Yet Another Inconvenient Truth or
Obesity and global warming are they similar canaries from the same mineshaft?

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Dean Touro University College of Osteopathic Medicine
Objectives

• Understand the impact of obesity to our future well being as a global society
• Understand potential interaction through inflammation between obesity, metabolic syndrome and global warming
• Understand, how we as the American College of Osteopathic Internists can make a difference
Global Warming
An Inconvenient Truth

• U.N. Intergovernmental Panel on Climate Change (IPCC)
  – 600 scientists from 40 countries

• Concluded for the first time that evidence of the earth’s rising temperature was “unequivocal” & this warming was greater than 90% due to human activity

• Even if all greenhouse-gas emissions ended today, the earth would continue to warm through the rest of the century because of the amount of carbon already in the atmosphere

IPCC February 2007
10 of the hottest years ever recorded were noted in the past 14 years with 2005 as the hottest year ever.

Summer of 2012 recorded as third hottest ever in USA (measured since 1895).

1968 when CO₂ broached 300-320 for the first time in over 50,000 years.

Stott BMJ 2006;332:1385
Another Inconvenient Truth

- Over the past 40 years despite advances in coronary artery bypass & percutaneous intervention strategies, advanced therapies for myocardial infarction, unstable angina and heart failure...

as well as age adjusted reductions in total cholesterol, systolic blood pressure, smoking prevalence and physical inactivity...

**Cardiovascular disease still remains the number one killer of adults in the United States**
30 Year Lipid Trends from NHANES (1976-2006)

LDL < 100

- NHANES II 1976-1980
- NHANES IV (1999-2006)

HDL > 40

BMI

Cohen AJC 2010;106:969
Is all Obesity the Same?

Or…The importance of identifying the overweight person who will benefit most from weight reduction.

• Is insulin resistance the Key?
• Insulin resistance is associated with increased risk DM, HBP, CVD
  – 5% people with BMI < 25 have IR
  – 22% people with BMI 25-30 have IR
  – 60 % people with BMI > 30 have IR
• Conclusion: Insulin Resistance found in 5% of normal weight and not found in 40% of obese people. Therefore insulin resistance is more than weight alone.

ATP III: Components of Metabolic Syndrome

- Abdominal Obesity
- Atherogenic Dyslipidemia
- Elevated Blood Pressure
- Insulin Resistance ± glucose intolerance
- Pro-inflammation
Central obesity (waist circumference) +

Plus two of the following factors:

- TG > 1.7 mmol/L (150 mg/dl)
- HDL-C < 1.03 mmol/L (40 mg/dl) men
- HDL-C < 1.3 mmol/L (50 mg/dl) women
- BP > 130/85 or treatment for hypertension
- FPG > 5.6 mmol/L (100 mg/dl)
Metabolic Syndrome Increases Risk for MACE Regardless of Framingham Estimated Risk

MACE = major adverse coronary events
Metabolic Syndrome Increases CV Risk

Estimated relative risk

Onat 2002
Lakka 2002
Resnick 2003
Ridker–low CRP 2003
Ridker–high CRP 2003
Satlar 2003
Girman 2004
Ford 2004
Katzmarzyk 2004
Rutter 2004
Hunt 2004
McNeill 2005 – W
McNeill 2005 – M

Combined

Heterogeneity $P < 0.001$

1.74

Original ATP III definition
Modified ATP III definition
W = Women; M = Men

Twin Epidemics: Parallels in Prevalence Overweight/Obesity and Metabolic Syndrome

Ford JAMA 2002;287:356
Twin Epidemics: Parallels in Prevalence Overweight/Obesity and Metabolic Syndrome

From 2000-2004 the World Health Organization gathered information about obesity rates in 36 different countries. 29/36 had less obesity than the USA.

National Center for Chronic Disease Prevention National Center for Health Statistics
Prevalence Metabolic Syndrome in Adults aged > 50

- Prevalence of metabolic syndrome in those with type II DM is 87%
- Individuals with diabetes but without metabolic syndrome had a similar prevalence of CHD as those with neither DM or metabolic syndrome

*Alexander Diabetes 2003;52:1210*
Metabolic Risk Factors, Weight and CVD

- Earlier evaluations suggested metabolically benign overweight/obese patients are not at increased risk CV events over 3-11 years compared to normal weight.
- However, Health Profession Follow-up in men and Nurses Health Study in women demonstrate a 40-200% increase risk CVD in overweight/obese with good metabolic parameters when followed over 16 yrs.

