

CHOLESTEROL AND YOUR HEART

Cholesterol  Goal Clinic

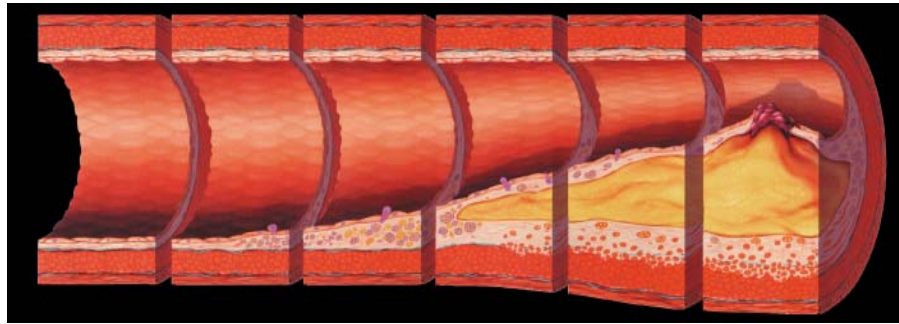
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TWO DISTINCT TERMS

- **Arteriolosclerosis:** The process of aging (hardening of the arteries). This occurs in everyone, but not necessarily at the same rate.
- **Atherosclerosis:** The build up of plaque (blockages of cholesterol) inside the artery. Some individuals exhibit rapid development of atherosclerosis (pre-mature heart disease). Also known as coronary heart disease. This process can occur in any artery in the body.

Atherosclerosis Timeline

Foam Cells Fatty Streak Intermediate Lesion Atheroma Fibrous Plaque Complicated Lesion/Rupture



————— Endothelial Dysfunction —————>

LIFESTYLE

Choices that affect our lipids

- Healthy habits. (dietary, smoking cessation, etc.)
- Exercise and activity level
- Stress reduction

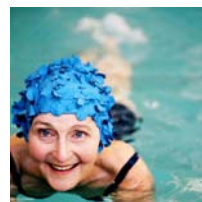
UNALTERABLE RISK FACTORS

- Age
- Gender
- Race
- Family History



ALTERABLE RISK FACTORS

- ♥ Smoking
- ♥ Hypertension
- ♥ Physical Activity
- ♥ Stress Reduction
- ♥ Obesity
- ♥ Hyperlipidemia
- ♥ Metabolic Syndrome
(pre-diabetic)



WHAT IS CHOLESTEROL?

- A fatty, waxy substance that is **necessary for normal body function**.
- Most cholesterol is **manufactured in the liver**. The liver makes all the cholesterol the body needs. We don't need any from dietary sources.
- Large concentrations are **found in the brain** and spinal cord, as well as the liver.
- Cholesterol is used for the cell lining of nerves, hormone synthesis and in the bile.

MORE DEFINITIONS

- **Lipids**: The entire fatty substances including cholesterol and triglycerides.
- **Lipoproteins**: Protein coated packages that carry fat and cholesterol through the blood stream. Lipoproteins are classified according to their densities:
 - HDL: The high density lipoproteins (the good lipid that carries cholesterol away from the artery).
 - LDL: The low density (bad) cholesterol that deposits in the artery.
- **Triglycerides**: The most common type of fat in the body. The body gets triglyceride directly from some foods (fatty acids) and makes it in the liver from other energy sources (carbohydrates, alcohol, and some cholesterol).

LDL CHOLESTEROL

- A sticky lipoprotein that **adheres to artery walls**.
- Strongly associated with **atherosclerosis and CHD events¹**
- Carries cholesterol around in the bloodstream.
- Remains the **cornerstone** of dyslipidemia therapy with optimal levels depending on your risk factors

Source: Wood D et al. Atherosclerosis. 1998;140:199-270.

HDL CHOLESTEROL

- The **"good" cholesterol** that carries LDL away from artery walls, thus **protecting against heart disease**.
- Recent studies suggest that every 1% increase in HDL results in up to a 3% reduction in CV risk
- Optimal level >40mg/dl for men >50 for women
- HDL cholesterol tends to be low when triglycerides are high²

Source: 1. NCEP, Adult Treatment Panel III. JAMA. 2001;285:2486-2497.
2. Wood D, et al. Atherosclerosis. 1998;140:199-270.

TRIGLYCERIDES

- Normal triglyceride levels: < 150 mg/dL
- Can be **directly related to diet and activity** level in some people
- Very high triglycerides: (≥ 500 mg/dL) increase **pancreatitis risk**
 - Initial aim of therapy is prevention of acute pancreatitis
- Patients with Type II diabetes or metabolic syndrome often have high TG
 - These patients often have low HDL as well

Source: 1. NCEP, Adult Treatment Panel III. JAMA. 2001;285:2486-2497.

