

## Energy Density's Role in Weight Management

Achieving and maintaining a healthy body weight can be challenging. In order to reverse the current trend toward overweight and obesity, many people need to eat fewer calories and be more active. There are many strategies for weight management; health professionals understand the value of helping individuals find a plan that aligns with their personal nutrition goals and lifestyle needs. Most clients and patients are likely aware of such calorie-reduction strategies as counting calories, reducing portion sizes and/or strictly limiting intake of certain macronutrients. For many people, these approaches can lead to weight loss, but may result in hunger or dissatisfaction, which can limit their acceptability and long-term effectiveness. A strategy for moderating energy intake that many consumers may not be familiar with is to eat foods that are relatively low in calories for a given amount—that is, low in energy density (kcal/g or kcal/ml).

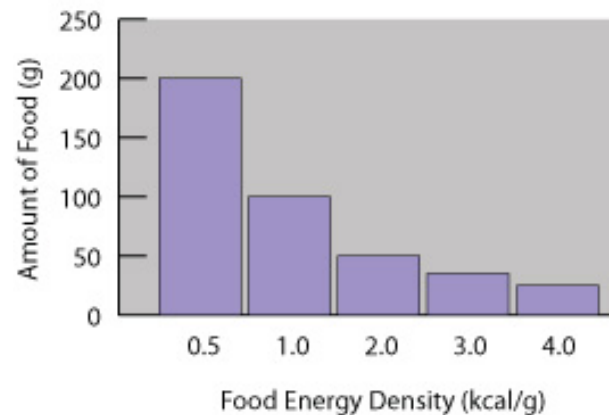
Most people eat a fairly consistent amount of food, by weight or volume, on a day-to-day basis (1-4). Therefore, the energy density of the foods people eat influences the number of calories consumed. Encouraging people to eat foods low in energy density allows them to decrease their energy intake while controlling hunger and can help them manage body weight.

### What is Energy Density?

Energy density is the amount of energy (measured as number of calories) in a particular amount (weighed amount) of food and is generally presented as calories per gram (kcal/g), although it can also be presented as calories per milliliter (kcal/ml) (5). [Note: When comparing energy density studies, it is important to understand what was included in the energy density calculation because inclusion of beverages, which tend to be lower in energy density than most foods, may disproportionately influence the results (6).] Foods with a lower energy density provide fewer calories per gram than foods with a higher energy density. For the same number of calories, a person can eat a larger portion of a food lower in energy density than of a food higher in energy density. Figure 1 shows the amount of food provided by 100-calorie portions of several foods that differ in energy density

Energy density values are influenced by the composition of foods. Water lowers the energy density of foods because it has an energy density of 0 kcal/g; thus, it contributes weight but not

**Figure 1. 100 kcal portions of foods differing in energy density**



Foods: 0.5 kcal/g = 1-1/2 oranges  
 1.0 kcal/g = 1/2 cup sweetened low-fat yogurt with fruit  
 2.0 kcal/g = 1 fried egg  
 3.0 kcal/g = 1/4 cup raisins  
 4.0 kcal/g = 1-1/2 tbsp chocolate bits

energy to foods. Fiber also has a relatively low energy density (1.5–2.5 kcal/g). On the opposite end of the energy density spectrum, fat (9 kcal/g) is the most energy dense component of food, providing more than twice as many calories per gram as carbohydrates or protein (4 kcal/g). In general, foods with a lower energy density tend to have a high water or air content, significant amount of fiber and/or little fat. Examples include fruits, vegetables, beaten egg whites, whole grains, lean meats and low-fat dairy products.

### Energy Density's Effect on Energy Intake, Hunger and Satiety

Observational studies of the foods people typically eat have found those who reported eating a lower-energy-dense diet ate fewer calories while consuming more food by weight than people who ate a higher-energy-dense diet (7, 8). This suggests that a diet low in energy density allows people to reduce their energy intake without necessarily decreasing the amount of

food they consume. Experimental studies not only confirm that eating foods lower in energy density is an effective strategy for reducing calorie intake but also show that calorie intake can be reduced *without* increasing feelings of hunger (2-4). Eating low-energy-dense foods promotes satiety, which, in turn, is a factor in helping people control their hunger (9, 10). Satiety and hunger control are important for long-term satisfaction and compliance with an eating plan.

