

# Evidence-Based Eating Patterns for Heart Disease



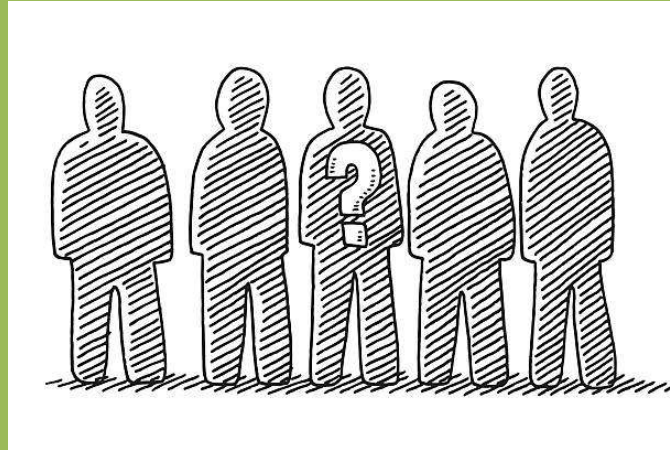
## Learning Objectives

- Recognize the current rates of heart disease and the mechanisms behind the disease process.
- Understand the therapeutic effects of a plant-based dietary pattern for heart disease.
- Understand how you can implement dietary changes into your own diet

# Epidemiology

# Epidemiology

1 in every 5 deaths in the U.S. is due to heart disease



National Center for Health Statistics. Multiple Cause of Death 2018–2022 on CDC WONDER Database. Accessed May 3, 2024.  
<https://wonder.cdc.gov/mcd.html>

The American Heart Association started reporting mortality statistics in May 1927. Heart disease has been the leading cause of death in the US since 1921. In addition, heart disease is responsible for 1 out of every 5 deaths of any cause in the United States.

There are different types of heart disease. The most common type of heart disease is coronary heart disease which is a result of atherosclerotic disease of the coronary arteries. CHD can lead to a myocardial infarction and death.

## Epidemiology

- Since 1950, death rates from CVD have declined 60%; the rates have fluctuated over the years and have recently trended upward.
- The number of people in the United States dying of a heart attack each year has dropped from 1 in 2 to now 1 in 8.

Heart Disease and Stroke Statistics—2024 Update: A Report From the American Heart Association. *Circulation*. 2024;149:e347–e913.

Overall, throughout the past century, people are living longer with less risk of having a heart attack or stroke or dying of coronary heart disease. Key numbers tell us the following

## Epidemiology

- It is estimated that roughly 127.9 million Americans (48.6%) ≥20 years of age have CVD, including coronary heart disease, heart failure, stroke or hypertension.
- More than 71% of US adults have overweight and obesity
- Fewer than one-fourth (24%) of US adults meet national recommendation for physical activity

Heart Disease and Stroke Statistics—2024 Update: A Report From the American Heart Association. *Circulation*. 2024;149:e347–e913.

Still, there is much work to be done. After decades of decline in CVD rates, more recent trends are moving up, attributed in part to worsening risk factors such as diabetes, population aging, health inequities, and other factors.

In 2020, social determinants of health were added. These are the non-medical factors that influence a person's health and well-being. (Education, Income, Employment, Housing, Food security, Healthcare Access, Transportation, Policy, Social Support and Neighborhood Safety)

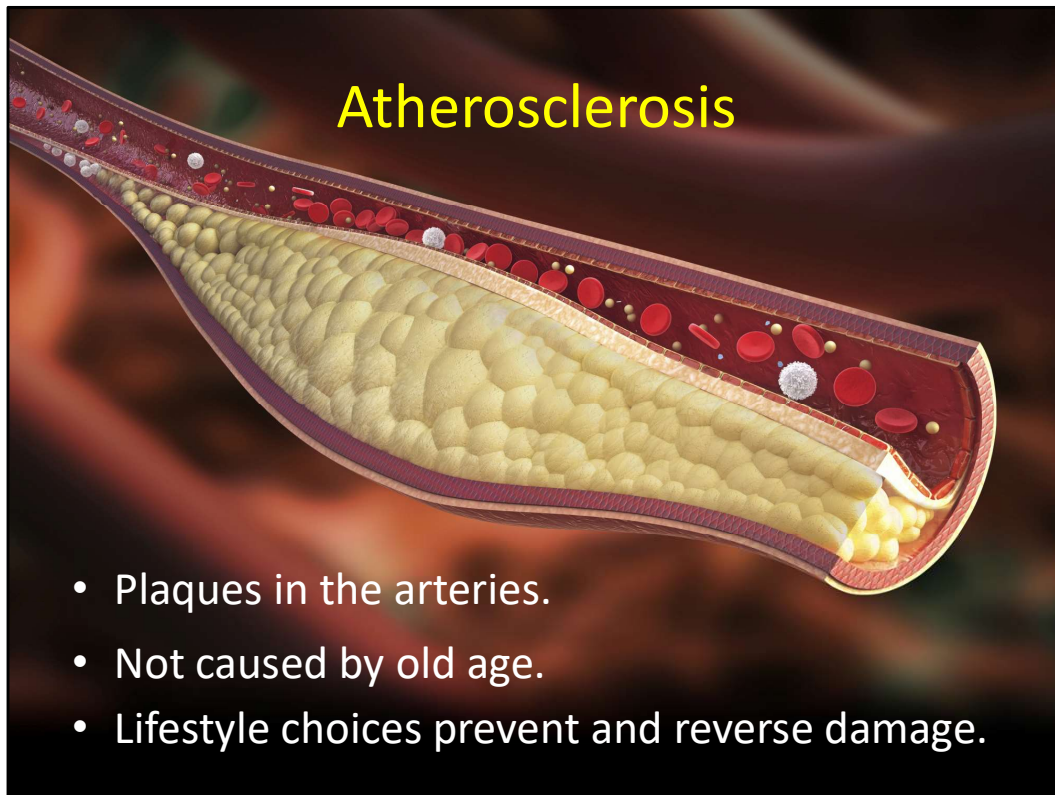
In 2023, there was an increased emphasis on health equity, as well as the addition of the Global Fact Sheets supplement and a toolkit that included fact sheets with key statistics by race, ethnicity, age, and sex translated into 7 languages to broaden the audience around the world.