GOAL TO TREATMENT

- For individuals with an event or diabetes, the **LDL needs to be <70**
- For **prevention: the LDL <100**
- For cholesterol, the total should be **100 + your age**
- For **HDL**, as high as it can get, **greater than 40 for men, greater than 50 for women**
- For **triglycerides**, less than 150
- Lp(a) less **than 10**
- Particle size, **pattern A**



APPROVED DRUG CLASSES FOR TREATING ABNORMAL LIPIDS

Drug Class	Mechanism
Statins	Interfere with cholesterol synthesis, upregulate LDL receptors, reduce VLDL-C, increase HDL-C, reduce non-HDL-C
Niacin	Reduces VLDL-C production, decreases uptake of HDL-C
Fibrates	Activate PPAR α , increase lipoprotein lipase activity, decrease VLDL-C production
Bile-acid binding resins	Prevent reabsorption of bile acids, upregulate LDL receptors
Cholesterol Absorption Inhibitors	Selectively inhibits the absorption of cholesterol in the small intestine

EFFECTS OF DRUG CLASSES ON SERUM LIPIDS

Drug Class	TC	LDL	HDL	TG
Resins	↓ 20%	↓ 10%–20%	↑ 3%–5%	Variable
Nicotinic acid	↓ 25%	↓ 10%–15%	↑ 15%–35%	↓ 20%–50%
Fibrates	↓ 15%	Variable	↑ 6%–15%	↓ 20%–50%
Statins	↓ 15%–60%	↓ 20%–60%	↑ 3%–15%	↓ 10%–40%
CAI	↓ 12%–13%	↓ 18%	↑ 1%	↓ 7%–9%

Adapted from Gotto AM Jr. Management of lipid and lipoprotein disorders. In: Gotto AM Jr, Pownall HJ, eds. Manual of lipid disorders. Baltimore: Williams & Wilkins; 1992; Rubins HB, et al. N Engl J Med. 1999;341:410-418. Ezetimibe Package Insert; October 2002.

DIETARY AND LIFESTYLE APPROACHES TO LOWER CHOLESTEROL

- Diet by addition...food as medicine: a Whole Foods diet
- Adding supplements to enhance medication effects
- Weight reduction, calorie restriction if necessary
- Good fats vs bad fats
- Plant Sterols
- Fiber
- Soy
- Fish and Omega 3 fatty acids
- Exercise
- Stress management



STATIN USERS EAT MORE, GAIN MORE WEIGHT!

- Adults who take statins consumed 14.4% **MORE** fat and 9.6% **MORE** calories than those who do not take statins
- Research from the University of California, Los Angeles
- Researchers state that for many people, statins provide a **false reassurance**, as people seem to believe that statins can compensate for poor dietary choices and a sedentary life – not true!
- They state that **LIFESTYLE** should always be First Line Therapy and medications should be used to decrease risk that lifestyle is not able to address

WHAT IS FAT?

- Fat is composed of a glycerol molecule and three fatty acids (long chain fatty compounds). Some of these are **essential** (the body cannot manufacture them).
- Fat essential for **assimilating fat-soluble vitamins**
- Fat is a **flavor enhancer and carrier**
- Good fats and bad fats:
- Saturated and trans fats, Polyunsaturated and Monounsaturated

TOTAL FAT

25 – 30% of total calories

- <http://www.bcm.edu/cnrc/caloriesneed.htm>
- www.mypyramid.gov
- Calculation – Maintain weight
- Subtract 500 per day to lose 1 # per week
- 500 calories x 7 days per week = 3,500 calories
- Add 500 per day to gain 1# per week

TOTAL FAT: 25-30% OF CALORIES FROM FAT

Example:

- 1200 calories 33-40 grams total fat
- 1500 calories 42-50 grams total fat
- 2000 calories 56-66 grams total fat
- A Chipotle vegetarian burrito with rice/beans/guacamole/sour cream has 985 calories and 42 grams of fat!



SATURATED FAT

- Saturated fats (usually solid at room temperature). This fat is responsible for plaque build up.
- Saturated fat **found in mostly *animal* foods**: fatty cuts of beef, pork and lamb
- Poultry skin, chicken wings, high-fat dairy products like whole milk and cheese
- Tropical oils: coconut, palm and palm kernel oil as well as cocoa butter
- **Always choose *lowest animal fat content*** possible; extra lean meat and cheese, skim or 1% milk



SATURATED FAT

- There's been controversy over the past decade about just **how bad saturated fat is for health**.
- Recently, several studies seemed to suggest that eating diets high in saturated fat **did not** raise the risk of heart disease—a finding that ran counter to decades of dietary advice.
- One highly-publicized report analyzed the findings of 21 studies that followed 350,000 people for up to 23 years.
- Investigators looked at the relationship between saturated fat intake and coronary heart disease (CHD), stroke, and cardiovascular disease (CVD).
- **Their controversial conclusion:** "There is insufficient evidence from prospective epidemiologic studies to conclude that dietary saturated fat is associated with an increased risk of CHD, stroke, or CVD."

