

# Diets for Cardiovascular Disease Prevention: What Is the Evidence?

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Patients often initiate commercial dietary plans to reduce obesity and prevent cardiovascular disease. Such plans include very low-carbohydrate, low-carbohydrate, very low-fat, and Mediterranean diets. Published evidence on several popular diets has made it easier for physicians to counsel patients about the health benefits and risks of such plans. Although the Atkins, Zone, Sugar Busters!, and South Beach diets have data proving that they are effective for weight loss and do not increase deleterious disease-oriented outcomes, they have little evidence of patient-oriented benefits. In contrast, the Mediterranean diet has extensive patient-oriented outcome data showing a significant risk reduction in mortality rates and in rates of fatal and nonfatal myocardial infarction. The American Heart Association released guidelines in 2006 that integrate recommendations from a variety of diets into a single plan. Physicians should emphasize diets that are rich in fruits, vegetables, and healthful fatty acids and that limit saturated fat intake. A stepwise individualized patient approach, with incorporation of one or two dietary interventions every three to six months, may be a practical way to help reduce a patient's cardiovascular disease risk. (*Am Fam Physician*. 2009;79(7):571-578. Copyright © 2009 American Academy of Family Physicians.)

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► **Patient information:** A handout on a heart-healthy diet, written by the authors of this article, is available at <http://www.aafp.org/afp/20090401/571-s1.html>.

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**I**ncreases in obesity rates and in the prevalence of obesity-related illness have made dietary counseling an integral part of medical care.<sup>1</sup> Patients often use commercial dietary plans to reach their weight-loss goals. Although some of these diets make unfounded claims, many of the more publicized plans have been studied in randomized, controlled settings. Focused counseling on the risks and benefits of these diets may be beneficial in helping patients reach their goals.

Many commercial diets can be subdivided into four categories based on the combinations of macronutrients recommended: very low-carbohydrate, low-carbohydrate, very low-fat, and Mediterranean diets (*Table 1*).<sup>2-32</sup> The more restrictive diets include very low-carbohydrate, low-carbohydrate, and very low-fat diets. These plans modify the typical macronutrient ratios by increasing or decreasing the intake of dietary fat, carbohydrate, and protein. Less restrictive diets, such as the Mediterranean diet and American Heart Association (AHA) dietary guidelines,<sup>32</sup>

aim to increase the intake of beneficial fatty acids, fiber, fruits, and fresh vegetables.

A useful approach to analyzing these diets includes an evaluation of the evidence for weight loss, disease-oriented outcomes, and patient-oriented outcomes.

## Very Low-Carbohydrate Diets

Dr. Robert Atkins published the first version of the Atkins diet in 1972.<sup>2</sup> This plan is a very low-carbohydrate diet that does not require calorie counting or portion limitation. It consists of four phases, with strict carbohydrate restriction in the initial phase (less than 20 g per day). Each consecutive phase permits increased carbohydrate intake, using weight loss as the goal for progression. The effectiveness of the diet is attributed to increased fat metabolism and satiety caused by carbohydrate restriction and subsequent ketosis.

## DISEASE-ORIENTED OUTCOMES

Very low-carbohydrate diets have been studied extensively.<sup>3-9,33</sup> Most of the randomized

**SORT: KEY RECOMMENDATIONS FOR PRACTICE**

| <i>Clinical recommendation</i>  | <i>Evidence rating</i> | <i>References</i> |
|---|------------------------|-------------------|
| Very low-carbohydrate diets are more effective than low-fat diets for short-term weight loss (six months or less) and do not cause adverse lipid profile changes. | B                      | 2-11              |
| A very low-fat diet, in combination with smoking cessation, exercise, and meditation, may improve cardiac perfusion and decrease angina symptoms.                 | B                      | 9, 11, 16-22      |
| The Mediterranean diet confers morbidity and mortality benefits in patients with known cardiovascular disease.  | A                      | 23-31             |
| The American Heart Association 2006 diet and lifestyle recommendations consist of evidence-based dietary interventions that lower cardiovascular risk.            | C                      | 32                |

*A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, go to <http://www.aafp.org/afpsort.xml>.*

controlled trials (RCTs) had small cohorts and lasted less than one year. Attrition rates were high, with 12 to 40 percent of participants discontinuing the intervention diet. A large meta-analysis of very low-carbohydrate diets evaluated six trials with 447 overweight participants (body mass index [BMI] greater than 25 kg per m<sup>2</sup>).<sup>33</sup> In most cases, the control diet was a low-fat, calorie-restricted plan.

