10-Year Coronary Incidence Per 10,000 Men

$y = 77 + 78x$

$r = 0.73$

(Keys 1980)
Colon Cancer Incidence / 100,000 Women

Per Capita Daily Meat Consumption (grams)

(Armstrong and Doll, 1975)
Age Adjusted Death Rate / 100,000 pop

Animal Fat Intake (g/day)

Carroll, 1975
To reduce your fat intake:

Eat more fruits, vegetables, and their juices. Most are naturally low in fat…and high in vitamins and minerals.

Here are some other ways to reduce fat in your food.

**TRY**  
Butter-flavored granules  
Nonfat yogurt  
Nonfat salad dressings  
Angel food cake  
Fat-free cookies and crackers

**INSTEAD OF**  
Butter or margarine  
Regular yogurt  
Regular salad dressings  
Devil’s food cake  
High-fat cookies and crackers
Mensink and Katan, 1987
Effect of Trans and Saturated Fat (10% E) on Blood Lipids (vs Monounsaturated fat)

*Mensink & Katan, 1990*

<table>
<thead>
<tr>
<th></th>
<th>Trans fat</th>
<th>Saturated fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cholesterol</td>
<td>+6%</td>
<td>+12%</td>
</tr>
<tr>
<td>LDL cholesterol</td>
<td>+14%</td>
<td>+18%</td>
</tr>
<tr>
<td>HDL cholesterol</td>
<td>-12%</td>
<td>0%</td>
</tr>
<tr>
<td>LDL/HDL ratio</td>
<td>+29%</td>
<td>+18%</td>
</tr>
</tbody>
</table>
Blood lipids
Blood pressure
Thrombotic tendency
Insulin resistance
Oxidation
Homocysteine
Inflammation/endothelial dysfunction
Ventricular irritability & arrhythmia

Diet

CHD
Age-Adjusted Plasma CRP by Quintiles of Trans Fatty Acid Intake in the Nurses’ Health Study

(P, trend = <0.001)

(Lopez-Garcia 2005)
Nurses’ Health Study (n=121,700)


Diet Diet Diet

Ocs

Smoking

Weight/Ht

Med. Hist.

Health Professionals Follow-up Study (n=52,000)


Diet Diet Diet

Blood

Nurses’ Health Study II (n=116,000)

1989 1991 1993 1995 1997 1999

Diet Diet Blood Diet

Investigators: Frank Speizer, Bernie Rosner, Meir Stampfer, Graham Colditz, David Hunter, JoAnn Manson, Sue Hankinson, Eric Rimm, Edward Giovannucci, Alberto Ascherio, Gary Curhan, Charlie Fuchs, Fran Grodstein, Michelle Holmes, Frank Hu
% Change in CHD

(Hu et al. 1997)
Quintiles of poly trans fat

Multivariate RR of CHD

Hu et al, 1997
Multivariate Relative Risk of Sudden Death

*(Albert et al., 2002)*

P = 0.007

Quartile of blood N-3 fatty acid (Mean, % of fatty acids)
Oil and Vinegar Salad Dressing and Risk of Coronary Heart Disease (NHS, 1980-1994) (Hu et al. 1992)

Multivariate Relative Risk

Frequency of Salad Dressing Consumption
Conclusions

1. CHD rates can be dramatically reduced by nutritional means, but this will not be achieved by replacing saturated fat with carbohydrate.

2. We should abandon recommendations regarding % of energy from fat and avoid pejorative references to fat or “fatty foods”.

3. Advice about dietary fat should focus on replacement of saturated and trans fat with vegetable oil, including sources of N-3 fatty acids.
MI, CHD Death, or Revascularization

HR, 0.97 (95% CI, 0.90-1.06)

(Time, y)

Cumulative Hazard

(Howard et al. 2006)
Multivariate RR’s of type 2 diabetes according to quintiles of specific types of dietary fat (mutually adjusted)

(Salmeron et al, 1999)
Trans Fat and Weight Gain

A recent 5-year study of monkeys provides evidence that on an isocaloric diet with 35% of calories coming from fat, monkeys on the diet with 8% E trans fat gained more weight (7.2% vs 1.8%) than monkeys on the diet with an equivalent amount of fat, but as monounsaturated cis fat.