1. Eat Better
2. Get Active
3. Stop Smoking-Cigarette smoking has fallen dramatically from >40% of US adults smoking in the mid-1960s7 to ≈11% today
4. Get Enough Sleep
5. Maintain a Healthy Weight
6. Control Cholesterol
7. Control Blood Sugar
8. Manage Blood Pressure

# Mechanics

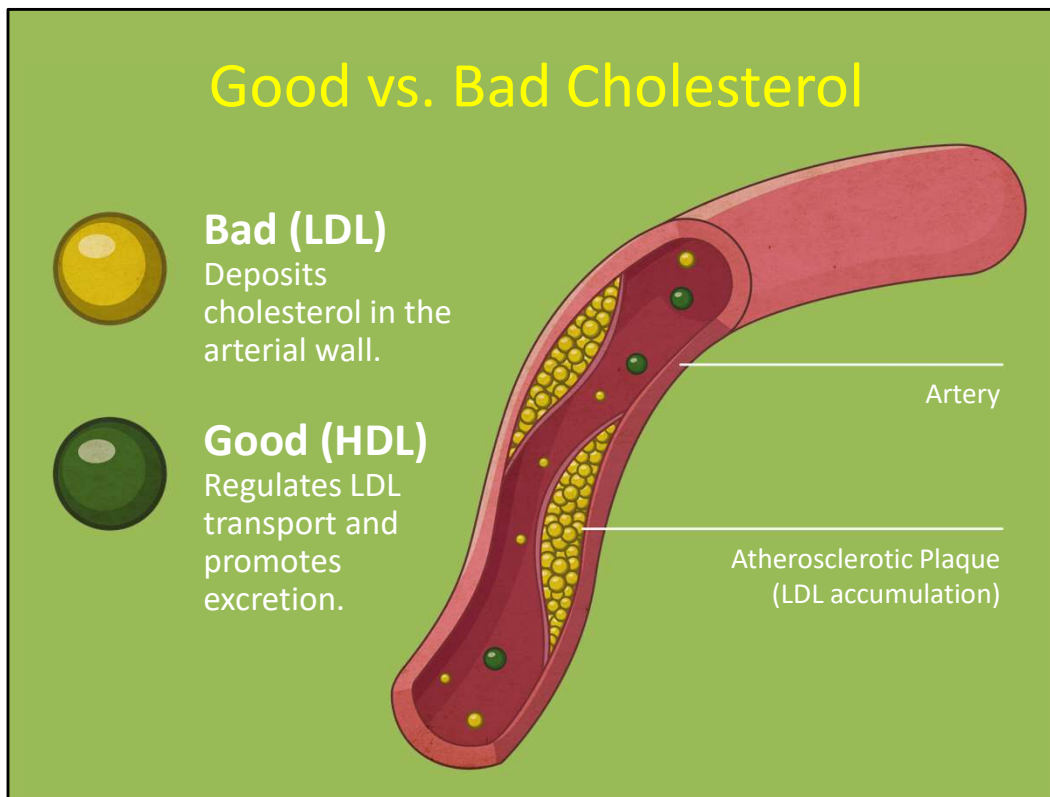




Coronary artery disease is caused by atherosclerosis. Plaques of cholesterol and other substances form in the coronary artery walls and eventually, the vessel lumen becomes significantly narrowed, leading to less blood flow. Less blood flow means less oxygen for the heart muscle. Chest pain (angina) occurs, initially when the heart requires increased oxygen such as during exercise or emotional excitement. In severe disease, angina can occur with minimal or no exertion. When the blood supply is completely cut off, cardiac muscle ischemia and infarction occur.

Atherosclerosis is not caused by old age. When battlefield casualties were examined during the Korean and Vietnam wars, American soldiers had significant atherosclerosis at only 18 or 20 years of age. Their Asian counterparts, raised on diets consisting mainly of rice and vegetables, had much healthier arteries.

Older people are more likely to have heart problems than younger people, because they have had more time to indulge in unhealthful habits, not because they have a hereditary tendency towards heart disease. Usually, the problem is not due to genetics, but to eating, smoking and other lifestyle habits. Your doctor can tell you if you are one of only about 5 percent of the population with a true genetic tendency towards heart disease.



To understand heart disease, we must first understand cholesterol. Cholesterol is not the same as fat. The liver manufactures cholesterol and sends it out to be used in the manufacture of hormones and cell membranes, and in other parts of the body. We have all heard of good cholesterol and bad cholesterol, but what do they actually do that is good and bad? What do they look like?

“Bad” cholesterol is also known as Low Density Lipoprotein or LDL. It’s protein-lipid globule full of cholesterol that is made in the peripheral circulation from the breakdown of very low density lipoprotein VLDL. LDL transports all types of lipids around the body and deposits them in tissues, including the lining of your arteries.

“Good” cholesterol is also known as High Density Lipoprotein or HDL. It is a smaller, hard ball of protein and lipids that collects cholesterol and other lipids from around your body, including your artery lining, and puts them back into the liver so that they can be used for many helpful bodily functions like making bile, steroid hormones, or used for energy.

The size and number of LDL particles appears to matter for heart disease risk. Smaller LDL particles, in larger numbers, are associated with higher risk. These small LDL particles seem to be associated with insulin resistance.