Although all participants lost weight, those following the low-carbohydrate plan had improved weight loss at six months, but no difference at 12 months. Of note, there was no significant difference in levels of low-density lipoprotein (LDL) between the diets. High-density lipoprotein (HDL) and triglyceride levels improved at six and 12 months in very low-carbohydrate dieters.

**Table 1. Components of Selected Diets for Cardiovascular Health**

| <i>Diet</i>   | <i>Commercial examples</i>                 | <i>Calorie restriction?</i> | <i>Fat intake</i>                      | <i>Fruit and vegetable intake</i> |
|---|--|-----------------------------|--|-----------------------------------|
| Very low-carbohydrate <sup>2-11</sup>                   | Atkins diet                                | No                          | Unlimited                              | Severely limited                  |
| Low-carbohydrate/ low-glycemic index <sup>9,11-15</sup> | South Beach Diet, the Zone, Sugar Busters! | No                          | Unlimited                              | Limited                           |
| Very low-fat <sup>9,11,16-22</sup>                      | Ornish diet                                | No                          | Less than 10 percent of total calories | Vegetarian-based diet             |
| Mediterranean diet <sup>23-31</sup>                     | NA   | No                          | Unlimited                              | Unlimited                         |
| American Heart Association guidelines <sup>32</sup>     | NA   | Yes                         | Unlimited                              | Unlimited                         |

*HDL = high-density lipoprotein; NA = not applicable; TLC = Therapeutic Lifestyle Changes. Information from references 2 through 32.*

A recent RCT of 311 premenopausal women showed greater mean weight loss at one year in participants following the Atkins diet (4.7 kg [10 lb, 6 oz]) compared with dieters using the Zone (low-carbohydrate; 1.6 kg [3 lb, 8 oz]), Ornish (very low-fat; 2.2 kg [4 lb, 14 oz]), and LEARN (Lifestyle, Exercise, Attitudes, Relationships, and Nutrition; low-carbohydrate; 2.6 kg [5 lb, 12 oz]) diets.<sup>9</sup> LDL levels were significantly reduced in the Atkins group, with no reduction in HDL levels or blood pressure. Insulin and fasting glucose levels did not differ among groups. Other studies have shown greater weight loss with very low-carbohydrate diets compared with low-fat plans in the first six months of use.<sup>3-6,33</sup>

#### PATIENT-ORIENTED OUTCOMES

No studies have measured differences in morbidity, mortality, or cardiovascular outcomes associated with a very low-carbohydrate diet. A recent analysis of a Swedish female cohort showed an increase in overall mortality rates among women with increased

protein and decreased carbohydrate intake.<sup>10</sup> However, concerns about the risk of coronary heart disease (CHD) may apply only to very low-carbohydrate diets that are high in fat and protein from animal sources. Very low-carbohydrate diets with fat and protein from vegetable sources may have a small beneficial effect on cardiac risk.<sup>34</sup> Patient-oriented outcomes are limited by the need for long-term follow-up and by noncompliance. Theoretic concerns about elevated LDL levels, accelerated heart disease, and ketoacidosis have not come to fruition.

