



Can eating fruits and
vegetables help people
to manage their weight?



DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION





There are many proposed strategies for losing or maintaining weight.

This presentation looks at only one strategy: substituting low-energy-dense fruits and vegetables for foods with high energy density in order to lower the number of calories consumed.

References to all studies are in “Can fruits and vegetables help people to manage their weight?” in the CDC Web site:

www.cdc.gov/nccdphp/dnpa and in the notes in this electronic PowerPoint presentation.



What Is Energy Density?

It is the relationship of calories to weight of food (i.e., calories per gram).

All foods are in one of three categories:

- ◆ ***High-energy-dense foods:*** 4-9 calories per gram (e.g., cookies, crackers, butter, bacon)
- ◆ ***Medium-energy-dense foods:*** 1.5-4 calories per gram (e.g., bagels, dried fruits, hummus, part-skim mozzarella)
- ◆ ***Low-energy-dense foods:*** 0.0-1.5 calories per gram (e.g., most fresh fruits and vegetables, fat-free yogurt, broth-based soups)



Dietary Guidelines for Americans (2005)

“...calorie-lowering strategies include eating foods that are low in calories for a given measure of food (e.g., many kinds of vegetables and fruits and some soups).”

“...make substitutions to avoid excessive calorie intake.”



Volume, Density, and Calories in Weight Management

- ◆ Feeling full is one reason people stop eating.
- ◆ Volume affects the feeling of being full.
- ◆ Low-energy-dense foods have fewer calories than the same volume of high-energy-dense foods. People who eat low-energy-dense foods can feel full while eating fewer calories.
- ◆ Water and fiber increase volume and reduce energy density.
- ◆ Fruits and vegetables have high water and fiber content and are relatively low in calories and energy density.

Conclusion: Fruits and vegetables are good substitutes for high-energy-dense foods in a weight management program.




So how do people lose weight?

- ◆ To lose weight people must consume fewer calories than they expend.

Eating fewer calories is difficult, but feeling full is one reason that people stop eating.

- ◆ The amount or volume of food a person eats prompts a feeling of being full.




One study* provides evidence that feeling full is more likely to make a person stop eating than than the total calories consumed.

- ◆ For 5 days, 20 participants ate as much as they wanted from food offered to them over 5 days.
- ◆ The diet alternated from low-energy-dense to high-energy-dense foods.

Result:

The participants felt full on the low-energy-density diet after eating just over half the calories (1570 kcal) they consumed before feeling full on the high-energy-density diet (3000 kcal).

* Duncan KH, Bacon JA, Weinsier RL. The effects of high and low energy density diets on satiety, energy intake, and eating time of obese and nonobese subjects. *Am J Clin Nutr* 1983;37:763-7.



Eating low-energy-dense foods = Fewer calories consumed than when eating high-energy-dense foods, but feeling equally full

- ◆ For 2 days, researchers provided meals and snacks for 2 days to women who were assigned to a low-, medium-, or high-calorie menu.
- ◆ The women in each group ate until they were full.
- ◆ All groups of women ate a similar amount, or volume, of food.
- ◆ The study suggests that the volume of food, not calories, makes people feel full.

Bell EA, Castellanos VH, Pelkman CL, Thorwart ML, Rolls BJ. Energy density of foods affects energy intake in normal-weight women. *Am J Clin Nutr* 1998;67:412-420.



Volume affects energy density and the feeling of being full.*

- ◆ Yogurt milkshakes were given 30 minutes before lunch on 3 different days.
- ◆ The shakes came in three sizes: 300 mL, 450 mL, and 600 mL, BUT had equal calories. (Higher volumes were achieved by incorporating air.)
- ◆ Participants consumed 12% fewer calories at lunch after drinking the 600 mL milkshake.
- ◆ Participants reported greater feelings of fullness after drinking the 450 ml milkshake or the 600 ml milkshake than after the 300 ml drink.

*Rolls BJ, Bell EA, Waugh BA. Increasing the volume of a food by incorporating air affects satiety in men. *Am J Clin Nutr* 2000;72:361-368.



Water, Energy Density, and the Feeling of Being Full

On 3 different days during a 4-week study*

- ◆ 24 women ate the same foods over 3 days, but prepared differently each day
- ◆ Day 1: chicken-rice casserole (1 1/3 cups).
- ◆ Day 2: chicken-rice casserole (1 1/3 cups) with a glass (8 oz.) water.
- ◆ Day 3: chicken-rice soup (2½ cups) made by adding 8 oz. water into the casserole ingredients used the previous day.

Eating the soup (compared to the foods on other days)

- Significantly increased the feeling of being full.
- Reduced the participants' hunger.
- Significantly reduced the number of calories the women consumed during lunch.


*Rolls BJ, Bell EA, Thorwart ML. Water incorporated into a food but not served with a food decreases energy intake in lean women. Am J Clin Nutr 1999;70:448-55.