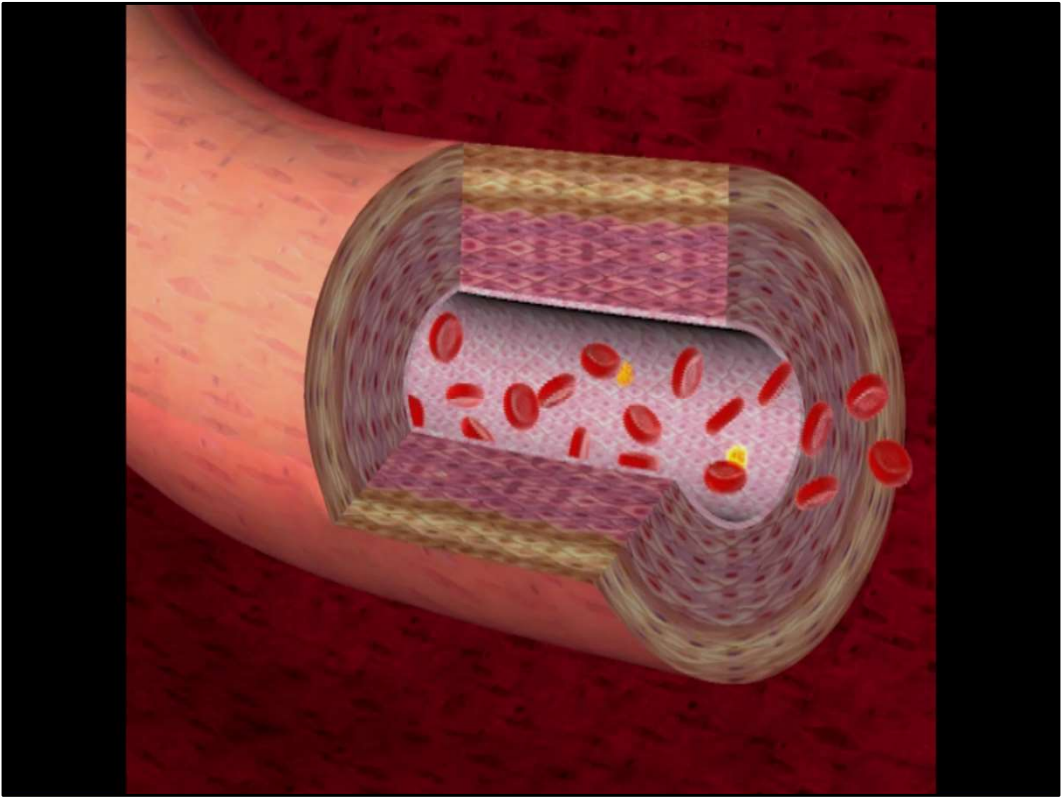
## Why Do We Have Cholesterol?

The liver makes one gram of cholesterol each day, meaning no cholesterol is needed from the diet.

Raw material for making hormones  
(estrogens, testosterone).

Key ingredient in cell membranes.

Needed in the production of bile acids.



# Nutrition Interventions

Disorders of Lipid Metabolism: Saturated Fat Evidence-Based  
Nutrition Practice  
Guideline from the Academy of Nutrition and Dietetics

**2023 Saturated Fat  
Recommendations**

- Reduced saturated fat intake within an individualized healthy dietary pattern for adults living with or without CVD
- Replace saturated fat intake with dietary polyunsaturated fat intake
- Results in reduction of LDL, total cholesterol, triglyceride levels and CVD events; no significant effect on all-cause CVD or CHD mortality

**2011 Saturated Fat  
Recommendations**

- Total fat intake 25-35% of calories with <7% of calories from sat fat and TFA.
- For individuals at an appropriate wt, replace sat fat with unsat fat and/or complex CHO
- Can lower LDL up to 16% and decrease risk of coronary heart disease

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Disorders of Lipid Metabolism: Saturated Fat Evidence-Based  
Nutrition Practice  
Guideline from the Academy of Nutrition and Dietetics









**2023 Saturated Fat  
Recommendations**

- RDs may prioritize reduction of sat fat over reduction of specific sources of saturated fat foods.
- Low certainty evidence demonstrates that a variety of dairy products are not associated with an increased risk of CVD; however, reduction of red meat and processed meat is associated with reduced CVD risk

**2011 Saturated Fat  
Recommendations**

- RDs should write a nutrition prescription that replaces sat fat calories with complex carbohydrates
- “In treating overweight or obese patients, where the goal is reduction of total energy, reduction rather than replacement of saturated fat calories may be warranted, depending on current intake of unsaturated fat.”

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Types of Fatty Acids	Examples of Sources	Health Impacts and Intake Recommendations
<p><b>Saturated</b></p>  <ul style="list-style-type: none"> <li>No double bond</li> <li>Straight structure</li> <li>Solid at room temperature</li> </ul>	 <p>Beef      Butter      Coconut oil</p>	<ul style="list-style-type: none"> <li>Increase risk of heart disease</li> <li>Less than 20g of saturated fats per day (for a 2000 kcal diet)</li> </ul>
<p><b>Trans</b></p>  <ul style="list-style-type: none"> <li>One or more double bonds in trans configuration</li> <li>Straight structure</li> <li>Semi-solid/Solid at room temperature</li> </ul>	 <p>Margarine      Cream soup with puff pastry      Chicken pie</p>	<ul style="list-style-type: none"> <li>Increase risk of heart disease</li> <li>Less than 2.2g of trans fats per day (for a 2000 kcal diet)</li> </ul>
<p><b>Monounsaturated</b></p>  <ul style="list-style-type: none"> <li>One double bond in cis configuration</li> <li>Bent structure</li> <li>Liquid at room temperature</li> </ul>	 <p>Olive oil      Canola oil      Peanut oil</p>	<ul style="list-style-type: none"> <li>May reduce risk of heart disease</li> <li>Moderate intake of monounsaturated fats</li> </ul>
<p><b>Polyunsaturated</b></p>  <ul style="list-style-type: none"> <li>Multiple double bonds in cis configuration</li> <li>Even more "bent" in structure</li> <li>Liquid at room temperature</li> </ul>	 <p>Soybean oil      Corn oil      Fatty fish</p>	<ul style="list-style-type: none"> <li>May reduce risk of heart disease</li> <li>Moderate intake of polyunsaturated fats</li> </ul>

Different types of dietary fats and health. (2019, October 16).



# Polyunsaturated Fat



- Fat molecules that have more than one unsaturated carbon bond in the molecule.
- Oils that contain polyunsaturated fats are typically liquid at room temperature but start to turn solid when chilled
- Omega-3 and Omega-6 are “essential” fats

Polyunsaturated fats. [www.heart.org](http://www.heart.org). (2023, October 25).