Change in Waist Circumference over 9 Years in 16,587 Men (Koh-Banerjee, 2003)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Waist Change (cm)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trans fat vs poly (2% E)</td>
<td>+2.7*</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total fiber (12 gm)</td>
<td>-2.21*</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Television watching (20 hr/wk)</td>
<td>+0.59</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Vigorous activity (25 MET/wk)</td>
<td>-0.38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Weight training (&gt;0.5 hr/wk)</td>
<td>-0.91</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Adjusted for measurement error
Fatty Acids Intake

All fats for carbs, 5% of energy
Saturated fat for carbs, 5% of energy
Mono unsaturated fat for carbs, 5% of energy
Poly unsaturated fat for carbs, 5% of energy
trans fat for carbs, 2% of energy
trans fat for n-6 poly fat, 2% of energy
trans fat for mono fat, 2% of energy

Percent Change in Risk of Ovulatory infertility

36.005
“So scientists from Harvard Medical School just found that eating trans fat can cause women to become infertile . . . . [pause] . . . . . So, guys out there: If your condom breaks, just buy your girlfriend a bucket of KFC!”

--Jay Leno, Tonight Show (1/23/07)
Women (591 cases)
Wolk et al., 1999

Men (734 cases)
Rimm et al., 1996

RR of CHD

Cereal Fiber, Energy-Adjusted, g/day

2.2  3.1  3.8  4.9  7.7

2.2  3.7  5.0  6.8  9.7
Blood Glucose

Insulin

Easily Digested Carbohydrate

![Graph of blood glucose and insulin levels over time for easily digested carbohydrates.](image)

Slowly Digested Carbohydrate

![Graph of blood glucose and insulin levels over time for slowly digested carbohydrates.](image)
Relative Risk of Type 2 Diabetes by Different Levels of Cereal Fiber and Glycemic Load

(Salmeron et al, 1997)
Relative Risk of Coronary Heart Disease

Body Mass Index (kg/M²)

- Tertile 1 (lowest)
- Tertile 2
- Tertile 3 (highest)

Relative Risk of Coronary Heart Disease

Glycemic Load

Liu et al., 2000
Attributable Risk of Coronary Heart Disease Due to Modifiable Diet and Lifestyle Risk Factors in the NHS (1980 to 1994)

Low Risk:

1. Non smoker
2. BMI < 25 kg/m²
3. Exercise ≥ ½ hr of brisk walking/day
4. Good diet (upper 2 quartiles of score based on low trans fat, high p/s ratio, low glycemic load, high cereal fiber, high fish, high total folate)
5. Alcohol 5+g/day

- Proportion at low risk = 3.1%
- Population Attributable Risk = 82% (95% CI = 58-93%)

Stampfer et al, 2000
Percentage of Type 2 Diabetes Potentially Preventable by Simultaneous Reduction of Five Modifiable Risk Factors (NHS) *(Hu et al.)*

**Low Risk**

1. Nonsmoking
2. BMI < 25
3. Moderate to vigorous exercise
4. Diet score in upper 40% (low trans fat, high cereal fiber, low glycemic load, high P:S ratio)
5. Alcohol 5+ grams/day

Percent in low risk group: 4.1%
Population attributable risk (PAR): 92% (82-96)
Proportion of Colon Cancers that are Potentially Preventable by Simultaneous Reduction 6 Modifiable Risk Factors (HPFS)  
*(Platz et al. 2000)*

Low Risk

1. BMI \( \leq 25 \text{ kg/m}^2 \)
2. Physical activity \( \leq 30 \text{ min/day of vigorous – moderate activity} \)
3. Alcohol <15 g/day or 15-30 g/day with supplemental folic acid
4. Folic acid supplement of \( \geq 100 \mu\text{g/day} \)
5. \( \leq 3 \) pack – years of smoking
6. Red meat \( \leq 2 \) servings/week

**Joint low risk group** = 3.1% of population  
**Population attributable risk (PAR):** 71% (33-92)
Lowfat products whenever possible; calcium supplements are an effective substitute for preventing fractures.

Importance is well-documented; greens and dark orange vegetables should be included. Even more frequent servings may be desirable.

Whole-grain, minimally processed products should be emphasized.


Misleading as 2-3 servings of meat/day is probably unhealthy.

Support for generous intake is well documented.
NUTRITIONAL EPIDEMIOLOGY
SECOND EDITION
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THE HARVARD MEDICAL SCHOOL GUIDE TO HEALTHY EATING
Including An All New Food Pyramid
Co-Developed with The Harvard School of Public Health
WALTER C. WILLETT, M.D.

Eat, Drink, & Weigh Less
A Flexible and Delicious Way to Shrink Your Waist Without Going Hungry
MOLLIE KATZEN & WALTER WILLETT, M.D.
Harvard School of Public Health
EAT DRINK AND BE HEALTHY