Food as Medicine

Nutrition to Prevent Chronic Disease

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Kettering Medical Center
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Figure 1. Metabolic Pathways Requiring Thiamin Pyrophosphate

PENTOSE PHOSPHATE CYCLE
ribose 5-phosphate → glyceraldehyde 3-phosphate
GLYCOLOYIS
pyruvate → lactate

GLUCOSE CYCLE
pyruvate → acetyl-CoA
Amino acid catabolism

Branched chain amino acids → acetyl-CoA
Branched chain α-keto acids → acetyl-CoA

CITRIC ACID CYCLE
acetyl-CoA → α-ketoglutarate

BCKDH, branched chain α-ketoacid dehydrogenase complex; CoA, coenzyme A; TPP, thiamin pyrophosphate.
Figure 4. Age-adjusted death rates for the 10 leading causes of death in 2016: United States, 2015 and 2016

- Heart disease: 2015 - 168.5, 2016 - 168.5
- Cancer: 2015 - 158.5, 2016 - 158.5
- Unintentional injuries: 2015 - 43.2, 2016 - 47.4
- Chronic lower respiratory diseases: 2015 - 41.6, 2016 - 40.6
- Stroke: 2015 - 37.6, 2016 - 37.3
- Alzheimer's disease: 2015 - 29.4, 2016 - 30.3

Notes: A total of 2.744.248 resident deaths were registered in the United States in 2016. The 10 leading causes accounted for 74.1% of all deaths in the United States in 2016. Rankings for 2015 data are not shown. Causes of death are ranked according to number of deaths. Access data table for Figure 4 at: https://www.cdc.gov/nchs/data/databriefs/db293_table.pdf#4.

Risk Factors for Chronic Disease Deaths

- Dietary risks
  - Tobacco use
  - High systolic blood pressure
  - High body mass index
  - High fasting plasma glucose
  - High total cholesterol
  - Impaired kidney function
  - Alcohol and drug use
  - Air pollution
  - Low physical activity
  - Occupational risks
  - Low bone mineral density
  - Residential radon and lead exposure
  - Unsafe sex
  - Child and maternal malnutrition
  - Sexual abuse and violence
  - Unsafe water, sanitation, and handwashing
45% of deaths due to heart disease, stroke, & diabetes are directly caused by poor diet.

Micha et al
JAMA 2018
“We are too busy mopping the floor to turn off the faucet.”
What I’ll Cover

- Consensus views on nutrition
- What do Americans and Filipinos eat?
- CV disease, insulin resistance, cancer, & obesity: what does the science suggest we should eat?
- Key points about macronutrients (carbs, fats, protein)
Making sense of nutrition studies: What does the overall skyline show?
Healthful
- Whole Grains
- Legumes
- Fruits
- Vegetables
- Nuts
- Seeds

Debatable
- Poultry
- Eggs
- Dairy
- Fish

Unhealthful
- Processed meat
- Red meat
- Added sugar
- Refined grains
- Ultraprocessed foods
Any meat that has been cured, smoked, fermented, or added preservatives.

Bacon, hot dogs, bologna, sausage, salami, pepperoni, ham, cold cuts, deli slices, chicken nuggets
Healthful

- Whole Grains
- Legumes
- Fruits
- Vegetables
- Nuts
- Seeds

Debatable

- Poultry

Unhealthful

- Processed meat
- Red meat
- Added sugar
- Refined grains
- Ultraprocessed foods

Beef, pork, lamb, goat, veal, venison
<table>
<thead>
<tr>
<th>Healthful</th>
<th>Debatable</th>
<th>Unhealthful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Grains</td>
<td>Poultry</td>
<td>Processed meat</td>
</tr>
<tr>
<td>Legumes</td>
<td>Eggs</td>
<td>Red meat</td>
</tr>
<tr>
<td>Fruits</td>
<td>Dairy</td>
<td>Added sugar</td>
</tr>
<tr>
<td>Vegetables</td>
<td></td>
<td>Refined grains</td>
</tr>
<tr>
<td>Nuts</td>
<td></td>
<td>Ultraprocessed foods</td>
</tr>
<tr>
<td>Seeds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Whole grains that have been stripped of most fiber and nutrients.
Whole Grains:
- Whole wheat
- Oats
- Rye
- Corn
- Brown rice
- Barley
- Kamut
- Spelt
- Millet
- Teff
- Wild rice

Pseudograins:
- Quinoa
- Amaranth
- Buckwheat

Anatomy of a grain

Bran: protects the seed
- Fibre
- B vitamins
- Minerals

Germ: nourishment for the seed
- B vitamins
- Vitamin E
- Minerals
- Phytochemicals

Endosperm: energy for the seed
- Carbohydrates
- Some protein
- Some B vitamins

The bran and germ are removed when wholegrains are refined.
Whole Grains:
- Whole wheat
- Oats
- Rye
- Corn
- Brown rice
- Barley
- Kamut
- Spelt
- Millet
- Teff
- Wild rice