## What do omega-3 fatty acids do?

Omega-3 fatty acids help all the cells in your body function as they should. They're a vital part of your cell membranes, helping to provide structure and supporting interactions between cells. While they're important to all your cells, omega-3s are concentrated in high levels in cells in your eyes and [brain](#). Lower risk of developing Alzheimer's disease, dementia, and age-related macular degeneration

In addition, omega-3s provide your body with energy (calories) and support the health of many body systems. Including endocrine and cardiovascular

One key benefit is that they help lower your [triglyceride](#) levels. Too many triglycerides in your blood ([hypertriglyceridemia](#)) raises your risk of [atherosclerosis](#), and through this, can increase your risk of heart disease and stroke. So, it's important to keep triglyceride levels under control. In addition, omega-3s may help you by raising your [HDL \(good\) cholesterol](#) and lowering your [blood pressure](#).

**omega-6s** help stimulate skin and hair growth, maintain bone health, regulate metabolism, and maintain the reproductive system.

# Omega 3

## **EPA (eicosapentaenoic acid)**

- Is a “marine omega-3” because it’s found in fish
- Herring
- Salmon
- Sardines
- Mackerel
- Trout
- Oysters

## **DHA (docosahexaenoic acid)**

- DHA is also a marine omega-3 found in fish
- Salmon
- Herring
- Sardines
- Mackerel
- Sea bass
- Tuna
- Tilapia
- Shrimp
- Cod

## **ALA (alpha-linolenic acid)**

- ALA is the form of omega-3 found in plants.
- Flaxseed oil
- Chia seeds
- Walnuts
- Flaxseed
- Canola Oil
- Soybean Oil
- Edamame
- Refried beans

U.S. Department of Agriculture, Agricultural Research Service. FoodData Central, 2019

Omega-3s are essential nutrients that you need to get from your diet. When you get ALA from food, your body is able to turn some of the ALA into EPA and subsequently to DHA. However, this process provides just a small amount of EPA and DHA. So, dietary sources of EPA and DHA (like fish) are essential.

Omega-3 fatty acids may lower your cardiovascular disease risk when you consume them as part of your diet. In general, it’s better to opt for food sources (like fish) rather than pills.

## Omega-3 Supplements



Cleveland Clinic. "Omega-3 Fatty Acids." *Cleveland Clinic*, 17 Nov. 2022, my.clevelandclinic.org/health/articles/17290-omega-3-fatty-acids

- Better to opt for food sources (like fish) rather than pills.
- Some supplements, depending on their dosage, may:
  - Interfere with some of your prescription medications.
  - Cause unpleasant side effects.
  - Raise your risk of atrial fibrillation.
  - Raise your risk of bleeding, if you're taking antiplatelet drugs or anticoagulants.
- Icosapent ethyl (a purified form of EPA). This type of supplement may help people who meet all of these criteria:
  - Have a diagnosis of atherosclerotic cardiovascular disease.
  - Have high triglycerides (135 to 499 milligrams per deciliter, or mg/dL).
  - Are taking statins and have their LDL cholesterol under control (below 100 mg/dL).

Your physician, including your [primary care provider](#) or [cardiologist](#), can prescribe you dietary supplements based on your risk characteristics and lipid levels.

Overall, clinical trials on omega-3 supplement benefits have mixed results. Some studies show omega-3 supplements help protect your [heart](#), while others show no benefit. This may be due to variations in research methods (like dosage amounts, omega-3 formulations and the patients enrolled in the study).

As researchers continue to explore this topic, the dietary guidelines and recommendations may change. So, it's important to have a conversation with your provider, who can offer tailored advice based on your needs and your medical history. The advice they provide will be the most accurate, up-to-date and scientifically backed information.



## Omega 6

- May raise inflammation
- The typical American diet tends to contain 14 to 25 times more omega-6 fatty acids than omega-3 fatty acids.
- The Mediterranean diet, on the other hand, has a healthier balance between omega-3 and omega-6 fatty acids
- Healthier ratio is 2:1 or 4:1 for Omega-6 to Omega-3

### Sources

- Sunflower Oil
- Safflower Oil
- Soy Oil
- Sesame Oil
- Corn Oil
- Sunflower Seeds
- Pumpkin Seeds
- Walnuts
- Supplements are not usually necessary

*Omega-6 fatty acids.* (n.d.). Mount Sinai Health System.

The average diet provides sufficient omega-6 fatty acids, so supplementation is usually not necessary unless you are treating a specific condition, such as:

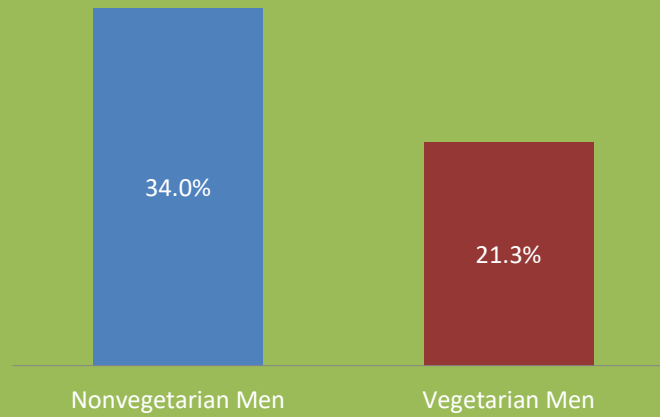
- Eczema
- Psoriasis
- Arthritis
- Diabetes
- Breast tenderness (mastalgia)