SATURATED FAT

- Some of the media and blog coverage of these studies would have you believe that scientists had given a green light to eating bacon, butter, and cheese.
- But that's an oversimplified and erroneous interpretation.
- Read the study and subsequent studies more closely, and the message is more nuanced: Cutting back on saturated fat can be good for **health if people replace saturated fat with good fats, especially, monounsaturated and polyunsaturated fats**.



SATURATED FAT

- Eating good fats in place of saturated fat lowers the “bad” LDL cholesterol, and it improves the ratio of total cholesterol to “good” HDL cholesterol, lowering the risk of heart disease.
- Eating good fats in place of saturated fat can also help prevent insulin resistance, a precursor to diabetes.
- Cutting back on saturated fat will likely have no benefit, however, if people replace saturated fat with refined carbohydrates—white bread, white rice, mashed potatoes, sugary drinks, and the like.
- Eating refined carbs in place of saturated fat does lower “bad” LDL cholesterol—but it also lowers the “good” HDL cholesterol and increases triglycerides.



SATURATED FAT

- The net effect of eating refined carbs in place of saturated fat is as bad for the heart as eating too much saturated fat—and perhaps even worse for people who have insulin resistance because they are overweight or inactive.
- Dietary Guidelines for Americans recommends getting less than 10% of calories each day from saturated fat.
- The American Heart Association goes even further, recommending limiting saturated fat to no more than 7% of calories.

SATURATED FAT

- In the U.S., **pizza and cheese** are the biggest food sources of saturated fat in the diet
- Other dairy products (whole and reduced fat milk, butter, dairy desserts) and meat products (**sausage, bacon, beef, hamburgers**) are also major contributors, as are foods made with them (**cookies and other grain-based desserts, Mexican dishes**).



SATURATED FAT

No more than 7% of total calories for those with existing heart disease or high cholesterol

Example:

- 1200 calories: 9 grams or less per day
- 1500 calories: 12 grams or less per day
- 2000 calories: 15 grams or less per day
- **1 oz cheddar cheese has 6 grams of saturated fat (4 dice, 1 finger)**





TRANS FAT

- Hydrogenated fats, usually manufactured by adding hydrogen to liquid fat to stabilize it. These fats will raise bad cholesterol and lower good cholesterol levels
- Now mandated to be listed on Nutrition Facts Label
- Look for lowest possible number. Try to get as little as this type of fat as possible: 0 grams per day
- Chemically processed "partially hydrogenated" oil
- FDA is moving to ban trans fats in food supply
- Stick margarine, baked goods: cookies, crackers, etc.
- Fast Food
- "Trans Fat Free" if less than 0.5 grams PER SERVING

MONOUNSATURATED FAT

- Monounsaturated fat, more beneficial to the body. Helps lower LDL cholesterol when used in place of saturated/trans fat
- Predominant fat of the Mediterranean Diet
- Found in foods like olives, avocado, olive oil, canola oil as well as nuts and nut butters
- Majority of fat should be monounsaturated



POLYUNSATURATED FAT

- Omega 6 and Omega 3 fatty acids
- Omega 6 to Omega 3 should be in a 2:1 ratio
- Typical American diet: more like 20:1 ratio
- We overeat Omega 6 fats and don't get enough Omega 3 fats
- Opposing but complimentary functions in the body

OMEGA 6

- Widespread in foods
- Vegetable oils (safflower, sunflower, sesame, corn)
- Salad dressings made with above oils
- Margarines
- Crackers, bread, chips, popcorn, etc
- Increase inflammation in the body
- Reduce intake of Omega 6 fats





OMEGA 3 FATS

- Increase HDL "good" cholesterol
- Reduce blood clot formation
- Suppresses inflammation in the body
- Decreases triglyceride levels in blood
- Decreases risk/incidence of sudden death and MI
- Inhibits growth of plaque
- Promote arterial relaxation, lowers BP
- Reduce susceptibility to arrhythmias

INFLAMMATION

- Omega 3 fatty acids act as an **anti-inflammatory**
- Inflammation has a profound effect on cardiovascular system
- Inflammation is one of the **risk factors** for heart disease, diabetes, obesity and even some cancers