Pseudograins:
- Quinoa
- Amaranth
- Buckwheat

Anatomy of a grain

Bran: protects the grain
- Fibers
- Minerals

Germ: nourishment
- Proteins
- Fats
- Vitamins
- Phytochemicals

Endosperm: energy for the seed
- Carbohydrates
- Some protein
- Some B vitamins

Refined Grain
Lose 90% of fiber & nutrients

The bran and germ are removed when wholegrains are refined.
INGREDIENTS: UNBLEACHED ENRICHED WHEAT FLOUR, MALTED BARLEY FLOUR, REDUCED IRON, NIACIN, THIAMIN MONONITRATE (VITAMIN B1), RIBOFLAVIN (VITAMIN B2), FOLIC ACID, WATER, SUGAR, YEAST, SOYBEAN OIL, SALT, MONOGLYCERIDES, CALCIUM PROPIONATE (PRESERVATIVE), DATEM, CALCIUM SULFATE, NATURAL FLAVOR, SOY LECITHIN, CALCIUM CARBONATE, CITRIC ACID, WHEAT GLUTEN, SOY FLOUR.

“Wheat bread” “Multigrain” “7-Grain”
<table>
<thead>
<tr>
<th>Whole Carbohydrates (Containing Natural Sugars)</th>
<th>Refined Carbohydrates (Often With Refined Sugars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRUITS</td>
<td>CANDY</td>
</tr>
<tr>
<td>LEAFY GREENS &amp; VEGGIES</td>
<td>SODA</td>
</tr>
<tr>
<td>STARCHY VEGGIES (POTATOES, SWEET POTATOES)</td>
<td>PASTRIES (DONUTS, SCONES, CROISSANTS)</td>
</tr>
<tr>
<td>BEANS, LENTILS, PEAS</td>
<td>SUGARY CEREALS</td>
</tr>
<tr>
<td>WHOLE GRAINS (BROWN RICE, QUINOA, OATS)</td>
<td>WHITE RICE</td>
</tr>
<tr>
<td>CORN</td>
<td>WHITE FLOUR PASTA</td>
</tr>
<tr>
<td>PASTA MADE FROM 100% WHOLE WHEAT, BROWN RICE, LENTILS, QUINOA, BEANS &amp; CHICKPEAS</td>
<td>WHITE BREADS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Protein</strong></th>
<th><strong>Protein</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High in Fiber</strong></td>
<td><strong>Low in Fiber</strong></td>
</tr>
<tr>
<td><strong>High in Water</strong></td>
<td><strong>Low in Macronutrients</strong></td>
</tr>
<tr>
<td><strong>High in Antioxidants</strong></td>
<td><strong>Highly Processed</strong></td>
</tr>
<tr>
<td><strong>High in Minerals</strong></td>
<td><strong>Minimally Processed</strong></td>
</tr>
<tr>
<td><strong>High in Vitamins</strong></td>
<td><strong>High in Macronutrients</strong></td>
</tr>
</tbody>
</table>
Healthful
- Whole Grains
- Legumes
- Fruits
- Vegetables
- Nuts
- Seeds

Debatable
- Industrially produced foods
  - Physical, biological, or chemical processing
  - Industrial/chemical additives (flavors, colors, sweeteners, emulsifiers etc)
  - Highly palatable

Unhealthful
- Processed meat
- Red meat
- Added sugar
- Refined grains
- Ultraprocessed foods
“...a diet **higher in plant-based foods**, such as vegetables, fruits, whole grains, legumes, nuts, and seeds, and **lower in calories and animal-based foods** is more health promoting and is associated with less environmental impact than is the current U.S. diet.”

Scientific Report of the 2015 Dietary Guidelines Advisory Committee
“Eat food. Not too much. Mostly plants.”
Michael Pollan
What is a Plant-Based Diet?
What About a Mediterranean Diet?

• Based on traditional dietary patterns in Mediterranean; varies by place

• Mediterranean diet scoring system:
  ✓ Get points for eating grains, beans, fruits, vegetables, olive oil, fish, & small amount of wine
  ✓ Lose points for eating dairy, poultry, & red meat

• Benefits for reduction of cardiovascular, cancer, diabetes risk
  ✓ Lyon Heart Study
  ✓ PREDIMED Study
• More plants → better outcomes
• More meats → worse outcomes
• Fish, olive oil, alcohol → not the primary benefit
Which of the following is the #1 source of calories among Americans ages 2 and up?

