Nutrition, the food system, and chronic disease

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The Setting

• Obesity/overweight – 2/3 US adults, prevalence x2 in ~25 yrs
• Pre/Diabetes – 40% US adults, prevalence DM ~x2 over 20 yrs
• Cardiovascular disease – still leading cause of death.
• Metabolic syndrome = early signs of other cluster diseases; 35% adults, ~55%>60 yrs
• Alzheimer’s disease – ½ >84 yrs old, 5.3M
Environmental Drivers of Chronic Disease

Environmental Factors
- Food system/Diet
- Fossil Fuels
- Socio-economic Stress
- Environmental Chemicals
- Built Environment/ incl. transportation

Altered Pathways
- Inflammation
- Disrupted Insulin Signaling
- Oxidative Stress

Western Disease Cluster
- Diabetes
- Obesity
- Abnormal Lipids
- Metabolic Syndrome
- Cardiovascular Disease

Chronic Disease
- Parkinson’s
- Alzheimer’s
Environmental Drivers of Chronic Disease

Environmental Factors  \[\rightarrow\]  Altered Pathways  \[\rightarrow\]  Chronic Disease

Mechanisms of Action

- Inflammation
- Disrupted Insulin Signaling
- Oxidative Stress
Inflammation

• Inflammation is a dimension of diabetes, metabolic syndrome, obesity, CVD, some neurodegenerative disorders, and other chronic illnesses.

• Numerous inflammatory markers involved (e.g. CRP, interleukin 6, tumor necrosis factor, prostaglandin E2, and others)

• Activated microglia produce inflammatory mediators that activate more cells to produce additional inflammatory mediators.
Oxidative Stress

INTERNAL
Mitochondria
Activated Immune Cells (phagocytes)

EXTERNAL
Tobacco smoke
Industrial pollutants
Ozone, particulate
Pesticides
Radiation
Anesthetics
Organic solvents
Some pharmaceuticals
High oxygen
Food*

Sufficient antioxidants keep this process in check.

Tissue Injury
Insulin Signaling = Normal Metabolism

Insulin signaling

- ↓ blood sugar
- ↓ artery disease
- ↓ triglycerides
Disrupted Insulin Signaling = Inflammatory Metabolism

- Insulin signaling
  - ↑ blood sugar
  - ↑ artery disease
  - ↑ triglycerides
Environment Drives Chronic Disease

Environmental Factors \[ \rightarrow \text{Altered Pathways} \rightarrow \text{Chronic Disease} \]

Food System/Diet
Novel Nutrients Are Pervasive, Promote Inflammatory Metabolism
What’s “Novel” in the Western Diet?

“Hypothetical scheme of fat, fatty acid (\(\omega_6, \omega_3, \text{trans}\) and total) intake (as percentage of calories from fat) and intake of vitamins E and C (mg/d). Data were extrapolated from cross-sectional analyses of contemporary hunter-gatherer populations and from longitudinal observations and their putative changes during the preceding 100 years [75].” From AP Simopoulos, *The importance of the ratio of omega-6/omega-3 essential fatty acids*. Biomedicine & Pharmacotherapy 56 (2002) 365-379.
Dietary salt

- On average, Americans consume more than 3,400 mgs of sodium daily.
- The amount above which health problems appear is 2,300 mgs daily.
- The recommended adequate intake of sodium is 1,500 milligrams per day, and people over 50 need even less.
- Most dietary salt comes from processed foods.
High Glycemic Carbohydrates Increase the Risk of Chronic Disease

High glycemic carbohydrates break down quickly during digestion, rapidly releasing glucose (sugar) into the bloodstream.