A literature review* found similar findings:

- ◆ Short-term studies: Low-energy-dense foods promoted feeling full, reduced hunger, and provided fewer calories.
- ◆ Long-term studies: Low-energy-dense foods promoted moderate weight loss.
- ◆ Studies lasting longer than 6 months: Weight loss was three times greater for people who ate foods of low energy density than for those who simply ate low-fat foods.

*Yao M, Roberts SB. Dietary energy density and weight regulation. Nutr Rev 2001;59:247-58.



Fruits and Vegetables = Low Energy Density

- ◆ Fat increases the energy density of foods.
- ◆ Water and fiber in foods increase volume and reduce energy density.
- ◆ In their natural state, fruits and vegetables have high water and fiber content and are low in fat and energy density.

The USDA's Web site on food composition (www.nal.usda.gov/fnic/foodcomp) lists water and fiber content, as well as other food components, including calories, for hundreds of vegetables and fruits.



Studies* with fruit and fruit juices show:

- ◆ Whole fruit is more satiating.
- ◆ Whole fruit contains fiber, and juice is fiber-free.

*Haber GB, Heaton KW, Murphy D, Burroughs LF. Depletion and disruption of dietary fibre. Effects on satiety, plasma-glucose, and serum insulin. *Lancet* 1977;2:679-88.

*Bolton RP, Heaton KW, Burroughs LF. The role of dietary fiber in satiety, glucose, and insulin: studies with fruit and fruit juice. *Am J Clin Nutr* 1981;34:211-17.



Vegetables, Fiber, Water, and Feeling Full

In a series of studies* by Gustafsson and colleagues:

- ◆ Researchers found that adding vegetables (carrots and spinach) to meals but keeping the same number of calories enhanced the feeling of being full if at least 200 g of vegetables were added.
- ◆ Ratings of fullness were correlated positively with the fiber content, water content, and total weight of the meal.

*Gustafsson K, Asp N-G, Hagander B, Nyman M. Effects of different vegetables in mixed meals on glucose homeostasis and satiety. *Eur J Clin Nutr* 1993;47:192-200.

Gustafsson K, Asp N-G, Hagander B, Nyman M. Dose-response effects of boiled carrots and effects of carrots in lactic acid in mixed meals on glycaemic response and satiety. *Eur J Clin Nutr* 1994;48:386-96.

Gustafsson K, Asp N-G, Hagander B, Nyman M. Satiety effects of spinach in mixed meals: comparison with other vegetable. *Int J Food Sci Nutr* 1995;46:327-34.

Gustafsson K, Asp N-G, Hagander B, et al. Influence of processing and cooking of carrots in mixed meals on satiety, glucose and hormonal response. *In J Food Sci Nutr* 1995;46:3-12.



Dietary Fiber and Weight Management

- ◆ In a review* of 22 studies, 20 studies found that high-fiber diets resulted in weight loss.
- ◆ Even in studies that did not restrict food intake, participants on high-fiber diets lost significantly more weight than those on the low-fiber diets.
- ◆ An increase of 14 g of fiber per day was associated with an average weight loss of more than 4 lb. within nearly 4 months, based on pooled data from 12 studies.


*Howarth NC, Saltzman E, Roberts SB. Dietary fiber and weight regulation. Energy density of foods affects energy intake across multiple levels of fat content in lean and obese women. *Am J Clin Nutr* 2001;73:1010-18.

Review* of Dietary Intervention Studies

Many studies have found that significant weight loss can occur when advice to increase the intake of fruits and vegetables is coupled with advice to reduce energy intake.

*Rolls BJ, Ello-Martin JA, Tohill BC. What can intervention studies tell us about the relationship between fruit and vegetable consumption and weight management? *Nutr Reviews* 2004;62:1-17.






Intervention 1: MRFIT*

Multiple Risk Factor Intervention Trial

- ◆ Participants were advised to reduce their fat intake and increase consumption of fruits and vegetables and whole grains to help them lose weight and improve their blood lipids and blood pressure.
- ◆ Increases in fruit and vegetable intake were related to maintenance of weight loss.
- ◆ Participants who lost more weight ate more fruits and vegetables than the others.

*Dolecek TA, Stamler J, Caggiula AW, et al. Methods of dietary and nutritional assessment and intervention and other methods in the Multiple Risk Factor Intervention Trial. *Am J Clin Nutr* 1997;65(suppl 1):196S-201S.



Intervention 2: Reduced Calories, Low Fat, and High Complex Carbohydrates*

- ◆ Allowed unlimited fruits and vegetables for 6 months.
- ◆ 147 (69%) of the 213 adult participants lost weight (average: 14 lb).
- ◆ During 25 months of follow-up—
 - 53% of the participants continued to lose or maintain their weight.
 - The mean net weight loss from pretreatment to the end of follow-up was more than 17 lb.

*Fitzwater SL, Weinsier RL, Wooldridge NH, et al. Evaluation of long-term weight changes after a multidisciplinary weight control program. J Am Diet Assoc 1991;91:421-4.