## Evidence for a Plant-Based Diet

# Seventh-Day Adventists

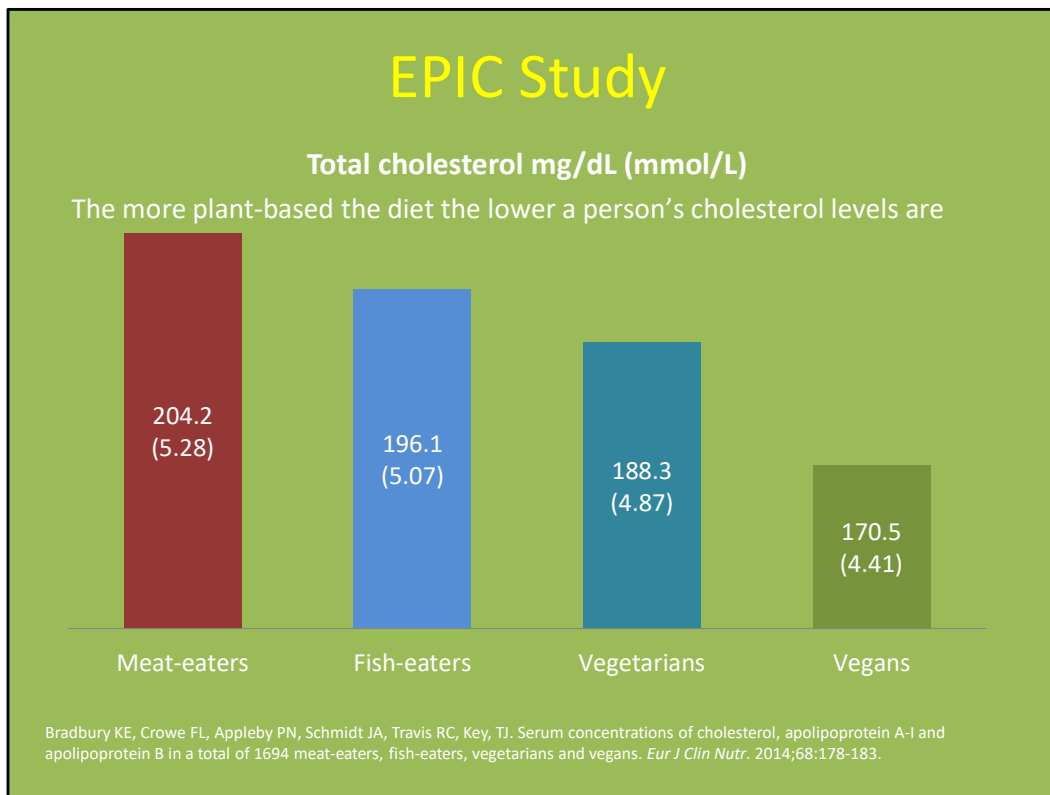
## Risk of ischemic heart disease

Lifetime risk of ischemic heart disease is lower in vegetarians.



Fraser GE. Associations between diet and cancer, ischemic heart disease, and all-cause mortality in non-Hispanic white California Seventh-day Adventists. *Am J Clin Nutr.* 1999;70:532S-538S.

A study including 34,192 Seventh-day Adventists used multiple-decrement-lifetable approach to an ischemic heart disease endpoint and found that nonvegetarian men had a lifetime risk of 34.0 percent, as compared with 21.3 percent ( $p < 0.05$ ) in vegetarian men, indicating that the lifetime risk of ischemic heart disease was 37.4 percent lower among vegetarian men (Fraser 1999).

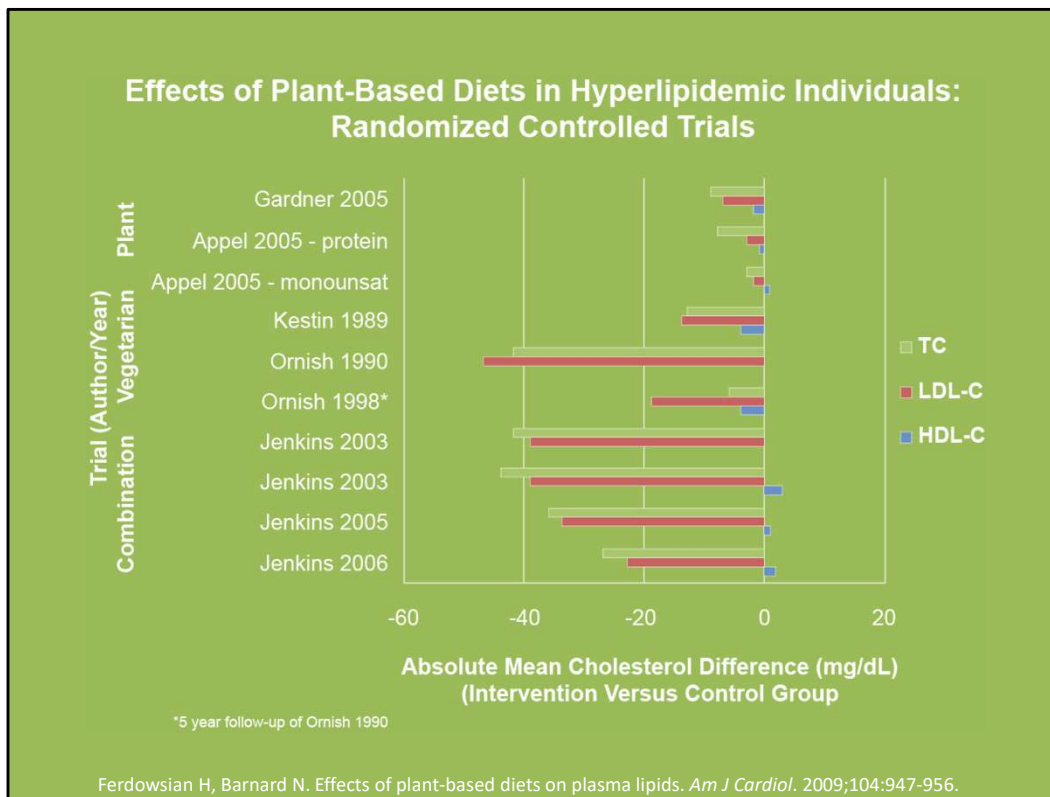


Those who consume vegan diets have better cholesterol levels than people who eat meat, fish, dairy, and/or egg products, according to a study published in the *European Journal of Clinical Nutrition*. Researchers examined data and blood samples from 1,694 participants from the European Prospective Investigation into Cancer and Nutrition-Oxford (EPIC) study. Participants were categorized as meat-eaters, fish-eaters, vegetarians, and vegans. Those who ate a vegan diet consumed the most fiber, the least total fat and saturated fat, and had the healthiest body weight and cholesterol levels, of all the diet groups. [A previous analysis](#) from the EPIC study found that vegan and vegetarian groups had a 32 percent lower risk of hospitalization or death from heart disease.

