
High-fat, low-carbohydrate diets are nutritionally inadequate.	C
In the short term, low-carbohydrate ketogenic diets cause a greater loss of body fat. Water weight is regained when the diet ends. If the diet is maintained long-term, it results in loss of body fat.	C
Overweight individuals consuming high-fat, low-carbohydrate, low-calorie diets under experimental conditions lose weight.	C
Free-living, overweight individuals who self-select high-fat, low-carbohydrate diets consume fewer calories and lose weight.	C
Low-carbohydrate diets that result in weight loss may also result in decreased blood lipid levels, decreased blood glucose and insulin levels, and decreased blood pressure.	C

[1]Grade A evidence is from well-designed, randomized, controlled trials that provide a consistent pattern of findings in the population for which the recommendation is made. Grade B evidence is from randomized, controlled trials, but they are small in size, and trial results are inconsistent. Grade C evidence is from nonrandomized trials and observational studies.

enzymes, organ tissues, and metabolites. Dietary supplements must be labeled as such and can come in many forms, including powder, tablet, liquid, or capsule. They should not be used as a conventional food or as a sole meal or diet.[10]

Dietary supplements can play an important role in health promotion and the prevention of chronic disease.[10] However, concerns over their safety, dose, and advertising must be considered. A primary concern is that DSHEA does not require pre-market safety approvals for dietary supplements. Manufacturers are not required to disclose any information they have about the safety or alleged benefits of their supplement products.[10] In one example, animal studies showed promise for the supplement hydroxycitrate, the active compound found in the *Garcinia cambogia* plant. However, a human trial[11] found no benefit for weight loss. Nevertheless, hydroxycitrate is still being promoted for weight loss based on the animal studies.

Another concern is that dietary supplements may be described as "natural" or even "drug-free," in advertising. Some patients may interpret this to mean that there are no safety concerns associated with the use of these products. Metabolife 356, for example, is marketed as a dietary supplement but contains ephedrine derived from the herb *ma Huang* and caffeine from the herb *guarana*. Ephedrine and caffeine are technically drugs, but when used in a dietary supplement, they are classified as herbs. Although controversial, there are safety concerns for ephedrine and even greater concerns when it is combined with caffeine. The Food and Drug Administration has proposed labeling changes for dietary supplements containing ephedrine alkaloids and has suggested limiting the dose per tablet because of several reports of adverse reactions and deaths associated with its use.[12]

Additional concern related to dietary supplements is the lack of congruency between doses and forms of products used in studies and those shown on the label of the supplement product. In the case of the dietary supplement pyruvate, for example, the dosage used in weight-loss studies

Table 2. Mean Scores[a] and Intakes in a Day for Adults Aged 19+ Years Who Consume a Nonvegetarian Diet

	30% or less (mean ± SE)	30% to 50% (mean ± SE)	>55% (mean ± SE)
Energy (kcal)	2,026 ± 71[a]	2,166 ± 25[b]	1,895 ± 17[a]
Total fat (%)	46 ± 0.7[a]	37 ± 0.1[b]	25 ± 0.1[c]
Carbohydrate (%)	25 ± 0.3[a]	45 ± 0.1[b]	62 ± 0.1[b]
Protein (%)	22 ± 0.5[a]	17 ± 0.1[b]	14 ± 0.1[c]
HEI[1]	44.6 ± 0.6[a]	60.4 ± 0.2[b]	71.2 ± 0.2[c]
Fruits score[1]	1.0 ± 0.1[a]	3.1 ± 0.1[b]	5.1 ± 0.1[c]
Variety score[1]	5.8 ± 0.2[a]	7.8 ± 0.1[b]	7.9 ± 0.1[b]

[a, b, c] Identical superscripts are not statistically significant from one another at $P < 0.05$. In other words, an item marked with an a is significantly different from an item in the same row marked with a b but is not significantly different from another item in the same row marked with an a.
[1]HEI score can vary from 0-100 (perfect score 100); Fruits score and Variety score can vary from 0-10 (perfect score 10).

ranged from 25 to 30 g/day. The typical dose found in products sold in health food stores and through mail-order companies contains only 400–600 mg pyruvate per capsule, with recommendations to take 2–3 capsules 2–3 times daily, which translates into 2.4–3.6 g/day.[13]

Because many patients choose to self-medicate with dietary supplements for weight loss despite the controversy and lack of evidence supporting their use, it is imperative for health care professionals to be aware of the safety concerns associated with weight-loss supplements. A selection of popular supplements and their associated safety concerns are presented in Table 3.[14–22]

Weight Management Strategies That Can Work

Evidence suggests that low- and moderate-fat, calorie-restricted diets promote weight loss and are more nutritionally adequate than high-protein, high-fat, low-carbohydrate diets. Evidence is lacking to support the inclusion of high-protein, high-fat, low-carbohydrate diets or weight-loss supplements in weight management programs.