SOURCES OF OMEGA 3 FATS

- Increase intake of Omega 3 fats
- Choose fatty fish (salmon, sardines, herring, trout)
- Flaxseed and flaxseed oil
- Edamame
- Omega-3 eggs
- Dark leafy greens, wheat germ
- Walnuts and walnut oil, pumpkin seeds



FISH OIL SUPPLEMENTS

- Two omega-3 fatty acids – **eicosapentaenoic acid (EPA)** and **docosahexaenoic acid (DHA)** found to help lower triglycerides, reduce blood clotting and decrease inflammation
- AHA: **healthy people should get about 1,000 mg** per day of EPA and DHA
- **High Blood pressure: 2,000 mg** per day
- **High triglycerides: 2-4 grams per day** (under care of health care provider)
- Fish oil supplements – quality matters
- Omacor/Lovaza/Vascepa – prescription fish oils

FISH OIL SUPPLEMENTS

- Over the counter brands:
- Nordic Naturals
- Carlson



CHOLESTEROL



- Counting cholesterol grams in the food you eat is **NOT** the most effective way to lower blood cholesterol
- More important to watch **saturated and trans fat in the diet**
- Shrimp/lobster (shellfish) VERY low in saturated/trans fat and high in protein
- Once a week (not buttered/fried)
- **Eggs: 2-4 per week** for those with high cholesterol

FOR THE SAKE OF YOUR HEART

- **Replace:** Sour cream with non-fat or low-fat sour cream or Greek yogurt
- Omega 6 oils with olive oil or walnut oil in salad dressings
- Eggs with omega 3-rich eggs or eggbeaters
- Full fat ice cream with low-fat ice cream or sorbet
- Butter with olive oil or plant sterol margarine or nut butters



Mediterranean Diet Swaps

Instead of....



Choose....

Mayonnaise on your sandwich

Hummus

Butter on your toast

Olive oil or nut butter

Meat in pasta sauce

More vegetables!

Chocolate cake

Baked pear & yogurt sauce

A bagel with jam

Oatmeal with berries or

Greek yogurt with granola





REPLACE

- Cheddar cheese with part-skim mozzarella or low-fat cheese
- Sandwich meat with 98% fat-free version (turkey breast, chicken breast, lean roast beef/ham): avoid nitrates
- Animal hamburgers with meatless version (Bean burger, Soy burger, etc)
- Full fat animal foods with lower fat version (milk, cheese, meat, etc.)

PLANT STEROLS OR PHYTOSTEROLS

- Occur naturally in parts of all plants
- Shown to lower cholesterol by up to 14%
- Block absorption of cholesterol in the intestine, leading to reduced levels in the blood
- Double the cholesterol-lowering power of statins – can take WITH statins
- Intake of 2 grams (or 2,000 mg) per day with meals

PLANT STEROLS IN FOOD PRODUCTS

- Benecol spreads
- Smart Balance Heart Right Light spread
- Metagenics Ultrameal Plus 360 (see Susan)
- Orowheat Whole Grain and Oat bread
- www.corowise.com/wheretobuy



PLANT STEROL SUPPLEMENTS

- Supplements taken with meals
- Nature Made Cholest-off – Walgreens, Walmart
- Twin Labs Cholesterol Success (www.vitacost.com)
- ModuChol (www.vitacost.com)
- Can also be taken *with* statin drugs for a synergistic effect
- Must take correct dose: 2,000 – 3,000 mg



FIBER

- Absorbs fat and cholesterol in the intestine
- 25-40 grams TOTAL fiber per day (soluble and insoluble).
Based on calorie intake
- Soluble fiber lowers cholesterol – oats, barley, lentils, fruits, vegetables, beans
- Try for 10-12 grams of soluble fiber
- Also helps with weight loss and helps stabilize blood sugar

FIBER

- Large epidemiological studies have demonstrated reduced risk for MIs and death from heart disease in people who consume higher amounts of dietary fiber
- Research of 7 major studies published in the journal Nutrition, Metabolism & Cardiovascular Disease in May, 2007: 285,000 men and women followed for 6-15 years
- People eating 3 servings per day of whole grains were 25% less likely to develop cardiovascular disease, stroke or die of CV causes

FIBER

- Psyllium (Metamucil), Konsyl can be used as supplements
- 10-12 grams per day of soluble fiber can reduce total cholesterol by up to 14% and LDL by up to 10%



SOY



- FDA approved health claim for soy
- 25-50 grams per day may reduce risk of heart disease (lowers LDL cholesterol)
- 10 grams soy protein in 1-2 cups of soymilk, or 4 oz of tofu or 1 soy burger
- Look for soy protein cereal, soy yogurt, soybeans, soy protein smoothies, soy meat replacements in Boca and Morningstar Farms