A prospective analysis in the Oxford Vegetarian Study of more than 11,000 individuals demonstrated that vegetarians had lower mortality from ischemic heart disease (RR 0.63; CI 0.42-0.93), compared with meat-eaters during 13.3 years of follow up, after adjusting for age, sex, smoking, and social class (Appleby 2002). The mortality from ischemic heart disease was also associated with consumption of total animal fat, saturated animal fat, and dietary cholesterol.

Crowe F, Appleby PN, Travis RC, Key TJ. Risk of hospitalization or death from ischemic heart disease among British vegetarians and nonvegetarians: results from the EPIC-Oxford cohort study. *Am J Clin Nutr.* 2013 ;97:597-603.

Appleby PN, Davey GK, Key TJ. Hypertension and blood pressure among meat eaters, fish eaters, vegetarians and vegans in EPIC-Oxford. *Public Health Nutr.* 2002;5:645-654.



Effects of plant-based diets on cholesterol in subjects with hyperlipidemia: randomized controlled trials. HDL-C HDL cholesterol; LDL-C LDL cholesterol.



## The Lifestyle Heart Trial

- Randomized controlled trial
- A low-fat, vegetarian diet
- Modest exercise
- No smoking
- Stress management



At the University of California in San Francisco, Dr. Ornish tested the theory that a more potent diet, along with other lifestyle changes, might actually reverse heart disease. He selected patients who had plaques that were clearly visible on angiograms and split the patients into two groups. Half were referred to a control group in which they received the standard care that doctors prescribe for heart patients. The other half began a vegetarian diet in which less than 10 percent of calories were contributed by fat. They were also asked to begin a program of modest exercise and learned to manage stress through a variety of simple techniques. Of course, smoking was not permitted.

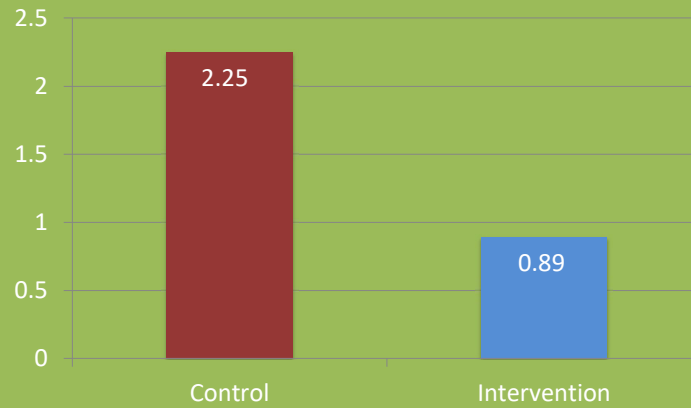
Results		
	Experimental	Control
Cholesterol	↓ 24%	↓ 5%
LDL	↓ 37%	↓ 3%
Weight	↓ 22 lbs	↑ 3 lbs
Reversal	82% of participants	42% of participants

Dr. Ornish’s patients started to feel better almost immediately, and continued to improve over the course of the year. They had previously been struggling with the crushing chest pain of heart disease, but “most of them became essentially pain-free,” Dr. Ornish said, “even though they were doing more activities, going back to work, and doing things that they hadn’t been able to do, in some cases, for years.”

Not only did their cholesterol levels drop dramatically, but, after a year, 82 percent of the patients who followed Dr. Ornish’s program showed measurable reversal of their coronary artery blockages. The plaques were starting to dissolve with no medications, no surgery, and no side effects.

The control group, following the more traditional medical routine, did not do so well. For most patients, chest pain did not go away, but continued to get worse, and their plaques continued to grow, cutting off blood flow to the heart a bit more with every passing day.

## Cardiac Events\* per Person Over 5-Year Follow-Up



\*MI, angioplasty, bypass, cardiac-related hospitalization, or cardiac-related death.

Ornish D, Scherwitz LW, Billings JH. Intensive lifestyle changes for reversal of coronary heart disease. *JAMA* 1998;280:2001-2007.

## Meta-Analysis Results

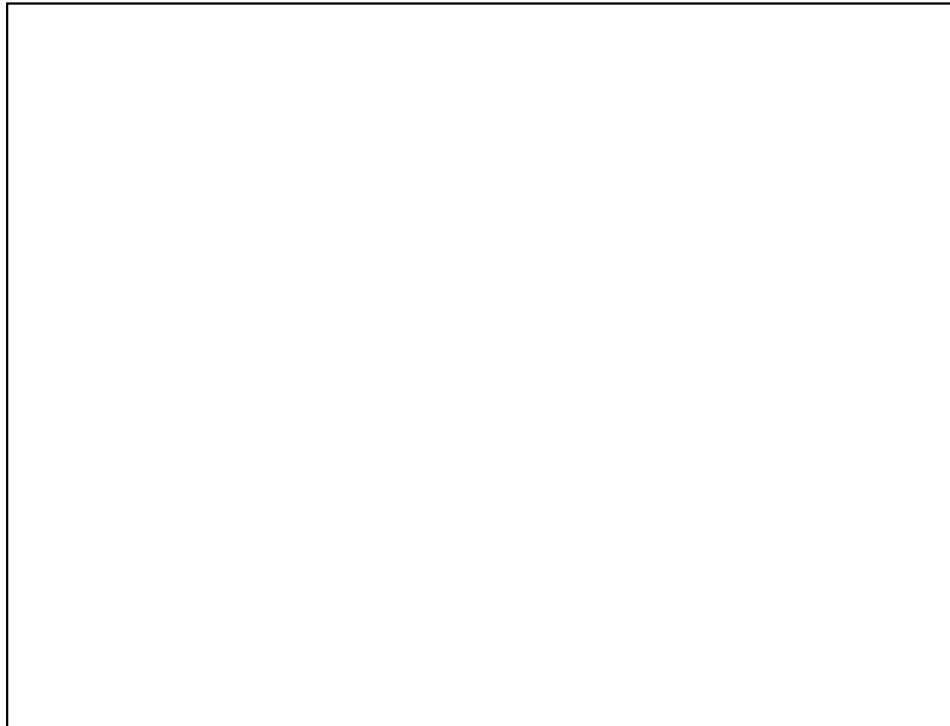
- Vegetarian diets effectively lower total cholesterol, LDL, HDL, and non-high-density lipoprotein cholesterol.
- Making the diet a nonpharmaceutical therapy for managing dyslipidemia, especially hypercholesterolemia.