Behavioral weight-loss programs that focus on calorie balancing, using a combination of decreased caloric intake and increased exercise, are shown to be the most effective approaches to weight loss. Such programs typically include a caloric goal of 1,200–1,500/day, which is designed to produce an energy deficit of 500–1,000 calories/day and consequently a 1- to 2-lb/week loss. In addition, they advocate consuming 20–25% of total calories from fat and expending a minimum of 1,000 calories/week[23] and optimally 2,000 calories/week[24] through exercise. Additionally, many successful programs offer education and guidelines for stimulus control; self-monitoring (i.e., regular weighing, logging food intake); restaurant and social eating; healthy food choices and portion control; stress management; modest goal setting; self-talk;[23,25] problem solving; recipe modification; assertiveness training;[24] and motivation enhancement.[23,26]

People participating in behavioral weight-loss programs lose an average of 8.4 kg (18.5 lb) during treatment (~20 weeks) and are able to maintain, on average, two-thirds of this loss 9–10 months after initial treatment.[27] However, within 3–5 years after treatment, they gradually return to their baseline weight.[4,27]

Although this sounds discouraging, some individuals have used effective strategies to maintain their weight loss over the long term. The National Weight Control Registry (NWCR) provides the largest collection of data on successful weight losers and maintainers. Participants eligible for enrollment in the registry must have lost ≥30 lb (13.6 kg) and have maintained the loss for ≥1 year.[28] More than 3,000 people are enrolled in the registry.[29]

A total of 629 women and 155 men from the registry were surveyed to identify strategies they used to successfully lose and maintain weight.[28] Participants in the study lost an average of 66 lb and maintained the minimum required weight loss (30 lb) for an average of 5.5 years. Sixteen percent of the sample maintained the 30-lb weight loss for ≥10 years. More than half (55%) of the sample sought formal or professional assistance for weight loss (e.g., Weight Watchers or sessions with a registered dietitian), whereas the remaining 45% lost weight on their own.

To facilitate weight loss, 89% modified both dietary and activity habits; 10% modified diet only; and 1% modified activity only. Of those who made dietary changes, the three most frequently used methods were limiting certain types of food or food groups (87.6%), decreasing portion sizes (44.2%), and counting calories (43.7%). In addition to dietary changes, physical activity and exercise were influential in participants' weight-loss efforts. Ninety-two percent of the participants exercised at home, and about one-third exercised with a group (31.3%) or a friend (40.3%). Women were more likely to report participating in walking and aerobic dancing, and men were more likely to participate in competitive sports and weight lifting.

Weight maintenance strategies used by registry participants were similar to those used for weight loss. A summary of these strategies is shown in Table 4. Strategies used by NWCR participants to lose and maintain weight are comparable to typical behavioral weight-loss interventions. Participants followed a low-fat (~25% of total calories) and low-calorie diet, practiced self-monitoring techniques (e.g., self-weighing), modified portion sizes, and expended >2,000 calories/week through physical activity and exercise.

Prioritizing Weight Management With Diabetes Management Goals

Strategies used to promote weight loss and weight maintenance are similar to strategies used for improving blood glucose control. Individuals with diabetes do benefit from improving food choices, spacing food intake throughout the day, reducing calories, and exercising regularly—all strategies necessary for weight management.[28–30] However, it is important to frame

Table 3. Safety Concerns of a Select Sample of Dietary Supplements Not Approved By the FDA[1]