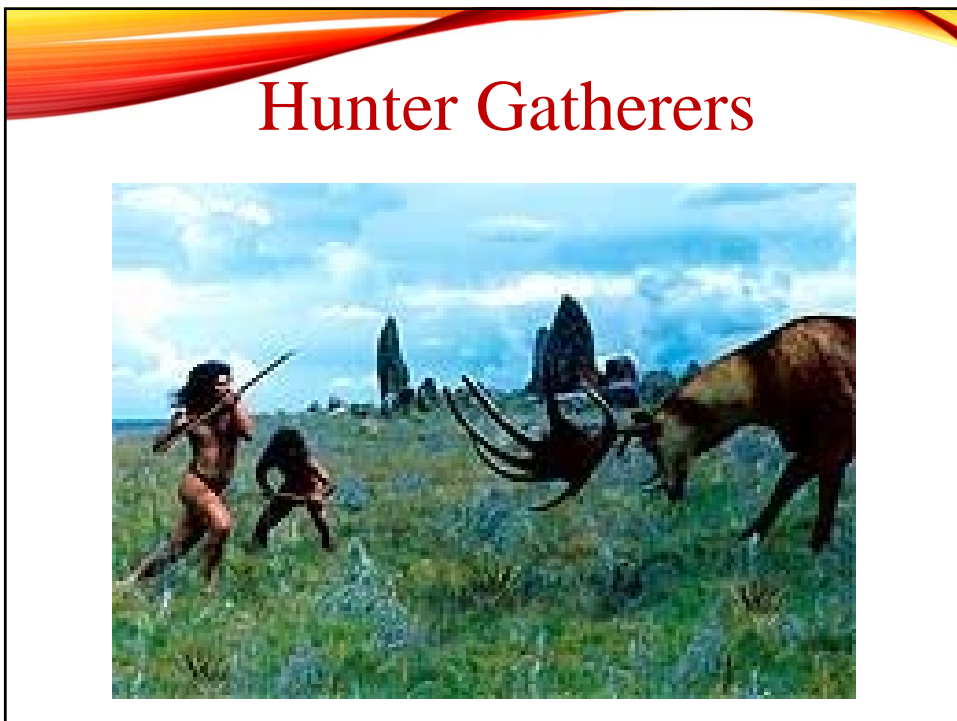
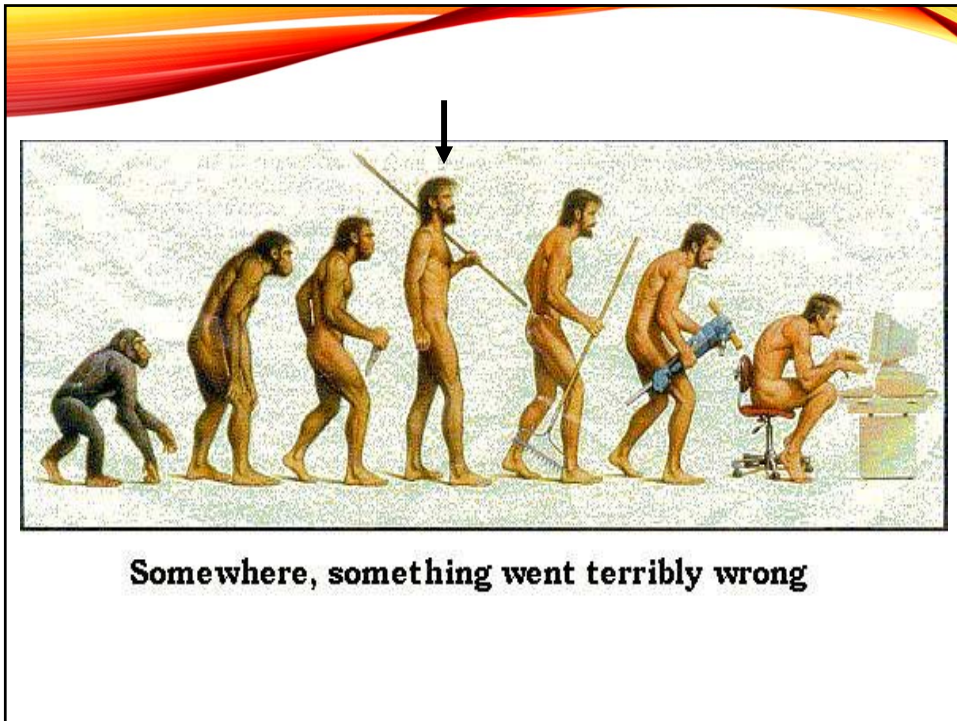


