Office hours this week:

Tuesday 11:00 - 12:00
Wednesday 3:30 - 4:30

Effect of temperature on metabolism

As temperature increases -
- activation energy increases
- structure of proteins changes

van’t Hoff equation

\[ Q_{10} = \frac{R_{t+10}}{R_t} \]
Our teeth, gut, and the diet of hunter-gatherers suggest an ancestral diet composed of low-calorie, high-fiber plant material, and low-fat animal protein.

Today, 50% of the world's population lives on 2200 cal/day or less.

Famine

Russia -
From 971 - 1970 there were 121 years of famine.
The famine of 1921 left 9 million dead. Famine of 1933 left 4-7 million dead.

China -
Famines of 1810-1849 killed 45 million.
Famine of 1958-1961 killed between 14 and 40 million.
In the 1940s, two doctors in Africa (A.P. Walker and H. Trowell) realized they had two types of patients.

### Diseases of western civilization

<table>
<thead>
<tr>
<th>Investigators:</th>
<th>Donnison and Burkitt</th>
<th>Trowell and Burkitt</th>
<th>Cleave and Campbell</th>
<th>Five continents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>1937&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1960&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1966&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1975&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Countries</td>
<td>Kenya</td>
<td>Africa, India</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Dental caries</td>
<td>No</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Constipation</td>
<td>AD</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Diverticular disease</td>
<td>AD</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Haemorrhoids</td>
<td>AD</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Colo-rectal cancer</td>
<td>AD</td>
<td>+</td>
<td>AD</td>
<td>+</td>
</tr>
<tr>
<td>Obesity</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Diabetes type II</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Coronary heart</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Gallstones</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Varicose veins, DVT/</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Hypertension</td>
<td>+</td>
<td>?</td>
<td>AD</td>
<td>AD</td>
</tr>
<tr>
<td>Thyrotoxicosis</td>
<td>+</td>
<td>+</td>
<td>AD</td>
<td>+</td>
</tr>
<tr>
<td>Pernicious anaemia</td>
<td>+</td>
<td>+</td>
<td>AD</td>
<td>+</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>AD</td>
<td>+</td>
<td>AD</td>
<td>+</td>
</tr>
<tr>
<td>Renal stone</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Duodenal ulcer</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>No</td>
</tr>
</tbody>
</table>

Glucose in the blood increases while the cells are starved. High blood glucose damages nerves and blood vessels. This causes heart disease, stroke, blindness, kidney disease, etc.

### Type II Diabetes

- Cells become resistant to insulin.
- Glucose in the blood increases while the cells are starved.
- High blood glucose damages nerves and blood vessels.
- This causes heart disease, stroke, blindness, kidney disease, etc.

#### Prevalence of adult onset diabetes: United States, 1976 (n = 64 142)*

<table>
<thead>
<tr>
<th>Age</th>
<th>Men, by BMI†</th>
<th>Women, by BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20–44 y</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>45–54 y</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>55–64 y</td>
<td>4.3</td>
<td>4.7</td>
</tr>
<tr>
<td>65+ y</td>
<td>6.7</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Causes of damage to the arterial wall include:

- Hyperglycemia
- High blood cholesterol (especially LDL or "bad" cholesterol over 100 mg/dL)
- Cigarette smoking and exposure to tobacco smoke
- High blood pressure
- Diabetes mellitus
- Obesity
- Physical inactivity

Why is sugar sweet?