A. Sugar-sweetened beverages
B. Desserts
C. Breads, bagels & rolls
D. Cheese & cheese products
Top Sources of Calories Among Americans ≥ 2 Yrs Old

#1 Grain-based desserts
Cake, cookies, pie, cobbler, sweet rolls, pastries, donuts

#2 Breads
White bread and rolls, mixed-grain bread, flavored bread, bagels

#3 Chicken and chicken mixed dishes
Fried and baked chicken parts, chicken strips/patties, stir-fries, casseroles, sandwiches, salads, other chicken dishes

#4 Soda/energy/sports drinks
Sodas, energy drinks, sports drinks, sweetened bottled water

#5 Pizza
70% of our calories come from processed & ultraprocessed foods

- **14%** meats, milk, eggs
- **14%** grains, Root vegetables, Legumes, vegetables, fruits (includes juices, refined grains)
- **30%** unprocessed or minimally processed foods
- **58%** industrially produced
  - Added sweeteners
  - Vegetable oils
  - Animal fats
  - Foods made with these (cheese, processed meats)
  - Breads
  - Desserts
  - Salty snacks
  - Soft drinks
  - Pizza
  - Breakfast cereals
  - Meat products etc
Cardiovascular Disease

Insulin Resistance

Cancer Prevention

Obesity
Cardiovascular Disease

Insulin Resistance

Cancer Prevention

Obesity
CORONARY DISEASE AMONG UNITED STATES SOLDIERS KILLED IN ACTION IN KOREA

PRELIMINARY REPORT

Major William F. Enos, Lieut. Col. Robert H. Holmes (MC), U. S. Army
and
Capt. James Beyer (MC), Army of the U. S.

The purpose of this paper is to describe and analyze the gross lesions found in the coronary arteries of United States soldiers killed in action in Korea. The histology will be discussed in detail in a subsequent paper as will such pertinent data as race, body build, and personal habits.

MATERIAL

Recently 300 autopsies were performed on United States battle casualties in Korea. Most of these soldiers were killed in action or suffered accidental death in front line areas. The coronary arteries were carefully dissected in all cases. No case in which there was known clinical evidence of coronary disease was included in this series.

The average age in 200 cases was 22.1 years. The ages in the first 98 cases were not recorded except that the oldest patient was 33. In the entire series, the youngest recorded age was 18 and the oldest 48.

FINDINGS

In 77.3% of the hearts, some gross evidence of coronary arteriosclerosis was found. The disease process varied from "fibrous" thickening to large atheromatous plaques causing complete occlusion of one or more of the major vessels (table 1).

In the great majority of cases, the location of the lesions followed a constant pattern. If the lesion was found in the proximal third of the left coronary artery, it was usually thickest on the epicardial side of the lumen, whereas, if it was in the distal third of the artery just proximal to the bifurcation of the circumflex artery, it tended to as-

<table>
<thead>
<tr>
<th>Site</th>
<th>No. of Cases</th>
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<tbody>
<tr>
<td>Left coronary</td>
<td></td>
</tr>
<tr>
<td>Above bifurcation</td>
<td>10</td>
</tr>
<tr>
<td>At bifurcation</td>
<td>22</td>
</tr>
<tr>
<td>And circumflex</td>
<td>1</td>
</tr>
<tr>
<td>And right coronary</td>
<td>1</td>
</tr>
<tr>
<td>Circumflex, and right coronary</td>
<td>1</td>
</tr>
<tr>
<td>Anterior descending</td>
<td></td>
</tr>
<tr>
<td>Branch</td>
<td>114</td>
</tr>
<tr>
<td>And circumflex</td>
<td>13</td>
</tr>
<tr>
<td>And right coronary</td>
<td>23</td>
</tr>
<tr>
<td>And left coronary</td>
<td>5</td>
</tr>
<tr>
<td>Left and right coronaries</td>
<td>4</td>
</tr>
<tr>
<td>Left coronary, and circumflex</td>
<td>1</td>
</tr>
<tr>
<td>Circumflex, and right coronary</td>
<td>8</td>
</tr>
<tr>
<td>Left and right coronary, and detach</td>
<td>11</td>
</tr>
<tr>
<td>Right coronary only</td>
<td>3</td>
</tr>
<tr>
<td>Circumflex only</td>
<td>4</td>
</tr>
</tbody>
</table>
• Grains
• Legumes
• Fruits
• Vegetables
• Nuts & Seeds
• Small amounts of meat/poultry/dairy/eggs
• Few highly processed foods
Red & Processed Meat – CV Risk

Incidence of diabetes and CVDs

- Unprocessed red meat: RR per 100 g per day
- Processed red meat: RR per 50 g per day

Relative risk (RR)

- Diabetes [13]
- Stroke [50]
- Stroke ischaemic [50]
- Stroke haemorrh. [50]
- CHD [34,52]
- Heart failure, M [54,55]
- Heart failure, W [56]

Wolk, Journal of Internal Medicine 2016
<table>
<thead>
<tr>
<th>Study</th>
<th>Ischemic Heart Disease</th>
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<tbody>
<tr>
<td>Key et al</td>
<td>↓ 24% (mortality)</td>
</tr>
<tr>
<td>(Am J Clin Nutr 1999, n&gt;76,000)</td>
<td></td>
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<tr>
<td>Huang et al</td>
<td>↓ 29% (mortality)</td>
</tr>
<tr>
<td>(Ann Nutr Metab 2012, n&gt;124,000)</td>
<td></td>
</tr>
<tr>
<td>EPIC Oxford</td>
<td>↓ 32% (incident cases)</td>
</tr>
<tr>
<td>(Am J Clin Nutr 2013, n&gt;44,000)</td>
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</tbody>
</table>
TMAO effects