NUTS

- 2006 review of 4 large epidemiological studies:
 - Nurses' Health Study
 - Adventist Health Study
 - Iowa Women's Health Study
 - Physicians' Health Study
- 37% reduced risk of coronary heart disease in those consuming nuts at least 4 x/week

CHOLESTEROL LOWERING FOODS AS GOOD AS FIRST LINE LOVASTATIN

- Research of hyperlipidemic adults randomly assigned to a
 - (1) low fat diet
 - (2) low fat diet and 20 mg statin
 - (3) low fat diet & fiber, nuts, plant sterols and soy
- LDL lowering 8% in the low fat diet, 30.9% in drug and diet, and 28.6% in the diet with cholesterol lowering foods.
- CR protein (inflammatory marker) dropped 28.2% in the food group.



THE NEW NATIVE-AMERICAN DIET

Native Earth Diet

Earth grains
Lean meat, buffalo/fish
Breads, corn
Vegetables
Fruits/berries
Clear clean water

The New Native American Diet

Processed grains
McDonalds/KFC
Fry bread/donuts
French fries
Sugar, corn syrup
Alcohol

PORTFOLIO EATING PLAN

- Univ. of Toronto research showed diet to be just as effective as taking starting dose of statins without the side effects
- Lowers LDL by up to 35%
- 1 oz almonds (about 23), 25 grams of fiber from oats, barley, psyllium, 50 grams of soy protein and 2,000 mg. of sterols
- In the context of an overall heart healthy diet
- <http://www.portfolioeatingplan.com>

TO REDUCE LDL CHOLESTEROL

<u>Strategy</u>	<u>Approx. LDL Lowering</u>
Moderate weight loss	5%
Add fiber/almonds/soy	5-6%
2 grams phytosterols	10%
Restrict saturated fat/trans fat/cholesterol	10%
Statin drugs	20-50%

OTHER HEART PROTECTIVE FOODS

Fruits/Vegetables – Research shows overall those who average 8 or more servings/day are 30% less likely to have had a heart attack or stroke



VEGETABLES AND FRUITS

- Recent research published in the *Journal of Epidemiology and Community Health*
- Data from more than 65,000 randomly selected adults aged at least 35, from 2001 to 2008
- Eating **at least 7 daily portions of vegetables and fruits** was linked to a **42% lower risk of death from all causes** and from cancer and heart disease/stroke it was 25% and 31% respectively
- Vegetables were **more protective** the study suggests
- **2-3 daily portions of vegetables** were linked to a **19% lower risk of death** compared with a **10% lower risk** for the same amount of fruit
- Each portion of vegetables seemed to confer a **12-15% lower risk of death**

FRUITS & VEGETABLES

- **What does 8 servings a day look like?**
- Breakfast: 6 oz. low-sodium V-8 and an orange
- Lunch: 2 cups salad and an apple
- Snack: 1 cup baby carrots/cherry tomatoes
- Dinner: 1 cup broccoli



SUPPLEMENTS

- Both the AHA and NCEP recommend 3 supplements as adjuncts to conventional treatments:
- Fish oil (high quality)
- Fiber
- Phytosterols



SUPPLEMENTS

- Red Yeast Rice – lovastatin (monitor)
- Coenzyme Q 10 – involved in energy production in the heart. Depleted by statins
- 100-200 mg per day w/ statins
- B vitamins: niacin in high doses can raise HDL and lower TG (talk with doctor)
- Folic acid and B-12 help lower homocysteine

SUMMARY

- To lower LDL:
- Eat more oats, barley, beans, brown rice, fruits and vegetables, green and black tea
- Eat less fatty meat, full-fat dairy products, hydrogenated vegetable oils and coconut and palm oils
- Plant Sterols



SUMMARY

- To raise HDL:
- Eat more salmon and other oily fish, walnuts, ground flaxseed, green leafy vegetables, red wine, purple-skinned fruits like grapes, blueberries, avocado, peanut butter, onions, oat bran and grapeseed oil.
- Eat less trans fat
- Exercise





SUMMARY

- To lower triglycerides:
- Eat more salmon and other oily fish, ground flaxseed, soy products, beans, walnuts and dark leafy vegetables
- Eat less "white carbs" candy, baked goods, soft drinks, fruit juices and alcohol
- Fish oil supplements 2-4 grams per day under guidance of health care professional

TO REDUCE LDL CHOLESTEROL

<u>Strategy</u>	<u>Approx. LDL Lowering</u>
Moderate weight loss	5%
Add fiber/almonds/soy	5-6%
2 grams phytosterols	10%
Restrict saturated fat/trans fat/cholesterol	10%
Statin drugs	20-50%

"Let nothing which can be treated by diet be treated by other means."