In experimental studies, the energy density of the foods served to study participants was carefully manipulated to ensure that all the foods were equally palatable (2-4). The researchers then measured the participants' food intake and ratings of hunger and satiety. Results showed that people tended to eat a consistent weight of food; therefore, energy intake varied directly with changes in the energy density of the foods. For example, Bell and colleagues manipulated the energy density of two-day diets by adding fruits and vegetables to mixed dishes. Although they could eat as much or as little as they liked, the study participants ate similar amounts of food, by weight, over each of the three two-day sessions. Consequently, reducing the energy density of the diet by 30% led to a 30% reduction in energy intake. Despite the substantial reduction in energy intake, subjects rated themselves equally full. In addition to reducing the energy density of main courses, research shows that another practical approach to moderate energy intake is to consume a low-energy-dense food such as salad or soup at the start of a meal (11, 12).

In practice, low-energy-dense foods are an important part of a variety of healthy eating patterns. Examples include those discussed in *Dietary Guidelines for Americans 2005* (13) and found on MyPyramid.gov (14), both of which recommend *getting the most nutrition for your calories*; spelled out in the Dietary Approaches to Stop Hypertension (DASH) Diet (15), which advises eating more fruits and vegetables (9-12 servings/day), low-fat dairy foods (2-3 servings per day) and keeping intake of fat to less than 25% of calories; and outlined in modified-carbohydrate diets that encourage eating carbohydrates that are slowly digested and absorbed, such as fiber-rich vegetables, fruits, beans and whole grains, as well as choosing lean protein, lower-fat dairy foods and mostly unsaturated fats (16).

### ***Low-Energy-Dense Diets and Managing Body Weight***

Observational studies suggest that the energy density of the diet

is related to body weight (7, 8). However, stronger evidence regarding the influence of energy density reduction on body weight is provided by long-term clinical interventions. Rolls and colleagues (17) found that incorporating a single low-energy-dense food into a reduced-energy diet was sufficient to reduce the overall energy density of the diet and increase weight loss. In this year-long study with overweight and obese individuals, weight loss among those consuming two servings of low-energy-dense soup per day was 50% greater (16 versus 11 lb) than among those consuming two servings of high-energy-dense snacks daily.

Taking a broader dietary approach, Ello-Martin and colleagues (6) found that advice to reduce the energy density of the diet was effective in achieving weight loss. In this study, one group of obese women was counseled to decrease the energy density of their diet by increasing consumption of fruits and vegetables and choosing reduced-fat foods (RF/FV). A comparison group was counseled only to choose reduced-fat (RF) foods. Participants in both groups lost weight without receiving specific goals for intake of energy or fat. After 12 months, the group counseled to eat more fruits and vegetables had a greater reduction in the energy density of their diet and lost more weight (17.4 vs. 14.1 lb). Over the course of the year, participants who ate the lower-energy-dense diet reported consuming an average of 25% more food and reported less hunger than those in the comparison group. Detailed food intake records completed by study participants also showed that energy intake during the intervention decreased significantly from baseline values for both groups (from 1836 ± 68 kcal at baseline to 1307 ± 62 kcal at 12 months for the RF group; from 1937 ± 78 kcal at baseline to 1437 ± 60 at 12 months for the RF/FV group). However, given variability of reported energy intakes, there were no significant differences between the groups that corresponded with the differences in weight loss.

Weight loss is not the only beneficial change associated with reducing dietary energy density. Ledikwe and colleagues (18) recently used data from a large intervention study to examine the relationship between changes in energy density and changes in diet quality. In this study, participants received one of three life-style interventions to reduce blood pressure. After six months, participants with a large reduction in energy density lost more weight (13 lb), than those with a modest reduction (9 lb) or those with a slight reduction in energy density (5 lb). In addition to weight loss, reductions in energy density were associated with improved diet quality. Both large and modest

reductions in energy density were associated with increased intakes of fruits, vegetables, fiber, vitamins and minerals, indicating that reductions in dietary energy density are a healthy weight management strategy.