- ↑ Uptake of cholesterol by macrophages
- ↑ foam cell formation
- ↑ platelet aggregation
- ↓ hepatic clearance of cholesterol

TMAO Increases

- All-cause mortality
- CV mortality
- Major adverse CV events
- CHF severity
- 30-day adverse CV events post ACS

Koeth R et al, Nat Med, 2013
Hazard ratio, CV mortality: 2.75 for >25% of kcal from added sugar

RR Coronary heart disease: 1.98 for highest quintile of refined carbohydrates
Limits on Added Sugar (AHA recommendations)

6 Teaspoons added sugars per day for women

9 Teaspoons added sugars per day for men

15 Teaspoons of sugars in a 20 oz. coke

23 Teaspoons ACTUAL sugars consumed by average American per day

Women: 6 tsp/100 Kcal/25g
Men: 9 tsp/150 Kcal/37.5g

Johnson et al, Circulation 2009
<table>
<thead>
<tr>
<th>agave juice</th>
<th>dri-mol</th>
<th>honey</th>
<th>mizuame</th>
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<tbody>
<tr>
<td>agave nectar</td>
<td>drisweet</td>
<td>honibake</td>
<td>molasses</td>
</tr>
<tr>
<td>agave sap</td>
<td>dri sweet</td>
<td>honi bake</td>
<td>nulomoline</td>
</tr>
<tr>
<td>agave syrup</td>
<td>dri-sweet</td>
<td>honi-bake</td>
<td>powdered sugar</td>
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<tr>
<td>beet sugar</td>
<td>dried raisin</td>
<td>honi-flake</td>
<td>rice syrup</td>
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<tr>
<td>brown rice syrup</td>
<td>sweetener</td>
<td>honi-flake</td>
<td>sorghum</td>
</tr>
<tr>
<td>brown sugar</td>
<td>edible lactose</td>
<td>invert sugar</td>
<td>sorghum syrup</td>
</tr>
<tr>
<td>cane juice</td>
<td>flo malt</td>
<td>inverted sugar</td>
<td>starch sweetener</td>
</tr>
<tr>
<td>cane sugar</td>
<td>flo-malt</td>
<td>isoglucose</td>
<td>sucanat</td>
</tr>
<tr>
<td>cane syrup</td>
<td>flomalt</td>
<td>isomaltulose</td>
<td>sucrose</td>
</tr>
<tr>
<td>clintose</td>
<td>fructose</td>
<td>kona ame</td>
<td>sucrevet</td>
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<tr>
<td>confectioners</td>
<td>fructose sweetener</td>
<td>kona-ame</td>
<td>sugar beet</td>
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<tr>
<td>powdered sugar</td>
<td>glaze and icing</td>
<td>lactose</td>
<td>sugar invert</td>
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<tr>
<td>confectioners</td>
<td>sugar</td>
<td>liquid sweetener</td>
<td>sweet n neat</td>
</tr>
<tr>
<td>sugar</td>
<td>glaze icing sugar</td>
<td>malt</td>
<td>table sugar</td>
</tr>
<tr>
<td>corn glucose syrup</td>
<td>golden syrup</td>
<td>malt sweetener</td>
<td>treacle</td>
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<td>corn sweet</td>
<td>gomme</td>
<td>malt syrup</td>
<td>trehalose</td>
</tr>
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<td>corn sweetener</td>
<td>granular sweetener</td>
<td>maltose</td>
<td>tru sweet</td>
</tr>
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<td>corn syrup</td>
<td>granulated sugar</td>
<td>maple</td>
<td>turbinado sugar</td>
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<td>date sugar</td>
<td>hi-fructose corn</td>
<td>maple syrup</td>
<td>versatose</td>
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<tr>
<td>dextrose</td>
<td>syrup</td>
<td>mazu aame</td>
<td></td>
</tr>
<tr>
<td>dri mol</td>
<td>high fructose corn</td>
<td>mizu-ame</td>
<td></td>
</tr>
</tbody>
</table>

• Systemic review and meta-analysis, 95 studies worldwide

• Each 2.5 servings/day of fruits & vegetables decreases risk by
  • 8% for CHD
  • 16% for stroke
  • 10% for all cause mortality

• Benefits continued up to 10 servings/day
• Nurses’ Health Study 1 & 2, Health Professionals Follow-Up Study; 4.8 million person-years of follow-up

• Plant-based diet index (PDI): high in all plant foods, low in animal foods
  • Healthy PDI: High in whole grains, fruits, vegetables, nuts, legumes, vegetable oils
  • Unhealthy PDI: high in fruit juice, refined grains, fried potatoes & chips, sugar-sweetened beverages, sweets/desserts
Hazard ratio, CHD incidence

- Overall plant-based diet: 0.92 (0.83-1.01)
- Healthy plant-based: 0.75 (0.68-0.83)
- Unhealthy plant-based: 1.32 (1.20-1.46)
Plant Foods & Cardiovascular Health: Mechanisms?