- Maimonides



CHOLESTEROL AND EXERCISE



THE LIPID/LIPOPROTEIN RESPONSE TO EXERCISE TRAINING

Exercise training of sufficient volume (kcal expenditure per week) generally increases HDL cholesterol and lowers total cholesterol, LDL and triglycerides.

Mechanisms:

- **Reduced body-fat stores**
 - Exercise improves weight loss and maintenance
 - Being overweight tends to increase the amount of LDL in the blood
- **Decreased hepatic lipase activity** (enzymatic regeneration of LDL)
 - Exercise increases the size of the protein particles that carry cholesterol through the blood
 - Some particles are small and dense; some are big and fluffy. The small, dense particles are more dangerous because they can squeeze into the linings of the heart and blood vessels
 - Exercise increases the size of the protein particles that carry both good and bad lipoproteins
- **Increased lipoprotein activity**
 - Exercise stimulates enzymes that help move LDL from the blood (and blood-vessel walls) to the liver
 - From there, the cholesterol is converted into bile (for digestion) or excreted. The more exercise, the more LDL the body expels

PRIMARY FACTORS INFLUENCING BLOOD LIPIDS AND THE EXERCISE BLOOD LIPID RESPONSE

- Frequency, duration and intensity of exercise (as these increase, total caloric expenditure increases)
- Type of lipid disorder (e.g., variety of genetic hyperlipidemias)
- Total exercise energy expenditure
- Length of training period (e.g., one month, six months, 18 months)
- Coexisting body-fat loss
- Corresponding and compensatory dietary changes
- Concomitant alcohol intake
- Baseline lipid values
- Plasma volume changes
- Gender and menopausal status
- Genetic factors (e.g., apolipoprotein E isoforms)
- Biologic variation (seasonal and diurnal changes)

PHYSICAL ACTIVITY VOLUME REQUIRED FOR SIGNIFICANT CHANGES IN BLOOD LIPIDS

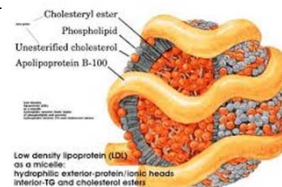
- Higher exercise energy expenditure thresholds (>2200 kcal/week) are likely required for individuals with elevated total and LDL cholesterol
- Fat weight reduction is generally required for the most favorable blood lipid response in those who have elevated and total LDL cholesterol
- Optimal volume of exercise similar to recommendations for obesity: **200 – 300 min/week or \geq 2000 kcal/week**
- As long as exercise is of sufficient volume, exercise intensity is not of primary importance in improving the overall blood lipid profile, although most research supports a minimum intensity of at least 40% of peak work capacity

TRIGLYCERIDE RESPONSE TO EXERCISE TRAINING

- Compared to other lipids (LDL), elevated blood triglycerides (TG) are generally more responsive to exercise training
- TG mobilization and utilization is directly proportionate to exercise energy expenditure
- Unlike total and LDL cholesterol, TG generally decrease immediately after a session of high-volume endurance exercise (> 45-50 minutes of sustained effort) and remain lower for up to **48** hours after the session
- Exercise session should follow the optimal FITT for fat-weight reduction:
 - **Frequency: 4-6 days/week**
 - **Intensity: 40-70% of aerobic capacity**
 - **Time: 40-60+ minutes**
 - **Type: Aerobic, endurance exercise**
- Four days a week of endurance exercise (~400+ kcal of energy expenditure) has been shown in a number of research trials to significantly reduce TG, especially in individuals with elevated baseline TG

LDL AND TOTAL CHOLESTEROL RESPONSE

- Exercise training that results in weight loss and plasma volume expansion is more likely to result in lower LDL and total cholesterol (e.g., aerobic, endurance exercise)
- Most research indicates minimal thresholds of 1000 kcal of exercise per week (e.g., 12 or more miles of walking per week)
- Ideally, **≥ 2000 kcal per week for 4 – 6 months** is required for significant reductions in LDL



HDL CHOLESTEROL RESPONSE

- Baseline HDL cholesterol and genetic factors have a significant impact on the capacity to increase HDL via exercise
- HDL may be more responsive to a **higher daily frequency** of exercise (e.g., three 15-minute sessions vs. one 40-minute session)
- Research also indicates that exercise-induced HDL increases can be independent of exercise intensity, especially in men and women older than 45 – 50 years of age
- Higher vs. moderate volumes of exercise may be required for significant HDL increases
- Older adults may take longer to increase HDL with exercise training, even up to 2 years