Song AJC 2007;100:1654
Katznarzyk Diab Care 2006;30:2145
Obes Res 1998;6 suppl 2:51S
Study of Women’s Health Across the Nation (SWAN)

• 475 women (mean age 51 yrs) divided in 3 gps:
  – Healthy normal weight
  – Metabolically benign overweight/obese
    • Less <3 risk metabolic syndrome components (with CRP > 3 substituting for waist since already overweight/obese)
  – At risk overweight/obese (≥ 3 metabolic syndrome components including CRP > 3)
• Evaluated for CIMT, aortic pulse wave velocity, CAC, aortic calcification

Khan Atheroscl 2011;217:179
Kuk Diab Care 2009;32:2297
## SWAN Baseline Data

<table>
<thead>
<tr>
<th></th>
<th>Normal (n=145)</th>
<th>Overweight/obese meta benign (n=260)</th>
<th>Overweight/obese at risk (n=70)</th>
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<tbody>
<tr>
<td>BMI</td>
<td>22.7</td>
<td>30.8</td>
<td>34.6</td>
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<tr>
<td>LDL</td>
<td>113</td>
<td>121</td>
<td>124</td>
</tr>
<tr>
<td>HDL</td>
<td>63</td>
<td>59</td>
<td>45</td>
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<tr>
<td>HDL &lt; 50</td>
<td>17%</td>
<td>20%</td>
<td>83%</td>
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<tr>
<td>TG</td>
<td>87</td>
<td>96</td>
<td>173</td>
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<tr>
<td>TG &gt; 150</td>
<td>8%</td>
<td>11%</td>
<td>64%</td>
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<tr>
<td>Glucose</td>
<td>84</td>
<td>88</td>
<td>102</td>
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<tr>
<td>Glucose &gt; 100</td>
<td>6%</td>
<td>7%</td>
<td>64%</td>
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<tr>
<td>CRP</td>
<td>.8</td>
<td>2.1</td>
<td>6.1</td>
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<tr>
<td>CRP &gt; 3</td>
<td>15%</td>
<td>35%</td>
<td>84%</td>
</tr>
<tr>
<td>BP</td>
<td>110/70</td>
<td>119/76</td>
<td>130/81</td>
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<tr>
<td>10 yr FRS</td>
<td>8.6</td>
<td>9.5</td>
<td>12.9</td>
</tr>
</tbody>
</table>

*Khan Atheroscl 2011;217:179*
Subclinical Atherosclerosis Outcomes in SWAN

*CIMT x 10, APWV cm/sec divided by 10, CAC & AAC both in % with Agatstan score > 10

Khan Atheroscl 2011;217:179
SWAN Results

• Metabolically benign overweight/obese women appeared to have significantly greater subclinical CVD than normal weight
  – Further adjustment for BMI attenuated the significance for aortic pulse wave velocity, CAC/AAC

• Many of these benign women actually have metabolic syndrome since they had 2 risk factors plus weight and/or had CRP > 3 in 35% of subjects

Khan Atheroscl 2011;217:179
ATP III: Components of Metabolic Syndrome

- Abdominal Obesity
- Atherogenic Dyslipidemia
- Elevated Blood Pressure
- Insulin Resistance ± glucose intolerance
- Pro-inflammation
  - Obese subjects with metabolic syndrome had significantly greater amounts of small dense LDL particles and higher CRP than obese subjects without metabolic syndrome

Iacobellis J Clin Lipid 2007;1:599
Does it make sense?  
Emerging Risk Factors

<table>
<thead>
<tr>
<th>Inflammation</th>
<th>Prospective Studies</th>
<th>Commerical Assay</th>
<th>Additive to Lipids</th>
<th>Additive to FRS</th>
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<tbody>
<tr>
<td>Hs-CRP</td>
<td>++++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
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<tr>
<td>sICAM-1</td>
<td>++</td>
<td>+/-</td>
<td>+</td>
<td>-</td>
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<tr>
<td>SAA</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Interleukin-6</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Interleukin-18</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
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<tr>
<td>Myeloperoxidase</td>
<td>+</td>
<td>-</td>
<td>+/-</td>
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<tr>
<td>sCD40 ligand</td>
<td>+</td>
<td>-</td>
<td>-</td>
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<tr>
<td>LpPLA2</td>
<td>+</td>
<td>+/-</td>
<td>+/-</td>
<td>-</td>
</tr>
</tbody>
</table>