Intervention 3: Families with Obese Parents and a Nonobese Child*

- ◆ Parent-focused behavioral intervention.
- ◆ Two groups: Both had a comprehensive behavioral program.
 - One group increased fruit and vegetable consumption.
 - Second group decreased their intake of high-fat and high-sugar foods.
- ◆ Materials for the children targeted the same dietary changes as for their parents, but with no calorie restrictions.

After 1 year:

- Parents in the increased fruit and vegetable group experienced greater decreases in weight than parents in the decreased fat and sugar group.
- Parents and children in the increased fruit and vegetable group also decreased consumption of high-fat and high-sugar foods.

*Epstein LH, Gordy CC, Raynor HA, Beddome M, Kilanowski CK, Paluch R. Increasing fruit and vegetable intake and decreasing fat and sugar intake in families at risk for childhood obesity. *Obesity Res* 2001;9(3):171-8.



Intervention 4: Increased Fruits and Vegetables with Decreased Fat Intake*

- ◆ Participants consumed a daily diet that included specific amounts of fruits, vegetables, juice and fiber, and provided 15%-20% of energy from fat.

After 1 year:

- ◆ Energy-adjusted intake of vegetables and dietary fiber, but not fruit, was associated with a decrease in body mass index (BMI).
- ◆ A decrease in percent energy from fat was not associated with a drop in BMI.

*Rock CL, Thomson C, Caan BJ, et al. Reduction in fat intake is not associated with weight loss in most women after breast cancer diagnosis: evidence from a randomized controlled trial. *Cancer* 2001;91:25-34.

Intervention 5: Polyp Prevention Trial*

Participants who increased their intake of fruits and vegetables and decreased their fat intake lost a significant amount of weight in 1 year.

*Lanza E, Schatzkin A, Daston C, et al. Implementation of a 4-y, high-fiber, high-fruit-and-vegetable, low-fat dietary intervention: results of dietary changes in the Polyp Prevention Trial. *Am J Clin Nutr* 2001;74:387-401.





Intervention 6: Cardiac Trials— Lower Fat and Increased Fruits and Vegetables

In a series of trials, cardiac patients who changed their diets by lowering their fat intake and increasing their consumption of fruits and vegetables lost a significant amount of weight.

*Singh RB, Rastogi S, Verma R, et al. Randomised controlled trial of cardioprotective diet in patients with recent acute myocardial infarction: results of a one year follow up. *Br Med J* 1992;304:1015-9.

Singh RB, Rastogi S, Niaz MA, et al. Effect of fat-modified and fruit- and vegetable-enriched diets on blood lipids in the Indian Diet Heart Study. *Am J Cardiol* 1992;70:869-74.

Singh RB, Dubnov G, Niaz MA, et al. Effect of an Indo-Mediterranean diet on progression of coronary artery disease in high risk patients (Indo-Mediterranean Diet Heart Study): a randomized single-blind trial. *Lancet* 2002;360:1455-61.



Research Review

- ◆ Very few studies examined a direct relationship between eating fruits and vegetables and losing weight.
- ◆ Some studies had few participants.
- ◆ Many studies focused on fruits and vegetables in the context of treating high blood pressure or cardiac disease—but also reported on weight loss.
- ◆ Some studies examined the short-term impact of eating fruits and vegetables on energy intake.



Summary:

- ◆ Feeling full cues people to stop eating.
- ◆ People feel full based on the volume of food consumed, not necessarily on the number of calories in the food.
- ◆ Eating low-energy-dense foods can help people feel full with fewer calories.
- ◆ Replacing foods of high energy density (high calories per weight of food) with foods of low energy density, such as fruits and vegetables, can be an important part of a weight management strategy.



Tips for Eating Fruits and Vegetables in a Weight Management Program

- ◆ Fruits and vegetables should be substituted for foods high in energy density.

Tips for Eating Fruits and Vegetables in a Weight Management Program

- ◆ To lower the energy density of foods, such as soups, sandwiches, and casseroles, substitute fruits and vegetables for some of the ingredients that have higher energy density, such as high-fat meat, cheese, and pasta.



Tips for Eating Fruits and Vegetables in a Weight Management Program:

- ◆ Breading and frying vegetables or adding high-fat dressings and sauces greatly increase the calorie and fat content of the dish.
- ◆ Some desserts that include fruit may also have high calorie, fat, and sugar content.



Tips for Eating Fruits and Vegetables in a Weight Management Program

- ◆ Eat whole fruit instead of drinking juice.
- ◆ Frozen and canned fruits and vegetables are good options when fresh produce is not available. Choose items without added sugar, syrup, cream sauces, or salt.



Tips for Eating Fruits and Vegetables in a Weight Management Program

- ◆ Vegetables tend to be lower in calories than fruit. Substituting more vegetables than fruit for foods of higher energy density can be helpful in a weight management plan.