Studies investigating relationships between dietary energy density and the *maintenance* of weight loss are beginning to appear in the literature. Greene and colleagues (19) examined energy density values two years after participation in a weight loss program that encouraged consumption of low-energy-dense foods. The researchers found that individuals who maintained weight loss had a lower-energy-dense diet than those who regained 5% or more of their body weight. While additional long-term studies are required to understand the impact of reduced-energy-density diets on weight maintenance, these initial findings are promising.

### ***Practical Approaches to Lowering the Energy Density of the Diet***

Palatability and food preferences play critical roles in food selection. Helping people modify the energy density of their existing diet may increase the likelihood of achieving lasting changes. Here are several general steps that your clients can take to build a healthy eating plan that is low in energy density:

- Incorporate generous portions of low-energy-dense **fruits and vegetables** into meals, appetizers and/or snacks. **Broth-based soups**, which are also low in energy density, are filling, relatively low-calorie food choices.
- Round out meals by adding **nutritious starchy vegetables, whole grains, legumes, lean meats and low-fat dairy foods**. These foods are important for creating a healthy, balanced diet.
- Pay attention to frequency of consumption and portion sizes of **foods with little moisture or fiber, higher-fat foods such as fried foods, full-fat dairy foods and fatty cuts of meat, sweets and high-calorie beverages**. These foods provide a higher number of calories relative to their weight and can easily be over-consumed. Such options can be part of a healthy diet when consumed occasionally in appropriate portions.

Additional specific strategies that can help people lower the energy density of their diet include:

- **Lower the energy density of frequently eaten foods.** The energy density of many foods can be lowered with slight modifications that are unlikely to compromise palatability. Suggest adding a variety of vegetables (e.g., spinach, carrots, zucchini, broccoli, etc.) to omelets, lasagna, pizza, chili, soups and other hot dishes. Promote using lower-fat meats and cheeses or smaller amounts of higher-fat ingredients.
- **Substitute foods lower in energy density for items higher in energy density.** Encourage people to identify some of the high-energy-dense foods they eat at meals and snacks and help them come up with enjoyable alternatives that are lower in energy density.
- **Prepare fruits, vegetables and other foods without excess fat and sugar.** Frying vegetables or topping them with butter or cream sauce increases their energy density. The same holds true for fruits with added sugar, syrup or fat. Suggest ways to prepare and serve vegetables with little or no added fat (e.g., blanching, steaming, “sautéing” in broth, broiling, grilling, seasoning with herbs and spices). Encourage clients to choose ripe “in-season” fresh fruits, frozen fruits without added sugars or canned fruits packed in natural juice.
- **Choose meats and cheeses that are lower in fat.** Advise clients to select “extra lean” or “lean” meat and poultry and fat-free or low-fat milk and dairy products. Also offer tips for lower-fat preparation methods.
- **Start a meal with a low-energy-dense appetizer.** Teach clients to pay attention to satiety cues. For example, taking time to enjoy a broth-based soup or crisp green salad at the start can help reduce overall calorie intake at that meal.
- **Keep low-energy-dense foods on hand.** Having low-energy-dense foods accessible makes it easier to choose these options at meals or for snacks.

An important key to successful weight management is the ability to sustain behavior change over time in order to align energy intake with energy needs. Incorporating low-energy-dense foods as a significant component of a healthy eating plan is one way to help clients achieve their weight loss and maintenance goals.

### Further Reading:

For information your clients can use to learn how food labels can help with weight management efforts, visit the US Food and Drug Administration's interactive website *Make Your Calories Count: Use the Nutrition Facts Label for Healthy Weight Management*: <http://www.cfsan.fda.gov/~ear/hwm/labelman.html>.

For information on the benefits of improving body weight, visit [http://www.kraftfoods.com/health/knu/knu\\_sp\\_03\\_prof\\_article.pdf](http://www.kraftfoods.com/health/knu/knu_sp_03_prof_article.pdf).

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