Ridker Circ 2004;109(25 suppl):IV6-19
Risk Factors for Future Cardiovascular Events: WHS

Lipoprotein(a)
Homocysteine
IL-6
TC
LDLC
sICAM-1
SAA
Apo B
TC: HDLC
hs-CRP
hs-CRP + TC: HDLC

Relative Risk of Future Cardiovascular Events

Attributable Risk CRP > 3mg/L from CV Risk Factors

Weighted multiple logistic regression analysis

Miller Arch Int Med 2005;165:2063
How to lower CRP

Best Results
- Exercise & weight loss
- Statins

Mixed results
- Alcohol in low amounts
- Multivitamins
- Omega 3 fatty acids
- Fibrates
- Niacin
- PPAR gamma (TZD)
- Clopidogrel, abciximab,
- CCB and nitrates
- ARB

No CRP Effect *(neutral effect)*
- Aspirin ±
- COX-1 and 2
- Ezetimibe (monotherapy)
- Stanol ester ± (monotherapy)
- Both ezetimibe and stanols may ↓ CRP when added to statin
Twin Epidemics of Obesity and Global Warming

Two Inconvenient Truths

National Center for Chronic Disease Prevention National Center for Health Statistics
Air Pollution and Atherosclerosis

• Air pollution is a heterogeneous mixture of gases and vapors interacting with solid and liquid particulate matter in atmosphere.

• Although both gaseous (eg, ozone) and particulate pollutants are linked, evidence is strongest for particulate matter (PM) as the greater risk for CV disease.
  – Most data to date (hundreds of studies) associate CV risk with PM <2.5 μm (PM$_{2.5}$)
  – Approximate range in US in 2010 = 5-35 μg/m$^3$ with annual mean Environmental Protection Agency standard of 15 μg/m$^3$
Fine Particulate Matter vs Ozone and CVD Mortality

• 448,850 subjects followed from 96 metropolitan areas for 18 yrs
  – Long term exposure to fine particulate matter (<2.5 µm) was risk factor for CVD & CV mortality

• Ozone is a single pollutant whose exposure did not increase CVD when corrected for PM$_{2.5}$ but ozone did increase the risk for respiratory death

Jerrett NEJM 2009;360:1085
Exposure to Air Pollution is Associated with Adverse CV Events

• Brief exposure to diesel exhaust (equivalent to exposure of driving in traffic) promotes myocardial ischemia and inhibits endogenous fibrinolytic capacity in those with baseline CAD

• The risk after brief exposure appears to persist for several days and is related to pulmonary oxidative stress, decreased O\textsuperscript{2} carrying capacity caused by ↑ levels carbon monoxide, enhanced systemic inflammation, and altered hemostatic-fibrinolytic balance

Mills NEJM 2007;357:1075
Brook Circ 2004;109:2655
Kelly Occup Envir Med 2003;60:612
Temperature Trends to Increase with Increasing Populations

Kelly Occup Envir Med 2003;60:612
Acute vs Chronic Exposure

- Short term exposure over a few hours to days increases risk of MI, stroke, HF exacerbation, arrhythmias, SCD
  - Risk approximate 1% increase CV mortality per 10 μg/m³ of PM$_{2.5}$ or about a 1 standard deviation increase in ambient levels in US
- Chronic exposure (yrs) lead to 10-20% increase in CV mortality per 10 ug/m³ increase in PM$_{2.5}$
  - Suggests cumulative exposure promotes development of chronic underlying disease state that exponentially augments future CV risk over years by enhancing progression and vulnerability of atherosclerotic plaque

Brook Circ 2010;121:2331
Sun JAMA 2005;204:3003
Exposure to Air Pollution is Associated with Adverse CV Events

Harvard Six Cities Study (1977-1988)

Characteristics of the Study Population and Mean Air-Pollution Levels in Six Cities