#### Low-Carbohydrate Diets

There are many low-carbohydrate diets, including Sugar Busters!, the Zone diet, and the South Beach Diet.<sup>12-14</sup> Many of these programs are based on the glycemic index, which is a measure of serum blood glucose response to the ingestion of 50 g of a given food. Foods with a higher glycemic index cause a more rapid increase in postprandial blood glucose and insulin levels over two

| <i>Saturated and trans-fat intake</i>  | <i>Challenges</i>  | <i>Summary</i>   |
|--|--|--|
| Unlimited, but discouraged   | Requires urine ketone monitoring   | No patient-oriented outcomes or long-term data; may improve triglyceride and HDL levels; better for short-term weight loss |
| Limited  | Requires knowledge of glycemic index   | Offers sound principles without ample patient-oriented data  |
| None   | Requires meditation, vegetarian diet, smoking cessation                              | Perfusion improvements and symptom reductions; very strict diet; lowers HDL levels   |
| Limited  | Costly, limited in some populations because of lack of produce or fatty acid sources | Excellent mortality data, but limited study populations  |
| Saturated fat: less than 7 percent of total calories<br><i>Trans-fat</i> : Less than 1 percent of total calories | Broad guidelines   | Same as TLC Diet, but with a greater emphasis on overall cardiovascular risk reduction and population health improvements  |

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hours. Many low-carbohydrate diets advocate the use of healthier sources of dietary fat. Of the commercial low-carbohydrate diets, the Zone and South Beach plans are the only ones that have been studied in randomized, controlled settings.

### DISEASE-ORIENTED OUTCOMES

A 2004 trial compared the South Beach Diet with the National Cholesterol Education Plan (NCEP) diet over 12 weeks.<sup>35</sup> Participants following the South Beach Diet lost 2.8 kg (6 lb, 2 oz) more than those following the NCEP plan. There was no difference in lipid levels between the groups. In a one-year comparison trial of commercial diets, participants following the Zone diet lost weight and had improved HDL, LDL, and triglyceride levels.<sup>11</sup> The improvements were modest and comparable to those in participants following the Ornish, Weight Watchers, and Atkins diets (although Atkins dieters did not have LDL improvements in this study). Large population-based trials show that diets with a higher glycemic index are associated with lower HDL levels, a risk factor for cardiovascular disease.<sup>15</sup>

### PATIENT-ORIENTED OUTCOMES

No studies of low-carbohydrate diets have measured patient-oriented outcomes.

### Very Low-Fat Diets

Very low-fat diets were developed in response to the correlation between saturated fat intake and coronary atherosclerosis.<sup>23</sup> These diets typically limit dietary fat intake to levels much lower than those of traditional low-fat diets. The most well-studied plan is the Ornish diet, which integrates a vegetarian diet with a fat intake of 10 percent of total calories.<sup>17</sup> The program also integrates exercise, meditation (one to two hours per day), and smoking cessation. Study groups following the diet were also advised against using alcohol or caffeine.

### DISEASE-ORIENTED OUTCOMES

Favorable pilot study findings spurred a long-term evaluation of the Ornish diet.<sup>19</sup> All participants were men diagnosed with coronary artery disease (CAD). The initial three-week

pilot study showed reductions in total cholesterol levels and a trend toward improved cardiac ejection fraction. However, HDL levels decreased by 20 percent. A five-year RCT of 48 patients with angiography-proven CHD showed that the diet lowered LDL levels by approximately 20 percent.<sup>20</sup> Triglyceride and HDL levels were unchanged. Dieters lost an average of 5.8 kg (12 lb, 13 oz) of body weight compared with no change in the control group. Myocardial perfusion improved in the intervention group, with an average improvement in vessel stenosis of 8 percent compared with a 27 percent worsening in the control group.<sup>21</sup>

### PATIENT-ORIENTED OUTCOMES

Study participants following the Ornish diet had a 91 percent decrease in angina symptoms at one year and a 72 percent decrease at five years.<sup>20</sup> The control group had a 186 percent increase in angina symptoms at one year and a 36 percent decrease at five years. The reduction at five years was attributed to greater rates of bypass surgery and angioplasty in the control group.

### Mediterranean Diet

The Mediterranean diet first gained interest when the Seven Countries Study showed low cardiovascular mortality rates in a cohort from Crete despite high levels of dietary fat intake (35 to 40 percent of total calories).<sup>23,24</sup> Although the diet has many commercial iterations, it consists of several principal components (*Table 2*).