- Replace disease-promoting foods
- Reduce LDL oxidation via polyphenols/antioxidants
- Improve endothelial function
- Reduce inflammation
- Beneficially alter gut microbiota
- Lower blood pressure via high potassium low sodium
- Decrease lipids
### Randomized Controlled Trials

<table>
<thead>
<tr>
<th>Diet Description</th>
<th>Decrease in Total &amp; LDL Cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi-veg diet, Lacto-ovo veg diet</td>
<td>10-15%</td>
</tr>
<tr>
<td>Vegan diet</td>
<td>15-20%</td>
</tr>
<tr>
<td>Veg w added fiber/soy/nuts</td>
<td>20-35%</td>
</tr>
</tbody>
</table>
The Pleiotropic Benefits of Plant Foods

**Healthful Plant-Based Diet**
- Low energy-density
- Low saturated fat, high fiber content
- High dietary fiber, especially cereal fiber
- Appropriate fat composition
- Low saturated fat, high unsaturated fat
- High levels of antioxidant nutrients: Polyphenols, carotenoids, Vitamins C & E
- High levels of certain micronutrients: B-vitamins, Magnesium, Potassium
- Low levels of certain dietary factors: Heme iron, nitrites, nitrates

**Benefits**
- Help with weight loss/maintenance
- Enhance glycemic control
- Improve lipid profile
- Reduce blood pressure
- Improve vascular health
- Decrease inflammation
- Improve gut microbial profile

**Result**
- Reduced cardiovascular risk
Intensive Lifestyle Changes for Reversal of Coronary Heart Disease

Dean Ornish, MD; Larry W. Scherwitz, PhD; James H. Billings, PhD, MPH; K. Lance Gould, MD; Terri A. Merritt, MS; Stephen Sparler, MA; William T. Armstrong, MD; Thomas A. Ports, MD; Richard L. Kirkeeide, PhD; Charissa Hogeboom, PhD; Richard J. Brand, PhD

JAMA 1998

• RCT, pts with CAD, 5 yrs
• Plant-based lifestyle vs physician’s diet advise
• CV events: RR 2.47 in control group, despite statins
• Angina: +186% in control, -91% in intervention

![Graph showing mean percentage diameter stenosis in treatment and control groups at baseline, 1 year, and 5 years. Error bars represent SEM; asterisk, P=.02 by between-group 2-tailed test; dagger, P=.001 by between-group 2-tailed test.](image)
Half Of Adults In The U.S. Have Diabetes Or Pre-Diabetes, Study Finds

Robert Glatter, MD, CONTRIBUTOR

I cover breaking news in medicine, med tech and public health. FULL BIO →

Opinions expressed by Forbes Contributors are their own.
Fat accumulation in skeletal muscle & liver cells (ectopic fat) is a primary cause of insulin resistance

- **Skeletal Muscle:** decreased glucose uptake
- **Liver:** decreased glycogen synthesis, increased gluconeogenesis
Fat accumulation in skeletal muscle & liver cells (ectopic fat) is a primary cause of insulin resistance.

• Skeletal Muscle: decreased glucose uptake
• Liver: decreased glycogen synthesis, increased gluconeogenesis

Additional factors include:
• Adiposity
• Excess calories
• Excess dietary fat
• Inflammation
• Oxidative stress
• Mitochondrial dysfunction
Risk of Diabetes Per Each Daily Serving

- Processed meat: 37%
- Red meat: 17%
- Sugar-added beverages: 21%

Schwingshackl et al., Eur J Epidemiol 2017
Kim et al, Metabolism 2015
• Replace carbs with protein → increased risk of DM2
• 22% increased risk for highest quintile of protein (109g/day)
• Association attributed to animal protein
Low-carb diets can *increase* the risk of diabetes...

- Bao et al, Diabetes Care 2016
- de Koning et al, Am J Clin Nutr 2011
- Schulze et al, Br J Nutr 2008

...and do not improve glycemic control over the long-term

- Snorgaard et al, BMJ Open Diabetes Res Care 2017
Fructose from Sugar-Sweetened Foods/Drinks

“Empty Calories” → Weight gain

Obesity

Lipotoxicity → Insulin Resistance

De novo lipogenesis in liver

Fatty liver & increased fat in skeletal muscle
Which type of foods most protective against type 2 diabetes?