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>PORTAGE, Wis.</th>
<th>TOPEKA, Kans.</th>
<th>WATERTOWN, Mass.</th>
<th>HARRIMAN, Tenn.</th>
<th>ST. LOUIS</th>
<th>STEUBENVILLE, Ohio</th>
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<tbody>
<tr>
<td>No. of participants</td>
<td>1,631</td>
<td>1,239</td>
<td>1,336</td>
<td>1,258</td>
<td>1,296</td>
<td>1,351</td>
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<tr>
<td>Person-years of follow-up</td>
<td>21,618</td>
<td>16,111</td>
<td>19,882</td>
<td>17,836</td>
<td>17,715</td>
<td>17,914</td>
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<td>No. of deaths</td>
<td>232</td>
<td>156</td>
<td>248</td>
<td>222</td>
<td>281</td>
<td>291</td>
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<td>Deaths/1000 person-years</td>
<td>10.73</td>
<td>9.68</td>
<td>12.47</td>
<td>12.45</td>
<td>15.86</td>
<td>16.24</td>
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<td>Female sex (%)</td>
<td>52</td>
<td>56</td>
<td>56</td>
<td>54</td>
<td>55</td>
<td>56</td>
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<tr>
<td>Smokers (%)</td>
<td>36</td>
<td>33</td>
<td>40</td>
<td>37</td>
<td>35</td>
<td>35</td>
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<tr>
<td>Former smokers (%)</td>
<td>24</td>
<td>25</td>
<td>25</td>
<td>21</td>
<td>24</td>
<td>23</td>
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<tr>
<td>Average pack-years of smoking</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Current smokers</td>
<td>24.0</td>
<td>25.6</td>
<td>25.2</td>
<td>24.5</td>
<td>30.9</td>
<td>28.0</td>
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<tr>
<td>Former smokers</td>
<td>18.0</td>
<td>19.7</td>
<td>21.8</td>
<td>21.1</td>
<td>22.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Less than high-school education (%)</td>
<td>25</td>
<td>12</td>
<td>22</td>
<td>35</td>
<td>45</td>
<td>30</td>
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<tr>
<td>Average age (yr)</td>
<td>48.4</td>
<td>48.3</td>
<td>48.5</td>
<td>49.4</td>
<td>51.8</td>
<td>51.6</td>
</tr>
<tr>
<td>Average body-mass index</td>
<td>26.3</td>
<td>25.3</td>
<td>25.5</td>
<td>25.1</td>
<td>26.0</td>
<td>26.4</td>
</tr>
<tr>
<td>Job exposure to dust or fumes (%)</td>
<td>53</td>
<td>28</td>
<td>38</td>
<td>50</td>
<td>40</td>
<td>48</td>
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<tr>
<td>Total particles (µg/m³)</td>
<td>34.1</td>
<td>56.6</td>
<td>49.2</td>
<td>49.4</td>
<td>72.5</td>
<td>89.9</td>
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<tr>
<td>Inhalable particles (µg/m³)</td>
<td>18.2</td>
<td>26.4</td>
<td>24.2</td>
<td>32.5</td>
<td>31.4</td>
<td>46.5</td>
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<tr>
<td>Fine particles (µg/m³)</td>
<td>11.0</td>
<td>12.5</td>
<td>14.9</td>
<td>20.8</td>
<td>19.0</td>
<td>29.6</td>
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<tr>
<td>Sulfate particles (µg/m³)</td>
<td>5.3</td>
<td>4.8</td>
<td>6.5</td>
<td>8.1</td>
<td>8.1</td>
<td>12.8</td>
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<tr>
<td>Aerosol acidity (nmol/m³)</td>
<td>10.5</td>
<td>11.6</td>
<td>20.3</td>
<td>36.1</td>
<td>10.3</td>
<td>25.2</td>
</tr>
<tr>
<td>Sulfur dioxide (ppb)</td>
<td>4.2</td>
<td>1.6</td>
<td>9.3</td>
<td>4.8</td>
<td>14.1</td>
<td>24.0</td>
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<tr>
<td>Nitrogen dioxide (ppb)</td>
<td>6.1</td>
<td>10.6</td>
<td>18.1</td>
<td>14.1</td>
<td>19.7</td>
<td>21.9</td>
</tr>
<tr>
<td>Ozone (ppb)</td>
<td>28.0</td>
<td>27.6</td>
<td>19.7</td>
<td>20.7</td>
<td>20.9</td>
<td>22.3</td>
</tr>
</tbody>
</table>

*Air-pollution values were measured in the following years: total particles, sulfur dioxide, nitrogen dioxide, and ozone, 1977 through 1985; inhalable and fine particles, 1979 through 1985; sulfate particles, 1979 through 1984; and aerosol acidity, 1985 through 1988.