Wang F, Zheng J, Yang B, Jiang J, Fu Y, Li D. Effects of vegetarian diets on blood lipids: a systematic review and meta-analysis of randomized controlled trials. J Am Heart Assoc. Published online October 27, 2015.

A vegetarian diet is beneficial for heart health, according to a meta-analysis published in the Journal of the American Heart Association. Researchers reviewed 11 studies on the effects of vegetarian diets on cholesterol levels. Those assigned to a vegetarian diet experienced a significant reduction in total, LDL, and HDL cholesterol, which corresponded with about a 10 percent reduced risk of heart disease. The vegetarian diet was especially beneficial for healthy weight and overweight individuals but less effective for obese individuals, underscoring the importance of early dietary intervention for long-term risk reduction. This is the first meta-analysis to assess randomized-controlled trials to evaluate the effects of vegetarian diets on blood lipids and points to the efficacy of dietary interventions for hypercholesterolemia.

According to a corresponding editorial, vegetarian diets include high intakes of dietary fiber and health-promoting phytochemicals, low intakes of dietary cholesterol and saturated fats, and complete avoidance of animal products, making it ideal for heart health.

Wang F, Zheng J, Yang B, Jiang J, Fu Y, Li D. Effects of vegetarian diets on blood lipids: a systematic review and meta-analysis of randomized controlled trials. J Am Heart Assoc. Published online October 27, 2015.



Effects of vegetarian diets on (A) TC and (B) LDL-C concentrations. The meta-analysis used the WMD in the random-effects model. Horizontal lines denote 95% CI. A diamond represents the overall estimated effect. LDL-C indicates low-density lipoprotein cholesterol; TC, total cholesterol; WMD, weighted mean difference.

## Putting Nutrition Into Practice

## Why Plant-Based?

- Highly effective for reducing cardiac risk factors
- Reduces risk for heart disease, cancer, and obesity

Craig WJ, Mangels RA. Position of the American Dietetic Association: vegetarian diets. *J Am Diet Assoc.* 2009;109:1266-1282.

From randomized control trials, we know that low-fat, plant-based diets are more effective than the typical standards of care.

One reason is that plant foods are full of fiber, animal products have no fiber at all. Fiber is a non-digestible carbohydrate which benefits your body in many ways. There are two types: soluble and insoluble. Soluble fiber helps to slow the absorption of some food components such as cholesterol. This beneficially affects the amount of cholesterol the liver makes. Finally, fiber also helps to control blood sugar, hormone levels and affects the gut microbiome. For every 14 gram increase in fiber, caloric intake drops by 10% on average. Additionally, every 10 grams of fiber per day cuts the risk of dying by 10%.

Epidemiological studies also show that populations who exclude meat and other animal products do better in terms of diabetes risk. People with diabetes are at particular risk for heart disease. A plant-based diet helps minimize the risk for heart disease, and can even reverse atherosclerotic narrowing of the coronary arteries, which is a great advantage. Also, because most people with type 2 diabetes are also overweight, a high-fiber diet that eliminates fatty animal products can lead to beneficial weight loss.

## What to Eat?

- Avoid cholesterol intake.
- Decrease fat intake, especially saturated and trans fats.
- Increase fiber intake, especially soluble fiber.
- Eat a plant-based diet.



Since our bodies make plenty of cholesterol for our needs, we do not need to add any in our diet. Cholesterol is found in all foods that come from animals: red meat, poultry, fish, eggs, milk, cheese, yogurt, and every other meat and dairy product. Choosing lean cuts of meat is not enough; the cholesterol is mainly in the lean portion. Many people are surprised to learn that chicken contains as much cholesterol as beef. Every 100 milligrams of cholesterol in your daily diet adds roughly 5 points to your cholesterol level, although this varies from person to person.

Keeping total fat intake low is an important way to lower cholesterol and reduce the risk of other chronic diseases.

Animal products, especially meat, ice cream, and cheese, as well as fried food, margarine, vegetable oil, mayonnaise, and many desserts are all loaded with fat. In the leanest cuts of beef, about 30 percent of the calories come from fat. Skinless chicken is nearly as high, at 23 percent. Even without the skin, chicken is never truly a low-fat food. saturated fat, which causes the liver to produce more cholesterol.

Fiber, which is only found in plants, will help pull out excess cholesterol that you consume or that your body is making.

