Foods, Obesity, and Diabetes – Are All Calories Created Equal?

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The State of U.S. Health, 2010

Cardiometabolic Risk Factors

Diet & Obesity/Diabetes: Conventional Wisdom

Advances in Nutritional Science

Diet & Obesity/Diabetes: Modern Science
Short-Term Weight Loss (Secondary Prevention)

Mean BMI at baseline = 31

Mean Weight Change (%) for both comparisons with the low-fat diet

- 30% fat
- 33% fat
- 39% fat

Mean Weight Change (%) for all comparisons with the low-fat diet

What About Primary Prevention?
Prevention of Long-Term Weight Gain

- The average adult gains ~ 1 lb (0.45 kg) per year.
- Very small, but adds up: 20 lbs over 20 years.
- This gradual pace makes it very difficult for individuals (or controlled trials) to perceive specific causes or remedies.
- Dietary trials of short-term weight loss in obese patients are unlikely to inform causes of long-term, gradual weight gain in non-obese populations.

What About Primary Prevention?
Prevention of Long-Term Weight Gain

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Weight Change Each Four Years (lbs)

Weight Change Associated with Each Increased Daily Serving of:

- Foods
  - Whole grain
  - Fiber content
  - Whole grain
  - Glycemic response
  - Liquid vs. solid

Choosing Carbs: Best Rule of Thumb?

- Compared 5 recommended metrics:
  - Industry-sponsored “whole grain stamp”
  - Three USDA-recommended definitions, each based on the ingredients list
  - Ratio of total carb to fiber per serving (AHA 2020 Goals)

- Best: Ratio of total carb to fiber
  - > 10:1 = Avoid
  - < 10:1 = A good choice (many options)
  - < 5:1 = A great choice (fewer options)

Grains and Sugars: What's The Healthy Choice?
Diet Quality and Obesity:

All Calories are Not Created Equal

Complex influences of different foods on:
- Hunger, fullness
- Insulin, adrenalin, other hormonal responses
- Liver fat production (de novo lipogenesis, conversion of carbohydrate to fat)
- Brain reward
- Microbiome
- Metabolic expenditure (energy out)

Fat quality alters long-term weight gain

Randomized controlled trial among green monkeys fed calorie-controlled diets containing cis or trans fat (8% energy) for 6 years.

Kavanagh et al., Obesity 2007

Diet quality alters hepatic fat synthesis

18 subjects with NAFLD
- Controlled, equal 5% weight loss with low-calorie vs. low-carb diets over 2 weeks
- Hepatic fat measured by H-NMR

Diet quality alters microbiome function

Less weight gain with either probiotic yogurt or purified Lactobacillus reuteri.
- No changes in microbial composition or total calorie consumption.
- Eating Lactobacillus reuteri triggered changes in microbiome function and host immune system.
- Dependent on both CD4+ T cells and interleukin-10.

Poutahidis et al., Plos ONE 2012

Diet quality alters brain reward activation

Identical appearing and tasting liquid test meals.
- Equal calories, macronutrients, palatability, sweetness.
- Only difference: glycemic index.

↑ flow in right nucleus accumbens (P=0.006)

Lennerz et al., AJCN 2013

Koh-Banerjee et al, AJCN 2003

Browning et al. AJCN 2012

Browning et al. AJCN 2011

Lennerz et al. AJCN 2013

Poutahidis et al., Plos ONE 2012
Diet quality alters energy expenditure

Figure 1. Study Design of the Diet in and Out Study

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>Low fat diet</th>
<th>Low GL diet</th>
<th>High fat diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy expenditure, kcal/day</td>
<td>3300</td>
<td>3100</td>
<td>2900</td>
<td>2700</td>
</tr>
</tbody>
</table>

P trend <0.001

Ebbeling et al. JAMA 2012

SSBs & Incident Diabetes

Percent increase in risk of diabetes

Risk for 1+ drink (12 oz) per day, compared with <1 per month

Among 91,249 women followed for 8 years. Schulze et al., JAMA 2004

Processed Meats & Incident Diabetes

RR = 2.28
(1.56, 3.35)