30-40 Year Trends

• In 1982 AHA, AMA and USDA recommended to decrease fat intake from 40% to 30% of calories
• We succeeded in doing this but as a result our weight has gone up by 25 pounds.

http://www.usda.gov/trpp#ENR%20V11N3fenrv11nJp44.PDF
Lustig Nature 2012;482:27
30-40 Year Trends

More Liquid Carbohydrate Intake

- 41% increase in soft drinks and 35% increase in fruit drinks
- Average can of soda = 150 calories x 365 days then divide by 3500 (number of calories per pound) = 15.6 pounds per yr

First Coke
1915 6.5 oz (8 lb/yr)
1960 12 oz (16 lb/yr)
1992 20 oz (26 lb/yr)
2005 Big Gulp 52 oz (52 lb/yr)

http://www.usda.gov/trpp#ENR%20V11N3fenrv11nJp44.PDF
Lustig Nature 2012;482:27
The start of a vicious cycle

The earlier you expose a child to sweets the more they crave it later.

The more sugar a pregnant women eats the more gets across the placenta causing developmental programming which can change a newborns adiposity before birth.

1. Kim Obesity 2006;15:1107
IS IT IN THE GENES?
Sugar Sweetened Beverages and Genetic Risk of Obesity

• Genetic predisposition scores calculated on the basis of 32 BMI-associated loci
  – Evaluated 6943 women from Nurses Health Study and 4423 men from Health Professionals Follow-up Study
• The genetic association with adiposity appeared more pronounced with greater intake of sugar sweetened beverages

Qi NEJM 2012;367
Combined genetic effects on BMI among those consuming sugar drinks daily were approximately twice as large those consuming them monthly

Or

Those with greater genetic predisposition to obesity appeared to be more susceptible to the deleterious effects of sugar sweetened beverages on BMI

Qi NEJM 2012;367
Glucose Metabolism

• Example of how glucose metabolized ie 120 calories (2 slices of white bread)
  – 80% glucose used by every cell for energy
    • 20% or 24 calories to liver
  – Most of glucose to the liver stored as glycogen
    • Glycogen will not injure the liver since it is non-toxic form of glucose storage
    • Only about $\frac{1}{2}$ to 1 calorie from the original 120 calories used for VLDL production

Lustig Nature 2012;482:27
Fructose Increasing in American Diet

Consumption fruits & vegetables decreased from 24 g in 1978 to 15 g/d today
And fiber reduced from 100g to 15g

Why is this trend related to obesity?

25% of adolescents consume > 15% of their diet from fructose

Bray Am J Clin Nut 2007
J Clin Investigation 2010
High Fructose Corn Syrup

- HFCS is the main component of soft drinks because it’s 20% sweeter than regular table sugar (sucrose).
  - Glucose is 26% less sweet than sucrose.
  - HFCS is also cheaper.
  - Current US consumption of HFCS = 63 lbs per person/yr.
- HFCS is 42-55% fructose + glucose.
- HFCS is essentially equivalent to sucrose which is 50% fructose connected to glucose by an ether linkage.
Fructose Metabolism

120 calories (glass of OJ) from sucrose (half glucose & half fructose)

- All 60 calories from fructose to liver
  - only liver can metabolize fructose
  - fructose is not metabolized by the brain so has no acute symptoms

- The 60 calories from glucose
  - 12 to liver and 48 to body

- The liver must metabolize 72 calories
  - 3x calories from glucose alone

Choi BMJ 2008 334:300
Feig JAMA 2006;300:924
Nguyen J Peds 2009
Fructose Metabolism II

• For the liver to metabolize the 72 calories, a lot of phosphate will be lost thru scavenger pathway resulting in end product of uric acid
  – Therefore, high fructose consumption increases uric acid
  – Uric acid can then block ENOS which predisposes to high blood pressure
• Obese adolescents with HBP, allopurinol decreased BP

Choi BMJ 2008;334:300
Feig JAMA 2008;300:924
Nguyen J Peds 2009
Low Fat Diet Myth

• The typical low fat diet isn’t really low fat if it is substituting fructose for fat
• Fructose although a carbohydrate is metabolized like fat, such that 30% of its calories is converted to fat

Parks J Nutr 2004;134: 1333
Schwarz Diabetes 2005;54:1907

A high fructose diet is a high fat diet

% calories converted to fat

2hr 4 6 8

30%
glucose
sucrose
Fructose *is not* Glucose

- Fructose increases the calorie load to liver
- Acute fructose ingestion does not stimulate insulin because no fructose receptor on Beta cell, if insulin doesn’t go up then leptin won’t go up (brain doesn’t recognize you ate something)
  - Fructose also does not suppress gherlin (hunger hormone)
- Fructose is 7 times more likely than glucose to form Advanced Glycation End Products

Is fructose at the Center of the Obesity Epidemic?