A. Cruciferous vegetables  
B. Berries  
C. Whole Grains  
D. Fish
Risk of Diabetes Per Each Daily Serving

- Processed meat: ↑ 37%
- Red meat: ↑ 17%
- Sugar-added beverages: ↑ 21%

Whole grains: ↓ 13%

Schwingshackl et al, Eur J Epidemiol 2017
Whole Grains lower diabetes risk: effect of cereal fiber

- Improves postprandial glucose response
- Lowers calorie density
- Increases satiety
- Metabolized by gut bacteria to form short-chain fatty acids
  - Increase GLP1
  - Increase insulin sensitivity
  - Regulate cytokines to decrease inflammation
  - Improve mitochondrial function
• >500,000 adults followed for 7 yrs
• Daily fruit consumption: 12% lower risk of diabetes
• In those who had diabetes at baseline, 3x/wk fruit lowered
  • All-cause mortality by 17%
  • Microvascular complications by 28%
  • Macrovascular complications by 13%
• Nurses’ Health Study 1 & 2, Health Professionals Follow-Up Study; 4.8 million person-years of follow-up
• Risk of type 2 diabetes
  ➢ Plant-based dietary pattern: **20% ↓ risk**
  ➢ Healthy plant-based pattern: **34% ↓ risk**
  ➢ Unhealthy plant-based pattern: **16% ↑ risk**
• Independent of body weight & other risk factors
Plant-Based Diet for Type 2 Diabetes

- RCT, 99 pts with DM2 x 74wks
- Low-fat plant-based diet (no calorie restrictions) vs conventional, reduced-calorie diet
- Better glycemic control with plant-based diet (a1c -0.40 vs -0.01, p<0.03) when med adjustments excluded
- Better lipid reduction & weight loss with plant-based diet

Barnard et al, AM J Clin Nutr 2009
<table>
<thead>
<tr>
<th>Lifestyle Therapy</th>
<th>Risk Stratification for Diabetes Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nutrition</strong></td>
<td>Maintain optimal weight</td>
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<tr>
<td></td>
<td>- Calorie restriction (if BMI is increased)</td>
</tr>
<tr>
<td></td>
<td>- Plant-based diet; high</td>
</tr>
<tr>
<td></td>
<td>polyunsaturated and monounsaturated fatty</td>
</tr>
<tr>
<td></td>
<td>acids</td>
</tr>
<tr>
<td></td>
<td>+ Avoid trans fatty acids; limit saturated</td>
</tr>
<tr>
<td></td>
<td>fatty acids</td>
</tr>
<tr>
<td></td>
<td>+ Structured counseling</td>
</tr>
<tr>
<td></td>
<td>+ Meal replacement</td>
</tr>
<tr>
<td><strong>Physical Activity</strong></td>
<td>150 min/week moderate exertion</td>
</tr>
<tr>
<td></td>
<td>- (eg: walking, stair climbing)</td>
</tr>
<tr>
<td></td>
<td>- Strength training</td>
</tr>
<tr>
<td></td>
<td>- Increase as tolerated</td>
</tr>
<tr>
<td></td>
<td>+ Structured program</td>
</tr>
<tr>
<td></td>
<td>+ Wearable technologies</td>
</tr>
<tr>
<td></td>
<td>+ Medical evaluation/clearance</td>
</tr>
<tr>
<td></td>
<td>+ Medical supervision</td>
</tr>
<tr>
<td><strong>Sleep</strong></td>
<td>About 7 hours per night</td>
</tr>
<tr>
<td></td>
<td>- Basic sleep hygiene</td>
</tr>
<tr>
<td></td>
<td>+ Screen OSA</td>
</tr>
<tr>
<td></td>
<td>+ Home sleep study</td>
</tr>
<tr>
<td></td>
<td>+ Referral to sleep lab</td>
</tr>
<tr>
<td><strong>Behavioral Support</strong></td>
<td>Community engagement</td>
</tr>
<tr>
<td></td>
<td>- Alcohol moderation</td>
</tr>
<tr>
<td></td>
<td>+ Discuss mood with HCP</td>
</tr>
<tr>
<td></td>
<td>+ Formal behavioral therapy</td>
</tr>
<tr>
<td><strong>Smoking Cessation</strong></td>
<td>No tobacco products</td>
</tr>
<tr>
<td></td>
<td>+ Nicotine replacement therapy</td>
</tr>
<tr>
<td></td>
<td>+ Referral to structured program</td>
</tr>
</tbody>
</table>
Cardiovascular Disease

Insulin Resistance

Cancer Prevention

Obesity
<table>
<thead>
<tr>
<th>Healthful</th>
<th>Debatable</th>
<th>Unhealthful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Grains</td>
<td>Poultry</td>
<td>Processed meat</td>
</tr>
<tr>
<td>Legumes</td>
<td>Eggs</td>
<td>Red meat</td>
</tr>
<tr>
<td>Fruits</td>
<td>Dairy</td>
<td>Added sugar</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Fish</td>
<td>Refined grains</td>
</tr>
<tr>
<td>Nuts</td>
<td></td>
<td>Ultraprocessed foods</td>
</tr>
<tr>
<td>Seeds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Processed meat causes cancer, says WHO

Ham, Sausages Cause Cancer; Red Meat Probably Does, Too, WHO Group Says

Hot dogs, bacon and other processed meats cause cancer, World Health Organization declares
MEAT AND CANCER

HOW STRONG IS THE EVIDENCE?