Evolution of the thrifty genotype
Consequences of a “Thrifty Genotype”

**Arizona versus Mexican Pima**

<table>
<thead>
<tr>
<th></th>
<th>Arizonian</th>
<th>Mexican</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity</td>
<td>&lt; 5 h/week</td>
<td>23 h/week</td>
</tr>
<tr>
<td>Energy expenditure</td>
<td>2671 cal/day</td>
<td>3289 cal/day</td>
</tr>
<tr>
<td>Fat intake</td>
<td>35%</td>
<td>25%</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>471 mg/day</td>
<td>211 mg/day</td>
</tr>
<tr>
<td>Dietary fiber</td>
<td>19 g/day</td>
<td>53 g/day</td>
</tr>
<tr>
<td>Obesity</td>
<td>69%</td>
<td>13%</td>
</tr>
<tr>
<td>Average weight</td>
<td>93 kg</td>
<td>66 kg</td>
</tr>
<tr>
<td>Type 2 diabetes</td>
<td>50 %</td>
<td>9 %</td>
</tr>
</tbody>
</table>

Consequences of a “Thrifty Genotype”

Fig. 1. Diabetes prevalence as a function of age in white Australians (open bars n = 3197, ≥25 yr [Busselton Survey]) (16) and Aborigines from six communities in northern and central Australia (black bars n = 1345, ≥15 yr). There were insufficient numbers in the Aboriginal cohort to include data from those aged ≥65 yr.
For 99.75% of our history we were hunter gatherers. What kind of animals are we now?

Habitat and foraging

Homo sapiens sapiens

Homo sapiens techno
Diet
Homo sapiens sapiens

Diet
Homo sapiens techno
Locomotion

Homo sapiens sapiens

Development

Homo sapiens sapiens

Homo sapiens techno

Homo sapiens techno
Prevalence of Obese Children (Ages 6 to 11) at the 95th percentile of Body Mass Index (BMI)

1999 to 2000  15.3%
1988 to 1994  11%
1976 to 1980  7%

http://www.obesity.org/subs/childhood/

Causes
There are many factors that contribute to child and adolescent obesity - some are modifiable and others are not.

Modifiable causes include:

Physical Activity - Lack of regular exercise.

Sedentary behavior - High frequency of television viewing, computer usage, and similar behavior that takes up time that can be used for physical activity.

Socioeconomic Status - Low family incomes and non-working parents.

Eating Habits - Over-consumption of high-calorie foods. Some eating patterns that have been associated with this behavior are eating when not hungry, eating while watching TV or doing homework.

Environment - Some factors are over-exposure to advertising of foods that promote high-calorie foods and lack of recreational facilities.

http://www.obesity.org/subs/childhood/
Homo sapiens sapiens

Development

Homo sapiens sapiens

Behavior

Homo sapiens sapiens

Homo sapiens techno

Homo sapiens techno
These are different animals.
Cardiovascular diseases: Claimed 871,500 lives in 2004 (36.3 percent of all deaths or 1 of every 2.8 deaths).

• Other 2004 mortality: total cancer 550,270; accidents 108,694; HIV (AIDS) 12,995.

• From 1994 to 2004, death rates from CVD declined 25 percent.

• In the same 10-year period the actual number of deaths declined 8 percent. www.americanheart.org/presenter.jhtml?identifier=4478


Change public policy:

  No child left behind - teach the evolution of the human diet to every 2nd, 4th, and 6th grader.
  No doctor left behind - teach prevention to doctors.
  Outlaw television and video games.
  Outlaw low fiber carbohydrates.
  Outlaw empty calories.
  Mandate hard physical labor or hard physical play.
  Mandate thermoregulation above or below the TNZ.
Muscle - How it works.
Or, why humans don’t understand gravity.

Chapter 10 in Eckert.

Skeletal muscle
Skeletal muscle

Glycogen

Myofibrils

I band  H zone  Z disk  A band  Z disk

M line

A band

1 μm

Skeletal muscle
Sliding-filament theory

A.F. Huxley
and
H.E. Huxley
1954

Shortening distance, shortening velocity depend on the number of sacromeres in series.

Force depends on...

Each sarcomere shortens

Chain shortens
Actin filaments

Myosin filaments

Two supercoiled α helices
Amino terminus
Myosin light chains

Carboxyl terminus
150 nm Tail
17 nm Heads
Myosin complexes polymerize spontaneously.