Name	Proposed Mechanism of Action	Evidence	Potential adverse effects/interactions/ contraindications	Notes
Chromium picolinate	Sensitizes insulin-sensitive glucoreceptors in the brain, resulting in appetite suppression	Conflicting studies; some conclude that chromium reduces body fat and increases fat-free mass, but others have shown no effect.[14] One study using picolinate form without exercise resulted in weight gain in obese women.[15]	May lower blood glucose levels; monitor closely.[15] One report of renal failure in a person who took 1,200–2,400 μg daily for 4–5 months to induce weight loss.[14] Concerns that picolinate form could have adverse effects on DNA are theoretical. Concerns when taken by patients with depression, bipolar disease, or psychosis because picolinic acid in chromium picolinate preparations can alter serotonin in the central nervous system.[15]	Chromium may aid in glycemic control in a subset of patients with type 2 diabetes. The American Diabetes Association does not recommend chromium supplementation unless chromium deficiency is present. Reliable tests for chromium deficiency have not been developed. Clinical benefit in glycemic control and optimal doses are not known.
Ephedrine[2]	A central nervous system stimulant. Claimed to increase metabolic rate of adipose tissue through thermogenesis; structurally similar to epinephrine and methamphetamine.	Several studies for weight loss; some conclude that ephedrine has mild positive effects.[16] Studies have small sample sizes, significant side effects in the first month of treatment, high dropout rates, and only marginal improvements in weight loss.[17] There are no published trials of Metabolife 356.[18]	Adverse reactions include tremors, agitation, anxiety, increased heart rate, increased blood pressure, and hyperglycemia. Stroke seizures, psychosis, and kidney stones have also been reported.[19] Increased risk of reactions when combined with caffeine or other stimulants. There is potential for drug/ephedrine interactions.	Has been marketed as a recreational drug due to its central nervous system stimulant activity and is used by some athletes in an attempt to boost performance. The FDA proposed in 1997 that ephedra-containing products must: 1) be labeled with all possible adverse effects, including death, 2) contain no more than 8 mg of ephedrine per serving, 3) be labeled to include a maximum daily dose of 24 mg, 4) be used for no more than 7 days, and 5) not be allowed to be marketed when combined with caffeine.[20]
5-HTP[3]	5-HTP is an intermediate metabolite in the biosynthesis of serotonin from L-tryptophan. It is thought that 5-HTP may increase serotonin and play a role in the regulation of appetite.	Four small studies using obese subjects, each with 25 or less patients and each lasting 6 weeks or less, showed 5-HTP to be effective for weight loss.[21] The same author conducted three of the studies.[21]	Nausea, vomiting, diarrhea, anorexia, euphoria, hypomania, restlessness, rapid speech, anxiety, insomnia, agitation (these are dose-related). Potential for interaction with SSRIs and other anti-depressants. Do not combine with carbidopa, a medication used for Parkinson's disease. Associated with EMS (one case) and asymptomatic eosinophilia (two cases).[22]	Initially thought to be a safe replacement for L-tryptophan, which has safety concerns of its own; however, the safety of 5-HTP is now questioned. 5-HTP products have been found to contain the impurities similar to those found in L-tryptophan before it was removed from the market.[22]

[1]Abbreviations: SSRI, serotonin re-uptake inhibitor such as Prozac, Paxil, or Zoloft; EMS, eosinophilia-myalgia syndrome is a serious systemic illness associated with increased eosinophils and severe muscle pain; HTP, hydroxytryptophan.

[2]Also known as ma Huang, which is the Chinese name for the herb ephedra. Metabolife is a popular weight-loss product containing ephedrine plus 17 other ingredients.

[3]5-Hydroxytryptophan; some products extract 5-HTP from *Griffonia simplicfico*.

Table 4. Weight Maintenance Strategies by NWCR Participants

Women	Men
1,297 kcal/day	1,724 kcal/day
24% energy from fat	23% energy from fat
19% energy from protein	18% energy from protein
55% energy from carbohydrate	56% energy from carbohydrate
2,669 kcal/week expended through activity[1]	3,490 kcal/week expended through activity[1]
Ate an average of 5 times/day	
Ate <1 meal/week in fast-food restaurants and ~2.5 meals/week in non-fast-food restaurants	
75% of participants weighed themselves at least once per week	

[1]Includes high-, medium-, and low-intensity activities (e.g, stationary or road cycling, weightlifting, aerobics, running or jogging, and walking) and calories expended in stairs climbed and blocks walked.

weight management goals with diabetes management goals. Often, when patients are diagnosed with type 2 diabetes, they are advised to lose weight to "avoid medication"; weight loss becomes a primary treatment goal.

Should weight loss be a primary treatment goal? How long should you hold off medication to see if weight loss will improve glycemic control? These are important questions for health care professionals to consider when recommending weight loss to individuals with diabetes.

While weight loss has been shown to improve glycemic control in most people, it does not do so in all individuals with diabetes.[32–35] In general, the greater the fasting plasma glucose (FPG), the greater the weight loss required to return FPG to a normal range.[32] Most individuals newly diagnosed with diabetes will respond to a 5- to 7-kg (11- to 15.4-lb) weight loss.[32] However, if the initial FPG is >252 mg/dl, for example, a significant and most likely unrealistic weight loss would be required to achieve normal FPG levels.

Even when an individual with diabetes diets sufficiently for 3 months to lose weight and reduces FPG to <108 mg/dl, this level of control is usually only maintained when energy intake continues to be restricted and more weight is lost. If the diet is restricted only sufficiently to maintain the initial weight loss, the FPG increases. Thus, reduction of energy intake is as important as losing weight and maintaining the weight loss if lowered FPG levels are to be maintained.[32] This same trend was observed in another study,[34] which showed that improvement in glycemic control for a given weight loss is greater initially than at 1 year.