IARC CARCINOGENIC CLASSIFICATION GROUPS

GROUP 1
- Causes cancer

GROUP 2A
-Probably causes cancer

GROUP 2B
- Possibly causes cancer

GROUP 3
- Not classifiable as a cause of cancer

GROUP 4
- Probably not a cause of cancer

Processed meats have been given Group 1 classification

Includes:
- Salami
- Bacon
- Sausages and hot dogs

Red meats have been given Group 2A classification

Includes:
- Pork
- Beef
- Lamb

(Does not include chicken or fish)

WE WILL BEAT CANCER SOONER
cruk.org
Risk of colorectal cancer:
• 17% increase per 100g/day red meat
• 18% increase per 50g/day of processed meat

(Chan et al, Plos One 2011)
What are the mechanisms?

- Nitrate Salts
- Heme iron
- Heterocyclic amines
- Polyaromatic hydrocarbons
- Advanced glycation end products
- N-Glycolylneuraminic acid (Neu5Gc)
Fruits & Vegetables

- 7.5 servings/day confers significant, 14% reduction in total cancer risk
- Significant benefit for cruciferous vegetables & green-yellow vegetables

Aune et al, Int J Epidemiol 2017

14% risk reduction at 600g (7.5 servings) per day
Whole Grains

• Every 3 servings/day
  ➢ Decreases colorectal cancer risk by 17%
  ➢ Decreases total cancer mortality by 17%

• In stages I-III colon cancer, every 5 g daily increase in whole-grain fiber associated with 33% decrease in colorectal cancer mortality
Fruits & vegetables: ↑ expression of genes used in cell defense & DNA repair
Plant-based diet: ↓ expression of tumor-promoting genes
<table>
<thead>
<tr>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Fatness</strong></td>
</tr>
<tr>
<td>Be as lean as possible within the normal range of body weight</td>
</tr>
<tr>
<td><strong>Physical Activity</strong></td>
</tr>
<tr>
<td>Be physically active as part of everyday life</td>
</tr>
<tr>
<td><strong>Foods and Drinks that Promote Weight Gain</strong></td>
</tr>
<tr>
<td>Limit consumption of energy-dense foods</td>
</tr>
<tr>
<td>Avoid sugary drinks</td>
</tr>
<tr>
<td><strong>Plant Foods</strong></td>
</tr>
<tr>
<td>Eat mostly foods of plant origin</td>
</tr>
<tr>
<td><strong>Animal Foods</strong></td>
</tr>
<tr>
<td>Limit intake of red meat and avoid processed meat</td>
</tr>
<tr>
<td><strong>Alcoholic Drinks</strong></td>
</tr>
<tr>
<td>Limit alcoholic drinks</td>
</tr>
<tr>
<td><strong>Preservation, Processing, Preparation</strong></td>
</tr>
<tr>
<td>Limit consumption of salt</td>
</tr>
<tr>
<td>Avoid moldy cereals (grains) or pulses (legumes)</td>
</tr>
<tr>
<td><strong>Dietary Supplements</strong></td>
</tr>
<tr>
<td>Aim to meet nutritional needs through diet alone</td>
</tr>
</tbody>
</table>

American Institute for Cancer Research, AICR.org
Cardiovascular Disease

Insulin Resistance

Cancer Prevention

Obesity
What’s the best diet for healthy weight loss?
What’s the best diet for healthy weight loss?

• Sustainable – not a temporary ‘diet’
What’s the best diet for healthy weight loss?

• Sustainable – not a temporary ‘diet’
• Optimizes overall health independent of weight loss
• Prospective cohort study: 130,000 pts, 20 yrs
• Low-carb diets – animal vs plant
• Increased mortality with animal-based diet
  ➢ All-cause, HR 1.23
  ➢ Cardiovascular, HR 1.14
  ➢ Cancer, HR 1.28
• Lower mortality with plant-based diet (HR 0.80)
"...the metabolic benefits of weight loss were completely abolished in women who consumed high-protein diets" despite the same, substantial degree of weight loss as women consuming a lower-protein diet.

Smith et al., 2016, Cell Reports 17, 849-861
Low-Carb High-Fat Diets

Possible Benefits

- Avoids added sugar & refined grains
- Short-term weight loss
- Short-term glycemic improvements in DM pts

Major Concerns

- Limited evidence; most studies short-term, w/ intermediate markers
- High saturated fat; LDL can increase or at best stay stable
- May increase risk of CV disease, cancer, premature death like other low-carb diets
- Can be low in fiber & restricts very healthful foods: whole grains, beans, most fruits
- Unclear if sustainable in long-term
“Eat food. Not too much. Mostly plants.”
Michael Pollan
More Plants...Healthier Weight

Prevalence Studies:
People eating diets high in plant foods have healthier BMIs

Tonstad, Diabetes Care 2009
Spencer, Int J Obesity 2003
Wang, Int J Obesity 2009

Prospective Studies:
Diets low in fiber & high in meat are strongly tied to weight gain