- Fructose consumption has increased in past 30 years coinciding with obesity epidemic
- Hepatic fructose metabolism leads to metabolic syndrome:
  - Hypertension
  - De novo lipogenesis, dyslipidemia, steatosis
  - Inflammation
  - Insulin resistance
  - Obesity
  - CNS leptin resistance promoting continuous consumption
- Fructose is a chronic hepatotoxic (alcohol without the buzz)
- **A calorie is not a calorie** (fructose is not glucose)

Removal of carbonated (fructose) drinks from schools in England (CHOPPS Program) for a year found the prevalence of obesity remained the same (-0.2%) Compared to keeping soda in the schools where rate of obesity continued to rise (+7.5%)

James BMJ 2004;328:1237

(CHOPPS Program = Christchurch obesity prevention project in schools)
Beyond CHOPPS

Replacement of sugar containing beverages with non-caloric beverages reduced weight gain and fat accumulation in normal weight children.¹

Overweight and obese adolescents received an intervention to decrease consumption of sugar beverages for one year which resulted in decrease in weight gain compared to controls. This improvement was lost by year two.²

¹ de Ruyter NEJM 2012;367
² Ebbeling NEJM 2012;367
Changes in Diet and Lifestyle and Long Term Weight Gain

- 120,877 men and women free of chronic diseases and obesity followed up from 1986-2006
- With each four year period participants gained an average of 3.35 lb on the basis of increasing daily servings

<table>
<thead>
<tr>
<th>Diet component</th>
<th>Additional lb</th>
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<tbody>
<tr>
<td>Potato Chips</td>
<td>1.69 lb</td>
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<tr>
<td>Potatoes</td>
<td>1.28 lb</td>
</tr>
<tr>
<td>Sugar sweetened beverages</td>
<td>1.00 lb</td>
</tr>
<tr>
<td>Red meats</td>
<td>0.95 lb</td>
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</table>

<table>
<thead>
<tr>
<th>Inversely related</th>
<th>Minus lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>-0.22 lb</td>
</tr>
<tr>
<td>Whole grains</td>
<td>-0.37 lb</td>
</tr>
<tr>
<td>Fruits</td>
<td>-0.49 lb</td>
</tr>
<tr>
<td>Nuts</td>
<td>-0.57 lb</td>
</tr>
<tr>
<td>Yogurt</td>
<td>-0.82 lb</td>
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</table>

Mozaffarian NEJM 2011;364:2392
Changes in Diet and Lifestyle and Long Term Weight Gain (Part 2)

- 120,877 men and women free of chronic diseases and obesity followed up from 1986-2006
- With each four year period participants gained an average of 3.35 lb on the basis of increasing daily servings

<table>
<thead>
<tr>
<th>Other components</th>
<th>Additional lb</th>
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<tbody>
<tr>
<td>Alcohol</td>
<td>0.41/drink/day</td>
</tr>
<tr>
<td>Smoking new quitters</td>
<td>5.17 lb</td>
</tr>
<tr>
<td>Former smoker</td>
<td>0.14 lb</td>
</tr>
<tr>
<td>Sleep (&lt;6 or &gt;8 hrs)</td>
<td>0.31 lb</td>
</tr>
<tr>
<td>Watch TV</td>
<td>0.31 lb</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inversely related</th>
<th>Minus lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity</td>
<td>-1.76 lb</td>
</tr>
</tbody>
</table>

Mozaffarian NEJM 2011;364:2392
Changes in Diet and Lifestyle

Nuts versus French Fries

**NUTS**
- Take longer to chew
- Contain fat and fiber that take longer to digest
- Your stomach stays fuller, and you feel satisfied longer
- SO YOU EAT LESS AT YOUR NEXT MEAL

Net loss of 0.57 pounds

**FRENCH FRIES**
- Cooked starch is quickly broken down
- Causes spike in glucose and insulin secretion leading to hunger
- SO YOU EAT MORE AT YOUR NEXT MEAL

Net gain of 3.35 pounds

Mozaffarian NEJM 2011;364:2392
In the Mineshaft

**Energy as Common Denominator**

- **Obesity** = excess energy intake over expenditure
  - Overnutrition, inactivity → “metaflammation”
    causing insulin resistance & obesity chronic disease

- **Environment** = excess carbon from energy sources overwhelm the capacity of environmental sinks (oceans, soil, plants) to absorb carbon
  - Industrial waste, pollution → “ecofflammation”
    causing carbon resistance & global warming ecological disorder and climate change

Egger MJA 2010;193:635
We have arrived

• In September 2011 the U.N. declared that for the first time in human history, chronic non-communicable diseases such as heart disease, cancer and diabetes pose a greater health burden worldwide than do infectious diseases, contributing to 35 million deaths annually.