The American Diabetes Association position statement on Nutrition Recommendations and Principles for People with Diabetes Mellitus[35] emphasizes the importance of improving the metabolic abnormalities associated with diabetes—hyperglycemia, dyslipidemias, and hypertension. Although weight loss is one of several strategies that can help improve metabolic abnormalities, it should not be the primary focus.[35]

Type 2 diabetes is a progressive disorder, and as a result, therapy needs to be intensified over time.[32] We should help patients understand and accept that, although weight loss and energy restriction may initially help them improve their diabetes control and even temporarily avoid oral agents or insulin, they may still require medication in the future. When the pancreas fails, diet therapy alone will not be enough, and medication will be needed to achieve blood glucose control.[32]

Bottom Line: What to Know and Say

What do we need to know as health care professionals, and what should we say to support our patients' weight management efforts while helping them achieve their diabetes management goals? First, explain to patients that weight management is not the primary focus of their diabetes management plan. Second, review their weight-loss expectations and goals. It is important to help patients establish realistic expectations and to provide them with support. Successful weight management is possible, but it is a lifelong process requiring the same level of commitment as diabetes management. Third, educate patients about popular diets and supplements as they emerge. Encourage them to resist the avoid the temptation to buy a "magic" pill or potion that promises effortless weight loss or weight maintenance. Table 5 offers additional patient education messages and counseling strategies.

It is our responsibility as health care professionals to stay abreast of the latest fad diets and dietary supplements so that we can effectively educate and inform our patients about their potential benefits and risks. Additional long-term and comprehensive weight management programs must be developed to deal with the epidemic of obesity and diabetes.

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Table 5. Key Messages and Counseling Recommendations for Diabetes and Weight-Loss Management

Topic	Key Messages for Professionals	Counseling Recommendations
Diabetes and Weight	• Diabetes management—not weight management— is the first priority. • Weight loss of 5–7 kg may improve glycemic control and for some people may reduce the need for medication. However, most individuals will need medication in spite of weight loss or in the future. • Energy restriction, without weight loss, can improve glycemic control.	• Prioritize goals for both health and quality of life. Set HbA_{1c}, blood glucose, blood pressure, and lipid goals as appropriate. • Explain the pathophysiology of type 2 diabetes, emphasizing the progressive nature of the disease and discussing the current or eventual need for oral medication or insulin. Even if weight-loss goals are achieved, medication or insulin may be required. • Review how foods affect blood glucose levels and how to select foods and determine portion sizes for meals and snacks.
Weight-Loss Expectations	• Initial goal of weight-loss therapy is to reduce body weight by 5–10% from baseline. • Improved glycemic control can often increase rather than decrease weight.	• Discuss the importance of setting realistic goals in an achievable time frame. • Emphasize health and fitness rather than physical appearance. • Reinforce weight maintenance strategies after 6 months of treatment. • Be proactive about discussing weight gain as a potential side effect of intensive therapy and improved blood glucose control.
Popular Diets & Weight Loss	• Caloric balance, not macronutrient composition, is the major determinant of weight loss. • The effect of macronutrient composition on long-term weight maintenance and adherence is unclear. • Scientifically validated and understandable information is needed for the millions of overweight and obese Americans who can attain weight loss but who struggle with weight maintenance.	• Support commitment to change. Be open to and acknowledge any positive aspects of alternative weight management approaches. • Stay abreast of current diets/trends. • Inform patients of scientific evidence (or lack thereof) supporting popular diet claims. • Discuss any side effects/contraindications associated with popular diets.
Weight-Loss Supplements	• Evidence does not support the use of supplements marketed for weight loss.	• Inform patients of scientific evidence (or lack therof) supporting popular diet claims. • Discuss any side effects/contraindications associated with herbs/dietary supplements.
Physical Activity	• Initially, moderate levels of physical activity for 30–45 min, 3–5 days/week should be encouraged. • Adults should set a long-term goal of accumulating 30 min or more of exercise on most days, and preferably all days of the week. • Physical activity combined with a low-calorie diet is recommended because it produces weight loss that may also result in decreases in abdominal fat and increases in cardiorespiratory fitness.	• Discuss how physical activity and exercise may help improve patients' glycemic control, cardiovascular health, and psychological well-being. • Assist patients with setting realistic and achievable exercise goals. • Discuss the importance of combined diet and physical activity for weight loss and weight maintenance.

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