**Table 2. Basic Components of the Mediterranean Diet**

|  |
|--|
| Plant-based foods (e.g., fruits, vegetables, breads, cereals, potatoes, legumes, nuts) |
| Locally grown, minimally processed food  |
| Fish and poultry   |
| Infrequent red meat intake   |
| Up to four whole eggs per week   |
| Moderate amount of dairy products  |
| Olive oil as the principal source of fat   |
| Moderate amount of red wine with meals   |
| Desserts primarily of fresh fruits   |

**DISEASE-ORIENTED OUTCOMES**

Disease-oriented outcomes from studies of the Mediterranean diet have been mixed. Several trials have shown improvements in LDL, HDL, C-reactive protein, and insulin levels in persons following the diet.<sup>36,37</sup> Other studies, however, have shown minimal improvements in these markers.<sup>27,38</sup> This lack of consistency among study results has been supplanted by strong patient-oriented evidence.

**PATIENT-ORIENTED OUTCOMES**

The Mediterranean diet has been extensively evaluated for its role in the reduction and prevention of CAD. This focus on patient-oriented outcomes differentiates it from other diets that focus on disease-oriented outcomes. The Lyon Diet Heart Study was a prospective RCT of 300 patients that evaluated the effectiveness of the Mediterranean diet in the secondary prevention of coronary disease.<sup>27</sup> Participants in the Mediterranean diet group supplemented with alpha-linoleic acid, a common source of omega-3 fatty acids. Those in the control group followed a standard low-fat diet.

After 27 months, there were no significant differences between the groups in serum lipid levels, blood pressure, or BMI.<sup>27</sup> However, the Mediterranean diet group had a 73 percent relative risk (RR) reduction for fatal and non-fatal myocardial infarction (MI) and a 70 percent RR reduction for overall mortality. There also was a significant RR reduction for the following end points: angina, stroke, heart failure, pulmonary embolism, and deep venous thrombosis. These findings were independent of total cholesterol levels, systolic blood pressure, male sex, and aspirin use. High levels of serum alpha-linoleic acid were associated with improved outcomes. After 46 months, dietary compliance was greater than 70 percent.

Similar results were found in the GISSI (Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto) trial, which showed that supplementation with n-3 polyunsaturated fatty acids (fish oil) after MI reduced the risk of MI recurrence, stroke, and death by 10 percent.<sup>28</sup> Differences between the groups were noted within three months of the beginning of the study. Another study showed decreased MI

rates in high-risk patients following a Mediterranean diet supplemented with soybean and mustard seed oils.<sup>29</sup> These findings suggest that Mediterranean dietary benefits can be replicated without the stringent use of regional Mediterranean foods. The mechanism for this risk reduction is unclear, but some studies suggest decreases in inflammation associated with poly- and monounsaturated fat intake<sup>39</sup> and increases in HDL levels.<sup>30</sup>

The first U.S. investigation of the Mediterranean diet was published as part of the National Institutes of Health–AARP Diet and Health Study.<sup>40</sup> It showed an inverse association between adherence to a Mediterranean-style diet and cardiovascular disease, cancer, and overall mortality rates. These effects were greatest in patients who smoked. The results of this trial warrant further investigation using a randomized, controlled approach.

Implementation of the Mediterranean diet in the United States presents several challenges, including the expense of increased fruit and vegetable intake compared with inexpensive processed foods.<sup>31</sup>

**AHA Dietary Guidelines**

The 2006 AHA dietary guidelines aim to integrate multiple dietary and lifestyle interventions (*Table 3*).<sup>32</sup> These guidelines have not been studied, but they incorporate many patient-oriented recommendations, including an increased intake of fruits, vegetables, healthful fats, and fiber. Limited salt, sugar, and *trans*-fat intake is also an integral part of these guidelines. Many diets fulfill these guidelines, including the TLC (Therapeutic Lifestyle Changes) Diet published by the National Heart, Lung, and Blood Institute.<sup>41</sup> These guidelines offer physicians a fairly complete list of evidence-based dietary initiatives that patients can undertake in a stepwise fashion.