EXERCISE AND POSTPRANDIAL LIPEMIA

- Postprandial lipemia – the blood fat, particularly triglyceride (TG) response to a meal
 - Depending on how much fat or sugar is consumed in a meal, a person with normal fasting TG will increase TG by 120 – 300+ mg/dL for 2 – 6 hours after the meal
 - Those with obesity, metabolic syndrome or type II diabetes have much larger increases in post-meal TG
- Prolonged elevated postprandial TG states diminish arterial function, lower HDL and expose the arterial wall to atherogenic lipoprotein particles (that deposit on the innermost layer of arterial walls)
- Sufficient exercise anywhere from 1 – 12 hours before a fat-rich meal will reduce postprandial lipemia by **25 – 40%** (Zhang et al., 1998; Petitt & Cureton, 2003; Malkova & Gill, 2006)



EXERCISE PROGRAMING FOR OVERALL LIPID MANAGEMENT

- **Optimal goals:**
 - ≥ 2000 kcal/week
 - 200+ minutes per week of aerobic activity (anything that increases heart rate)
 - And/or $\geq 70,000$ total steps per week if using a pedometer
 - $\sim 2,000$ steps = ~ 1 mile = ~ 100 kcal (120 – 150 kcal/mile for BMI >35)
- **Minimum:**
 - 1500 kcal (in addition to baseline physical activity)
 - 30,000+ step counts
- Do not forget to include a 5 – 10 minute warm-up and cool-down period in addition to the goal or interval time
- Always check with a doctor before beginning an aerobic or strength training routine, and be aware of contraindications

SAMPLE GRADUATED WEEKLY EXERCISE ENERGY EXPENDITURES

- **Protocol A (600 – 800 kcal/week)**
 - Mon, Wed, Fri: Walk 2 miles/day* = 600 kcal
 - Sun: 20 minutes of low-level stationary cycling = 100 kcal
- **Protocol B (1000 – 1200 kcal/week)**
 - Mon, Wed, Fri: Walk 2 miles/day* = 600 kcal
 - Tues: Walk 3 miles* = 300 kcal
 - Sun: Nine holes of golf or 30 minutes of singles tennis = 300 kcal
- **Protocol C (1500 – 1800 kcal/week)**
 - Mon, Wed, Fri: Walk 3 miles/day* = 900 kcal
 - Tues, Thurs: 30 minutes of cycling (50-60% VO₂ max) = 300 kcal
 - Sun: 60 minutes of singles tennis plus 2-mile walk* = 500 kcal
- **Protocol D (2000+ kcal/week)**
 - 5 days per week: average 300 kcal workout (e.g., 30 – 45 minute aerobic session) = 1500 kcal
 - 1 day per week: perform a long, slow-distance workout (e.g., 2 hour moderate-fast pace variable terrain walk) = 600+ kcal



*Walking at moderate pace (2.5 – 4 mph)

RESISTANCE TRAINING AND LIPID DISORDERS



- Blood lipid response to strength training is likely related to total net energy expenditure (kcal per workout), as is the case with endurance exercise
 - An example of a relatively high-energy-expenditure resistance-training session is low-resistance, high-repetition circuit weight training performed for extended periods and approaching 300 kcal or more per session
- Stronger muscles burn more calories all day, not just after a workout. And burning more calories results in greater weight loss, which lowers TG and LDL cholesterol
- Remember strength training should always compliment, not replace, aerobic activity. Aerobic exercise is a priority, ideally done before strength training to reduce strain on the cardiovascular system
- Schedule an orientation with a certified fitness professional to be instructed on:
 - Appropriate weight loads
 - Proper lifting technique
 - Range of motion for each exercise
 - Correct breathing patterns to avoid strain/Valsalva maneuver

REALISTIC TARGET LIPID GOALS WITH EXERCISE

- Exercise-lipid responses vary among people and the volume of exercise required for significant changes is generally a higher weekly energy expenditure than that for reducing blood pressure or improving physiological well-being
- A **5 – 15% reduction in LDL cholesterol**, or a **10 – 20% reduction in non-HDL cholesterol** (includes more responsive TG-rich lipoproteins) is generally a realistic goal for the first **12 – 16 weeks** of exercise training, assuming sufficient weekly exercise expenditure
- Many people take **6 months** or longer to show significant decreases in total and LDL cholesterol

- Exercise has many advantages beyond lowering cholesterol. Exercise has been shown to:
 - Keep bones strong, reduce the risk of cancer, diabetes, stroke, heart disease and obesity and to improve mood.
- To learn more, or to begin an exercise program, consult with one of South Denver Heart Center's certified fitness professionals in the Wellness Gym, or call us at (303) 715-2261.