• Today, worldwide, there are 30% more people who are obese than are undernourished.

*Lustig Nature 2012;482:27*
Hungry Brain Syndrome

• The inherent directive from the brain to eat and defend against loss of fat emerged early in our evolution due to the uncertainty of that next meal.
  – This process is also related to 24 hour (day/night) cycle which is up-regulated with sleep disturbances and stress which decrease metabolism but increase the yen for high calorie food

• However, the myth that obesity is caused by a loss of willpower or lack of motivation is simply a misconception.

Kim Obesity 2006;15:1107
Obesity and Global Warming

Energy as Common Denominator

• Obesity = excess energy intake over expenditure
  – Overnutrition, inactivity → “metaflammation”

Metaflammation = immune system reacts at a lower level to pro-inflammatory environmental inducers than to acute injury or microbes for which it had no time to adapt

Metaflammation linked to chronic disease via a form of low grade systemic inflammation caused by spillover fat, inactivity and environmental factors

Metaflammation is to chronic disease what inflammation is to injury or acute disease

Egger MJA 2010;193:635
Differences in Risk with Obesity
(Aerobics Center Longitudinal Study ACLS)

• 42,265 subjects followed from 1979-2003
  – 46% of obese subjects were metabolically healthy (0-1 risk factors for metabolic syndrome) and had better fitness than obese non-metabolically healthy

• After adjusting for co-founding factors including fitness, the metabolically healthy obese patients had 38% lower risk for all-cause mortality
  – If metabolically healthy the risk of developing or dying from CVD or cancer reduced 30-50%
  – No significant difference for CVD between metabolically healthy obese and normal weight participants

Ortega Eur Heart J 2012
Differences in Risk with Obesity
(Aerobics Center Longitudinal Study ACLS)

- A better cardio-respiratory fitness level should be considered a characteristic of the subset of metabolically healthy obese phenotype
  - Once fitness is accounted for, metabolically healthy but obese individuals is a relatively benign condition with a similar prognosis as metabolically normal weight individuals and better prognosis than their obese peers with abnormal metabolic profiles
  - This highlights the important role of physical fitness as a health marker

Ortega Eur Heart J 2012
Obesity and Global Warming

Energy as Common Denominator

• Environment = excess carbon from energy sources over the capacity of environmental sinks (oceans, soil, plants) to absorb carbon

  – Industrial waste, pollution “ecofflammation”

  **Ecoflammation** = Biosphere is unable to soak up carbon dioxide & other greenhouse gases because environmental sinks are overwhelmed by emissions from oxidation of fossil fuels resulting in a form of inflammation and “carbon resistance”

  **Ecoflammation** is a result of the post-industrial environment driven by exponential economic growth particularly the increase fossil fuels since 70s when a reverse in relationship between economic growth and health started to occur

Egger MJA 2010;193:635
AOA Resolution 435-A

• At the 2011 AOA House of Delegates, House Resolution 435-A was approved to have all DOs address the obesity epidemic in their practices

• A pilot study is being implemented to determine whether an educational program will change medical students attitudes which will change behavior and ultimately change their patients outcomes
Obesity Bias in Health Care Professions

• Using the fat phobia scale Primary Care Physicians, Physician Assistants, Nurses and Dieticians all viewed obese patients as awkward, unattractive, lazy, weak willed and noncompliant

• Bias and negative attitude toward obese patients creates a barrier in the treatment of obesity

Foster Obes Res 2003;11:1168
Poon J Clin Nurs 2009;18:2355
**Fat Phobia Scale**

*Listed are 14 pairs of adjectives sometimes used to describe obese or fat people. For each adjective pair please place an X on the line closest to the adjective that best describes your feelings and beliefs.*