**Putting It into Practice**

Effective dietary counseling is difficult within the constraints of a typical outpatient visit. Clinical knowledge of popular commercial diets can make it easier for physicians to offer nonbiased, specific patient recommendations. Although all of the diets discussed in this article have some disease-oriented

**Table 3. American Heart Association Lifestyle Interventions**

| <i>Intervention</i>  | <i>Improves lipid profile?</i> | <i>Improves morbidity and/or mortality rates?</i> |
|--|--------------------------------|---|
| Count calories to achieve a hypocaloric diet (for weight loss)                                       | Yes                            | Yes   |
| Increase aerobic exercise to 30 minutes or more on most days; increase to 60 minutes for weight loss | Yes                            | Yes   |
| Increase intake of fresh fruits and vegetables (not juice)   | Yes                            | Yes   |
| Increase intake of whole grains and other high-fiber foods   | Yes                            | Unknown   |
| Consider plant stanol supplementation  | Yes                            | Unknown   |
| Consume oily fish twice per week   | Yes                            | Yes   |
| Increase intake of healthful fats (e.g., olive oil, canola oil, nuts)                                | Yes                            | Yes   |
| Supplement with omega-3 fatty acids in persons who do not eat fish                                   | Yes                            | Unknown   |
| Limit saturated and <i>trans</i> -fatty acids  | Yes                            | Yes   |
| Limit alcohol intake to two drinks per day in men and one drink per day in women                     | No                             | Yes*  |
| Limit salt intake to 2 g per day   | No                             | Yes (in persons with high blood pressure)         |
| Minimize sugar intake  | Yes                            | Unknown   |
| Use caution when eating outside of the home  | Unknown                        | Unknown   |

\*—Alcohol abstinence may increase cardiovascular risk. One drink is equivalent to 1.5 oz of 80-proof liquor, 5 oz of wine, or 12 oz of beer. Information from reference 32.

**Table 4. Cardiovascular-Related Outcomes of Selected Diets**

| <i>Diet type</i>                      | <i>LDL</i>             | <i>HDL</i> | <i>Triglycerides</i> | <i>Cardiovascular events</i> | <i>BMI</i> | <i>Strength of evidence for cardiovascular outcomes</i> | <i>References</i> |
|---------------------------------------|------------------------|------------|----------------------|------------------------------|------------|---|-------------------|
| Very low-carbohydrate                 | No change              | Increase   | Decrease             | No data                      | Decrease   | C   | 2-11              |
| Low-carbohydrate/low-glycemic index   | No change              | No change  | No change            | No data                      | Decrease   | C   | 17-20, 22         |
| Very low-fat                          | Decrease               | Decrease   | Decrease             | Decrease                     | Decrease   | B   | 9, 11, 16-22      |
| Mediterranean diet                    | Decrease/<br>no change | Increase   | Decrease             | Decrease                     | No change  | A   | 23-31             |
| American Heart Association guidelines | Decrease               | Increase   | No change            | No data                      | Decrease   | C*  | 32                |

BMI = body mass index; HDL = high-density lipoprotein; LDL = low-density lipoprotein.

A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series.

\*—Based on combined evidence of combined interventions.

Information from references 2 through 11, and 16 through 32.

benefits, patient-oriented benefits are more limited. None of the diets show any significant worsening of patient outcomes. Consultation with a nutritionist should be considered for patients with significant comorbidities in whom a restrictive diet may lead to complications.

A survey of patient outcome data shows that diets that are rich in fruits, vegetables, and healthful fatty acids and that limit saturated fat intake seem to result in the best outcomes (Table 4).<sup>2-11,16-32</sup> The AHA guidelines incorporate most of these recommendations without severe dietary restrictions.

A stepwise, individual patient approach incorporating one or two interventions every three to six months may be a useful way to utilize these guidelines.

The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U.S. Air Force Medical Department or the Air Force service at large.

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