Pan et al, AJC 2011

Nuts & Incident Diabetes

RR of diabetes per 4 servings (25.4g) week of nuts

Afshin et al, AJC 2014

Dairy Foods & Incident Diabetes

RR trend = 0.50
P-trend = 0.06
P-trend = 0.01

Shuji et al., AJC 2012

Preventing Chronic Diseases: Food Patterns
Dietary Priorities for Health

**EAT:**
- Fish, seafood
- Fruits
- Nuts
- Vegetables, legumes
- Vegetable oils
- Whole grains
- Moderate dairy

**LIMIT:**
- Starches, refined grains, sugars
- Processed meats
- Sweetened drinks
- Industrial trans fat
- Salt
- Alcohol

Mozaffarian, Appel, & Van Horn. Circulation 2011

Calorie/Fat Focus: Recipe for Confusion

<table>
<thead>
<tr>
<th>Food Group</th>
<th>SD (Whole Grains Preferred)</th>
<th>BWH (Low-Fat Focus)</th>
<th>WHOL (Whole Foods Only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>Almost at heart, beans, and legumes with added fat and salt</td>
<td>Almost at heart, beans, and legumes with added fat and salt</td>
<td>Almost at heart, beans, and legumes with added fat and salt</td>
</tr>
<tr>
<td>Meats, Dairy, Fats, Eggs, Nuts, and Salsa</td>
<td>Almost at heart, beans, and legumes with added fat and salt</td>
<td>Almost at heart, beans, and legumes with added fat and salt</td>
<td>Almost at heart, beans, and legumes with added fat and salt</td>
</tr>
<tr>
<td>Serves and Beverages</td>
<td>Mostly water, tea, and coffee</td>
<td>Mostly water, tea, and coffee</td>
<td>Mostly water, tea, and coffee</td>
</tr>
<tr>
<td>Fruits/Condiments</td>
<td>Mostly water, tea, and coffee</td>
<td>Mostly water, tea, and coffee</td>
<td>Mostly water, tea, and coffee</td>
</tr>
</tbody>
</table>


Calorie/Fat Focus: Recipe for Manipulation

- Low calorie = “Less weight gain”
- Fat free = “Healthy”
- Low saturated fat = “Healthy”

Lessons From Past Public Health Successes

US Centers for Disease Control and Prevention, MMWR Morb Mortal Wkly Rep, 1999
Lessons From Past Public Health Successes

- **Driver:**
  - Education.
  - Licensing.
  - Limits on phone use, texting.

- **Car:**
  - Active: seat belts, child seats, motorcycle helmets.
  - Passive: paddled interiors, collapsible steering columns, shatterproof glass, air bags.
  - Crash safety standards.
  - Safety inspections.

- **Road:**
  - Road engineering, guard rails, rumble strips.
  - Speed limits.
  - Stop signs, stop lights, caution signs.

- **Culture:**
  - Designated driver campaign.
  - Drunk-driving legislation.
  - Private advocacy, e.g., MADD.

Evidence-Based Policy Interventions for Diet

<table>
<thead>
<tr>
<th>Media and Education</th>
<th>• Sustained, focused media campaigns, especially combined with multi-component strategies, focused on specific foods or drinks.</th>
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<td>Labeling and Information</td>
<td>• Mandated nutrition facts, front-of-pack labels/icons, or menu labeling to influence industry behavior and product formulations.</td>
</tr>
<tr>
<td>Schools</td>
<td>• Multicomponent diet and activity program including classes, teacher training, supportive policies, environmental changes, family components.</td>
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<tr>
<td>Workplaces</td>
<td>• Comprehensive worksite wellness programs for diet, activity, tobacco.</td>
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<tr>
<td>Economic Incentives</td>
<td>• Subsidy strategies to lower prices of more healthful foods and beverages.</td>
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<tr>
<td>Bans and Mandates</td>
<td>• Direct bans [e.g., sodium, trans fats] or mandates (e.g., vegetable oils).</td>
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Mozaffarian, Hemenway, & Ludwig, JAMA 2013

Mozaffarian et al, AHA Scientific Statement, Circulation 2013