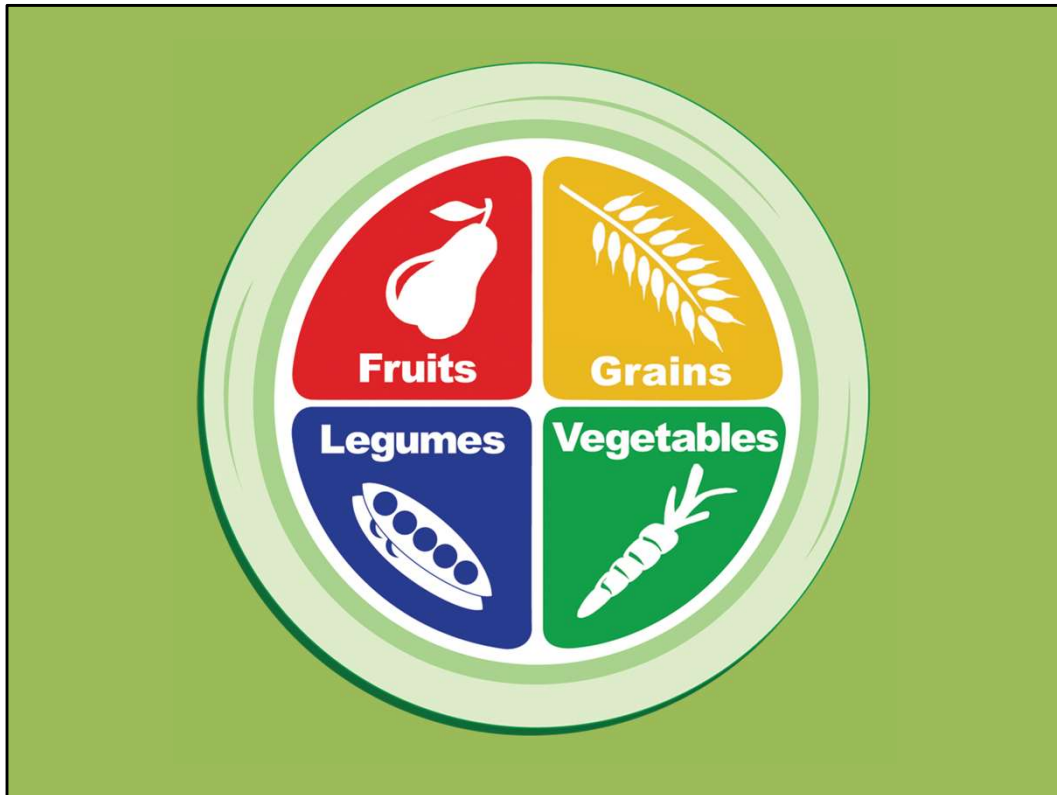
Going plant-based takes care of all of the above. There is no cholesterol in an animal-free diet and fat, especially saturated fat, will be greatly reduced when following a low-fat, plant-based diet.



## Soluble Fiber

- Great sources :
  - Oats
  - Barley
  - Apples (with skin)
  - Sweet potato (with skin)
  - Beans
  - Oranges

There are two types of dietary fiber—soluble and insoluble. Soluble fiber dissolves in water and is found in a variety of fruits, vegetables, legumes, and grains. It cuts cholesterol, adds to your feeling of fullness, and slows the release of sugars from food into the blood. These actions reduce your risk for health problems including heart disease, obesity, and diabetes.



The Power Plate is a no-cholesterol, low-fat plan that supplies a substantial amount of fiber and zero cholesterol.

In 2011, the USDA revised its recommendations with MyPlate, a plan that reduces the prominence of animal products and vegetable fats. But because regular consumption of such foods—even in lower quantities—poses serious health risks

The major killers of Americans—heart disease, cancer, and stroke—have a dramatically lower incidence among people consuming primarily plant-based diets. Weight problems, a contributor to a host of health concerns, including heart disease, can also be brought under control by following the Power Plate recommendations.

## Boosting HDL

- Exercise
- Vitamin C-rich foods



# Plant-Based Substitutions

Animal Product

Plant Alternative



Transitioning to a vegan diet may entail a bit of education. It's important to become familiar with common substitutions to animal products.

What can we recommend to a patient who needs an alternative for cow's milk? He or she might choose almond milk, soymilk, rice milk, etc.

To replace meat, patients might choose nuts, beans, or various meat substitutes. In reality, though, there are a great many foods that can replace meat and dairy products for people who aim to improve their health.

## Healthful Sources of Protein



Halton TL, et al. Low-carbohydrate-diet score and risk of type 2 diabetes in women. *Am J Clin Nutr* . 2008;87:339-346.

Some patients will ask about protein on a plant-based diet. Here is what you need to know: Of the approximately 20 different amino acids used by the body, nine (essential amino acids) cannot be synthesized by the body and must be obtained from the diet. All nine are found in plants.

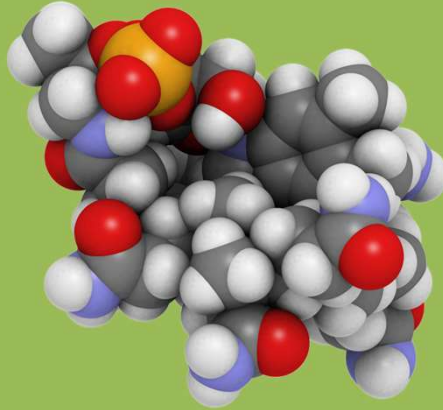
So it is easy to meet protein needs regardless of dietary choices. If you meet your calorie needs, you will meet your protein needs.

Amino acids that are low in some plants are high in others – usually reflected in traditional meals such as beans and rice. For example, grains are low in lysine while beans are high in lysine. But these

combinations tend to occur automatically in a varied plant-based diet. There is no need for patients to try to choose complementary proteins.

## Vitamin B12 (Cobalamin)

Produced by microorganisms - plants and animals can not synthesize B12.



One nutrient does merit attention: Vitamin B12 is not synthesized by plants or animals. Rather, B12 is produced by microorganisms.

## Vitamin B12

- RDA for adults: 2.4 mcg.
- Supplements for anyone over age 50 or on vegan diet.



Although human needs are very small, many people run low in B12. It is important that anyone over age 50 or who consumes an entirely plant-based diet take a B12 supplement. People can also run low in B12 if they have been taking acid-blockers or metformin, which is the most commonly prescribed oral drug for diabetes. People with celiac disease or who have had bariatric surgery may also have trouble absorbing B12. It pays to recommend a B12 supplement (such as a multiple vitamin) for all patients, but especially for those over 50 or who follow vegan diets.





**Great Job!**

Now you have the knowledge to guide your patients to an eating pattern that can prevent and treat diabetes. Practice will reinforce and refine the skills you have learned. In the next couple of weeks, try explaining a healthful dietary approach for preventing or treating diabetes to a friend or family member who has diabetes or is at risk of getting the disease. You are on the path to becoming a clinician who can give effective advice that can save patients' lives.