Diet, Inflammation and Cardiovascular Disease

Jayne Byrne, MS, RDN
Associate Professor of Nutrition
Department of Nutrition
College of St. Benedict/St. John's University (1994-present)
• I have no disclosures to report related to this presentation

Inflammation is Essential to Survival
• Central component of innate immunity
• Local response to cellular injury

Goals of inflammation
- eliminate the cause of cell injury
- remove damaged cells
- initiate cellular repair
- resolve the inflammatory process

Inflammation can be Acute or Chronic

Acute
• Develops rapidly in response to injury or invasion
• Redness, swelling, pain, heat, loss of function
• Usually self limiting

Chronic
• Slowly develops (months, years)
• Symptoms may be "silent"
• May be detected by presence of inflammatory biomarkers
• Inducers are “naturally occurring”

Two Types of Chronic Inflammation

“High Grade”
- Progressive shift in immune cell types at inflammation site is constant
- Cyclic destruction/healing w/gradual function loss
- Elevated serum markers measureable, may include auto antibodies
  - Rheumatoid Arthritis
  - Inflammatory Bowel Disease
  - Asthma, psoriasis

“Low Grade”
- Shift in cell types at inflammation site is gradual
- Non-cyclical; removing or reducing triggers reduces inflammation
- Elevated serum markers difficult to measure, not likely to include autoantibodies
  - Obesity, atherosclerosis, Type 2 Diabetes, osteoporosis, sarcopenia, Alzheimer’s??

Calder PC et al. Br J Nutr 2013
Atheroma—the primary lesion of CVD

Dietary Fat, Lipoproteins and Inflammation

Lipoproteins and Atheroma Formation

Type of Dietary Fat Impacts Risk

High Fat Diets Promote Inflammation!!
Types of Saturated Fatty Acids

Individual fatty acids have different impacts

- Palmitic, myristic and lauric acid
  - Increase expression of pro-inflammatory cytokines
  - Promote the uptake of endotoxin in the gut
  - Greater impact on serum lipids

Prominent sources

- Palmitic: excess energy intake, palm oil, meat, dairy
- Lauric: coconut oil, palm kernel oil
- Myristic: palm kernel oil, coconut oil, nutmeg oil


Types of SFA.....

Stearic, medium chain sat. fatty acids
- Less inflammatory, more neutral on blood lipids

Stearic Acid Food Sources
- Beef, pork, lamb, dairy, cocoa butter, chocolate

Medium Chain Fats Food Sources
- Coconut oil, dairy (cheese, butter)

Polyunsaturated Fat (PUFA)

Monounsaturated Fat (MUFA)

- Associated with less adiposity (especially omega-3)
- Lowers total, LDL and HDL cholesterol
- Replacing SFA/trans with PUFA/MUFA reduces risk of inflammation, CVD, possibly aids with reducing adiposity

Omega 6 vs. Omega 3

- Metabolites initiate inflammation
- Intake proven to reduce LDL cholesterol
- Not associated with increased inflammatory markers

- Metabolites resolve inflammation
- High intakes reduce lipid levels, reduce vascular inflammation, reduce blood pressure
- EPA and DHA lower triglycerides, heart rate, blood pressure, inflammation, platelet activation

How much Omega-3??

There may be negative outcomes from excessive intake!
- Animal studies suggest excessive intake alters pathogen clearance, increases mortality from infection
- May interfere with tumor surveillance
- ↑ serum levels associated with ↑ prostate cancer, atrial fib
- May ↑ INR in anticoagulated patients

**Practical Advice – Fatty Acids**

- Safe to replace SFA with PUFA and MUFA (not sugars and starches)
- Overall fat intake 25-35% of kcal
- Emphasize sources of omega-3 when it is practical to do so
  - fatty fish 2-3x weekly
  - nuts and seeds as snacks/protein flip in meals
- Use of vegetable oils with ↑ n-3 content
- Vegetable and olive oils for cooking, salad dressing, etc.
- If n-3 supps are used, limit to ≤ 1 gm EPA/DHA daily

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**Plants (also referred to as phytos-)**

Intake associated with less inflammation (surprise!)

Contributions to reducing inflammation based on:

- Fiber content (improves gut barrier, promotes short chain f.a. production)
- Vitamin and mineral content
- Antioxidant activity
- Flavonoids and other phytochemicals

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**Anti-inflammatory molecules with substantial evidence**

- Allicin - garlic
- Catechins-tea (green and black), cocoa, red wine, many fruits, acai oil
- Cinnamaldehyde-cinnamon
- Curcumin-tumeric
- Lycopene-tomato, watermelon
- Quercetin — peppers, onions, cranberries, cocoa, apples
- Resveratrol-grapes, peanuts, blueberries, cranberries, cocoa, red wine
- Sulphoraphane-broccoli, cabbage, kale, brussels sprouts

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**Practical Advice-Plants**

- Include some at every meal-variety in color is important
- Portion varies with starch content
- Season and add flavor with herbs and spices and reduce sodium
- Some cooked, some raw
- Small amounts of fat improve use of fat soluble vitamins and other components!!
Grains

Whole Grain Intake

More recent concerns about
- Gluten
- Lignans
- FODMAPS

Short Chain Fatty Acids-the Fiber Connection
- Produced in the intestine when microbes ferment undigestible fiber
- Short chain =1-5 carbons in length
- Acetate, Propionate and Butyrate
- In humans, SCFA have been found to:
  -↑ fatty acid oxidation in liver, muscle
  -↑ insulin sensitivity
  -↓ biomarkers of inflammation

Dietary Patterns

Mediterranean Diet
- Observational and interventional evidence of ↓ inflammation, CVD
- Whole grains, plants, olive oil, fish, with limited red meat, added sugar
- Portion sizes smaller. Red wine with food often included
- Meal time is longer, eating is a valued social event


Multi Ethnic Study of Atherosclerosis (MESA)

Foods grouped and then scored for ability to increase biomarkers of inflammation

Highest to lowest impact (summary)
- Fats and oils, high-fat and processed meats, fried potato and salty snacks, desserts, cheese, red meat
- Beer, nuts, seeds, peanut butter, whole milk, wine and spirits
- Low fat dairy desserts, low fat milk, whole grains, tea, beans, vegetables, fruit


Dietary Inflammatory Index

- Literature search for human data associating whole foods and food components to biomarkers of inflammation
- Developed a Dietary Inflammatory Index (DII) to rank foods from maximally anti-inflammatory-maximally pro-inflammatory

Examples

Maximally Pro
- Sat Fat, total fat, trans fat
- Energy, cholesterol

Maximally Anti
- Fiber, beta-carotene, n-3 fa,
- PUFA, onion, spices, herbs,


Food Processing and Cooking

Advanced Glycation End-Products (AGE)
- Non-enzymatic browning: reducing sugars react with amino acids
- Formation enhanced by
  - presence of lipids, protein, reducing sugars in low water environment.
  - high temp cooking of short duration, dry heat
- Some evidence supporting oxidative stress, insulin resistance, cancer

**Food Processing**

Other proposed additives

- Emulsified fat, surfactants, artificial sweeteners, organic solvents, nanoparticles.
- Excessive use of sugar, HFCS and salt

**Evidence Based Resources for Patients, Clients and Professionals**

American Institute for Cancer Research
http://www.aicr.org/reduce-your-cancer-risk/diet/

The Arthritis Foundation
www.arthritis.org

The “official” DASH diet (there are many counterfeit versions)
https://www.nhlbi.nih.gov/health/health-topics/topics/dash