INSULINEMIC RESPONSE

- Low glycemic food
- High glycemic food
Types of Fatty Acid

- **Saturated fat**
- **Unsaturated fat**

**PUFA**
- **Omega 3**
  - Fish
  - Canola, flax seeds
  - Green vegetables
  - Products from grazed animals
  - Eggs from flax-fed chickens

**Omega 6**
- Fast & processed food
- Grain-fed animal products
- Corn, soy, sunflower
- Safflower, peanut oils

**MUFA**
- Olive oil
## Properties of Fatty Acids

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<thead>
<tr>
<th>Food System</th>
<th>Omega-3</th>
<th>Omega-6</th>
<th>Saturated</th>
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<tbody>
<tr>
<td>Perishable</td>
<td>Durable</td>
<td>Increased in factory farmed animals</td>
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<tr>
<td>Short shelf life</td>
<td>Processed foods</td>
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<tr>
<td>Increased in pasture-fed animals</td>
<td>Long shelf life</td>
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<table>
<thead>
<tr>
<th>Immune Properties</th>
<th>Omega-3</th>
<th>Omega-6</th>
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<tr>
<td>Anti-inflammatory</td>
<td>Inflammatory &amp; Anti-inflammatory</td>
<td>Inflammatory</td>
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<thead>
<tr>
<th>Evolutionary Context</th>
<th>Omega-3</th>
<th>Omega-6</th>
<th>Saturated</th>
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<tr>
<td>Recent marked decline</td>
<td>Recent marked increase</td>
<td>Recent marked increase</td>
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Novel Nutrients Disrupt Insulin Signaling, Drive Inflammatory Metabolism

- Saturated fat
- Omega-3, (↑Omega-6)
- ↑Antioxidants

Inflammation ↔ Oxidative stress

Insulin signaling

- ↑ blood sugar
- ↑ artery disease
- ↑ triglycerides

High Glycemic Carbohydrates
Fructose
Influence of Nutrition on Chronic Disease

- Increase risks
  - saturated and trans fats
  - high glycemic carbohydrates
  - lack of fruits/vegetables/omega 3s
  - excess omega 6s?

- Reduce risks
  - fruits, vegetables
  - omega 3s
  - low glycemic carbohydrates
  - Mediterranean diet
Benefits of Mediterranean-Type Diet on Chronic Disease Risk

Clinical intervention studies

- 70% ↓ heart attacks, cardiac death & total mortality  DeLogeril 94
- 60% ↓ cardiac events in CVD patients*  Ornish 98
- ~50% ↓ metabolic syndrome  Esposito 04
- 39% ↓ in CRP  Esposito 04
- ↓ insulin resistance  Esposito 04
- ↓ weight  Esposito 04

Prospective observation studies

- 80% ↓ diabetes  Martinez-Gonzalez 08
- ~31% ↓ all-cause & cardiovascular mortality, 22% ↓ cancer mortality**  calculated from Sofi 08 ↓ 73% Alzheimer’s mortality  Scarmeas 07
- 25-30% ↓ Parkinson’s disease  Gao 07

*10% low fat, vegetarian diet + exercise, stress reduction

**For every 2 point increase in adherence (on a 9 point scale), risk reductions were observed of 0.91 for all cause mortality, 0.91 for CV mortality, 0.94 for occurrence and mortality from neoplasm. To convey the implications of these findings, we have applied the risk reductions across a 9 point adherence scale to yield a calculated ~31% ↓ all-cause & CV mortality and a 22% ↓ in cancer mortality.
Economic implications

• Diabetes and pre-diabetes will account for an estimated 10 percent of total health care spending by the end of the decade at an annual cost of almost $500 billion -- up from an estimated $194 billion this year ("The United States of Diabetes: Challenges and Opportunities in the Decade Ahead.” [UnitedHealthcare, Inc.])

• Hospital costs: $83 billion (AHRQ)
Health care costs of diabetes

• The average annual health care costs in 2009 for a person with known diabetes were about $11,700 compared with about $4,400 for the non-diabetic public (data drawn from 10 million UnitedHealthcare members)

• Doubles in people with complications of diabetes
Resource:

Environmental Threats to Healthy Aging

by
Jill Stein MD, Ted Schettler MD, MPH,
Maria Valenti and Ben Rohrer

Available at:

www.agehealthy.org

Greater Boston Physicians for Social Responsibility (www.psr.org/Boston)
and
The Science and Environmental Health Network (www.sehn.org)