<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lazy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Industrious</td>
</tr>
<tr>
<td>No will power</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Has will power</td>
</tr>
<tr>
<td>Attractive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unattractive</td>
</tr>
<tr>
<td>Good self control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Poor self control</td>
</tr>
<tr>
<td>Fast</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Slow</td>
</tr>
<tr>
<td>Having endurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Having no endurance</td>
</tr>
<tr>
<td>Active</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Inactive</td>
</tr>
<tr>
<td>Weak</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Strong</td>
</tr>
<tr>
<td>Self Indulgent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Self sacrificing</td>
</tr>
<tr>
<td>Dislikes food</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Likes food</td>
</tr>
<tr>
<td>Shapeless</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Shapely</td>
</tr>
<tr>
<td>Undereats</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Overeats</td>
</tr>
<tr>
<td>Insecure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Secure</td>
</tr>
<tr>
<td>Low self esteem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High self esteem</td>
</tr>
</tbody>
</table>
Survey Value

positive

1 2 3 4 5

negative

< 2.5 = positive or neutral attitudes

3.6 = average bias level

> 4.4 = high level of negative attitudes

<table>
<thead>
<tr>
<th>Group</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family physicians</td>
<td>3.6</td>
</tr>
<tr>
<td>Dietician Students</td>
<td>3.7</td>
</tr>
<tr>
<td>Physician Assistant students</td>
<td>3.7</td>
</tr>
<tr>
<td>Registered nurses</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Self efficacy of Family Medicine Practitioners to Treat Obesity

- Self efficacy is a belief in one’s ability to organize and execute a course of action required to produce a given result
- 29 FP were analyzed before and after an interactive course designed to enrich their knowledge of obesity management
  - Post course efficacy scores were significantly improved

Katz BMC Med Ed 2005;5:4
Self efficacy of Family Medicine Practitioners to Treat Obesity

Content of interactive course on obesity:

• Epidemiology
• Pathogenesis and metabolic factors
• Nutrition and diet
• Self control and behavior modification
• Physical activity
• Drug and surgical treatment
• Metabolic syndrome
• Mechanism of hypertension in obesity
• Diabetic obese patient
• Infertility in obese women

Katz BMC Med Ed 2005;5:4
Remember Obesity is *Not* the cause, rather a marker for metabolic dysfunction

- Diseases associated with metabolic syndrome:
  - Diabetes, hypertension, lipid problems, CVD, non-alcoholic fatty liver disease, cancer, dementia
    - ~20-30% obese people have normal metabolism & have a normal lifespan
  - So a reasonable goal is to achieve healthy metabolic goals independent of weight
    - And encourage cardio-respiratory fitness for all

*Lustig Nature 2012;482:27*  
*Bremer Peds 2012;129:1-14*
Not so easy Recommendations For Intervention

• Achieve an LDL-C similar to that of an infant ~ 40 mg/dl
• Move to a climate that isn’t polluted with PM <2.5 μm (PM_{2.5}) < 5 μg/m^3
• Change your genes
• Change your inherent bias toward obesity
**LDL-C Distribution in Patients With CHD in NHANES III**

What do the following have in common?

- Andorra – Highest inhabited country in Europe between Spain and France
- Macau – 60 km west of Hong Kong
- San Marino – Apennine Mtns surrounded by Italy
- Guernsey – Island off coast of Normandy
- Faroe Islands – Norwegian Sea between Norway, Scotland and Iceland
- Isle of Man – Irish Sea off Newfoundland
- Saint Helena – Island south Atlantic between Africa and South America

Climate Change Performance Index 2008
Measures: emission levels, emission trends & climate policy
Thrifty Gene

• Thrifty gene (or pig out gene) 825T allele of B3 subunit of heteromeric G-protein (GNB3)
  – Associated with development of obesity and metabolic syndrome in absence of regular exercise

• Highest thrifty gene prevalence in people of African descent (80-90%), next Asian (50%) and lowest in Caucasians (30%)
  – Furthermore Asian Indians are predisposed to the deadly lipid tetrad (↑small dense LDL, ↑TG, ↑Lp(a), ↓HDL)

• Sweet tooth genetic profile

Gupta J Assoc Phy India 1997;45:683
Deedwania Curr Athero Reports 2006
Easier to Use Recommendations For Lifestyle Intervention

- Get rid of all sugar liquids: only water and milk
- Eat your carbohydrate with fiber (fruits and vegetables)
- Wait 20 minutes for second portion
- Buy your screen time minute for minute with physical activity