Vergnaud et al, AM J Clin Nutr 2010
Halkjaer et al, Int J Obesity 2011
• 12 RCTs of vegetarian vs nonvegetarian diets; 1151 subjects, median 18 wks

• Weight loss significantly greater with vegetarian diet

• Mean difference, -2.02 kg (95% CI: -2.80 to -1.23)
  ➢ Vegan diet: -2.52 kg (95% CI: -3.02 to -1.98)
  ➢ Lacto-ovo-vegetarian diet: -1.48 kg (95% CI: -3.43 to 0.47)

• Greater weight loss when energy restricted
• Increases satiety without extra calories
• Add 14g fiber/day → 10-18% lower calorie intake
• Whole grain fiber increases metabolic rate & promotes loss of calories in stool
• Promotes beneficial gut bacterial patterns & production of SCFAs
• Improves blood sugar response to food
• Reduces heart disease, diabetes, & cancer risk
A Day of Beverages
1370 Calories

110 calories: orange juice (8 oz.)
400 calories: mocha (medium)
280 calories: regular cola (20 oz.)
230 calories: fruit drink (16 oz.)
200 calories: sweet tea (16 oz.)
150 calories: beer (12 oz.)
Carbs, Protein, & Fat: The Bottom Line
### Whole vs. Refined Carbs

<table>
<thead>
<tr>
<th>Whole Carbohydrates (Containing Natural Sugars)</th>
<th>Refined Carbohydrates (Often With Refined Sugars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits</td>
<td>Candy</td>
</tr>
<tr>
<td>Leafy greens &amp; veggies</td>
<td>Soda</td>
</tr>
<tr>
<td>Starchy veggies (potatoes, sweet potatoes)</td>
<td>Pastries (donuts, scones, croissants)</td>
</tr>
<tr>
<td>Beans, lentils, peas</td>
<td>Sugary cereals</td>
</tr>
<tr>
<td>Whole grains (brown rice, quinoa, oats)</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td></td>
</tr>
<tr>
<td>Pasta made from 100% whole wheat, brown rice,</td>
<td></td>
</tr>
<tr>
<td>lentils, quinoa, beans &amp; chickpeas</td>
<td></td>
</tr>
<tr>
<td>High in Fiber</td>
<td>Low in Fiber</td>
</tr>
<tr>
<td>High in Water</td>
<td>Low in Macronutrients</td>
</tr>
<tr>
<td>High in Antioxidants</td>
<td>Highly Processed</td>
</tr>
<tr>
<td>High in Minerals</td>
<td></td>
</tr>
<tr>
<td>High in Vitamins</td>
<td></td>
</tr>
<tr>
<td>Minimally Processed</td>
<td></td>
</tr>
</tbody>
</table>

Forksoverknives.com
Protein
Protein Needs vs Actual Intake

Fulgoni et al, Am J Clin Nutr 2008
Figure. Dietary mean protein intakes standardized to 2,000 kcal/day by dietary pattern in the Adventist Health Study 2. Adjustments were made for age, sex, and race. *Significant contrast (P<0.05) and a mean difference ≥20% when compared to nonvegetarian dietary pattern as the group of reference.
Problems With Excess Protein

- Obesity
- Diabetes
- Heart Disease
- High Blood Pressure
- High Cholesterol
- Kidney Stones
- Worsened Kidney Function
- Gout
- Cancers
Among those 1 with ≥ risk factor, replacing just 3% of animal protein lowered mortality by
- 34% for processed red meat
- 19% for eggs (including 17% decrease in cancer death)
- 12% for unprocessed red meat
- 8% for dairy
- 6% for poultry & fish
The package matters....
What nutrient are 97% of Americans deficient in?

A. Iron
B. Omega 3 fatty acids
C. Calcium
D. Fiber
Fats
# The Skinny on Fats

## Saturated
- Highest in animal foods, tropical oils
- Increase LDL, atherosclerosis, insulin resistance

## Monounsaturated
- Olives, avocados, nuts
- Decrease insulin resistance

## Trans-Fats
- “Partially hydrogenated” oils
- Mostly manmade
- Ultra processed foods
- Highly atherogenic

## Polyunsaturated
- Vegetable oils, nuts, seeds, fish (omega 3)
- Decrease insulin resistance, lower LDL
A word about saturated fats...

Butter Is Back

By Mark Bittman

March 25, 2014
• Lower risk of CHD when saturated fat replaced with
  ➢ Polyunsaturated fat
  ➢ Monounsaturated fat
  ➢ Whole grains
  ➢ Plant proteins

• “Current dietary recommendations should focus on replacing saturated fat with unsaturated fats or whole grains as an effective approach towards preventing CHD.”
The package matters!
Protein & fat: animal vs plant sources
Carbs: refined vs whole-food sources
Then God said, “I give you every seed-bearing plant on the face of the whole earth and every tree that has fruit with seed in it. They will be yours for food.”

-Genesis 1:29