Food choices and diet costs: An economic analysis

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Poverty and Obesity: Disparities in Diet and Health.
ECOR Interdisciplinary Forum, Seattle, WA, March 2, 2007
Disparities in diet and health: A new focus on money and time

Some basic points:

• Energy-dense foods cost less
• Nutrient-rich foods cost more
• Healthier diets cost more per MJ
• There are inequities in food access

• Consumer food choices are driven by
  • Taste, cost, convenience, health, variety
Consumers care about food costs.
Some health professionals do not
Are healthy diets available to all?

Is this the perfect diet... or is it economic elitism?

The Harvard SPH Food Pyramid
Taste, cost, convenience = sugar + fat

Obesity

Sugar/fat

Variety

Health
First question

Do energy-dense foods cost less?

- Energy density defined as MJ/kg
- Energy cost defined as $/MJ (€/MJ)
- Energy and nutrients from databases
- Mean national food prices in France
Energy density (MJ/kg) depends on the water content of foods.
Energy density (kcal/100g) and energy cost (Euros/1000kcal) – INCA study

Log scale!
Energy density (kcal/100g) and energy cost (Euros/1000kcal) – INCA study

- Oil
- Butter
- Sugar
- Desserts
- Soft drinks
Energy density (kcal/100g) and energy cost (Euros/1000kcal) – INCA study
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Disparity in food costs: Are “junk” foods simply cheaper?

- High glycemic Index
- High glycemic load
- Hydrogenated fats
- Trans fatty acids
- Added sugars
- Added fats
- Energy dense foods
- Empty calories
- Minimal nutritional value

- Low energy density
- High satiating power
- Antioxidants
- Phytochemicals
- Fiber
- CLA
- Vitamins
- Minerals
Second question

Are energy-rich foods nutrient-poor?

• Energy-dense foods cost less
  • Grains, fats, oils are more affordable
• Energy-dense foods taste better
  • Palatability = energy density
• Are low-cost, energy-dense foods low in key nutrients?
We need to create a nutrient density score for foods:

- Nutrient Density Score is the ratio between the amount of nutrients in a food and the energy that the food provides
  \[ NDS = \left( \frac{NAS}{ED} \right) \times 100 \]
- Nutrient Adequacy Score is based on percent DVs for \( N \) key nutrients as provided by 100 g of food
  \[ NAS = \frac{\left( \sum \left( \frac{\text{Nutrient}_i}{\text{DV}_i} \right) \times 100 \right)}{N} \]
- Nutrient-to-price ratio NPR = NAS/price per 100g

Work by Darmon, Drewnowski, Monsivais
Yes – energy dense foods have lower Nutrient Density Scores (NDS/100kcal)

Darmon, Darmon, Maillot, Drewnowski JADA 2005
Higher nutrient-density (per 100g) usually means higher cost (also per 100g)

Darmon, Darmon, Maillot, Drewnowski JADA 2005
Nutrient Density Score (NNR version)

Energy density (MJ/kg)

NNR scores for vegetables and fruit

- vegetables
- fruit

- applesauce
- grape juice
- raisins
- fried potatoes
- potato chips
- potatoes
- canned pears
- avocado
- blueberries
- tangerines
- strawberries
- grapefruit
- kiwi
- cantaloupe
- mango
- spinach
- romaine
- broccoli
- tomato
- OJ
Third question:

Do energy-dense *diets* cost less?

- French INCA study conducted by AFSSA
- Sample of 1,985 adults; 7-day food diaries
- National prices for 650 foods
- Diet costs measured in €/d
- Energy cost measured in €/10MJ
At each intake quintile, higher energy density = lower cost (€/wk)

INCA data
At each intake quintile, higher energy density = lower cost (€/wk)

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INCA data
Spend less = Eat more
Are obesity and poverty linked by the low cost of energy-dense foods that are both palatable and convenient?

Drewnowski & Specter, Am J Clin Nutr 2004;79:6-16

Energy density and food costs
Drewnowski and Specter AJCN 2004;79:6-16

The paradox – Saving on food costs leads to energy dense diets
Energy dense diets permit overeating
Spend less – eat more
The Energy Density curve
Drewnowski and Specter AJCN 2004:79:6-16

The paradox – it is possible to spend less and get more
But the calories will be refined grains, added sugar and fat
As dietary ED increases – so do total energy intakes

INCA data
Last question:

What happens when you stratify diets by energy cost?

Food expenditures can be a proxy for SES
An epidemiological dogma falls

The unshakeable relationship between nutrients and calories *disappears*
A principle of nutritional epidemiology

- “Intakes of virtually all nutrients are positively correlated with total caloric intake”
- “People who consume more total food have higher nutrient intakes”
- “Nutrient intakes are biologically important in relation to caloric intakes”
- Hence the need to correct for energy in epidemiologic studies

Willett and Stampfer in Nutritional Epidemiology, 2nd Ed, OUP 1998
The INCA (1998) data set

- INCA is a nationally representative study of 1,985 French adults.
- Dietary intakes based on 7-day diet records.
- More than 850 foods in the nutrient database.
- Mean national food prices supplied by the French government (INSEE); by market research agencies (SECODIP), as well as Paris websites.
- Diet costs estimated by multiplying unit price for each item by portion size and summing over all foods consumed by that person.
- That is the estimated cost of the diet – assuming that all foods are purchased and prepared at home.
Low-cost diets: Spend less – but eat more

<table>
<thead>
<tr>
<th></th>
<th>Quartiles of energy cost (€/10MJ)</th>
<th>P Anova</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Q1 (4.9)</td>
<td>Q2 (5.9)</td>
</tr>
<tr>
<td>Energy Density (MJ/kg)</td>
<td>6.4</td>
<td>6.1</td>
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<tr>
<td>Energy Intake (MJ/d)</td>
<td>9.4</td>
<td>9.0</td>
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<tr>
<td>Vitamin C (mg/day)</td>
<td>65</td>
<td>79</td>
</tr>
<tr>
<td>Vitamin D (µg/day)</td>
<td>2.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Vitamin E (mg/day)</td>
<td>6.9</td>
<td>7.2</td>
</tr>
<tr>
<td>ß-Carotene (mg/day)</td>
<td>2287</td>
<td>2824</td>
</tr>
<tr>
<td>Folates (µg/day)</td>
<td>237</td>
<td>255</td>
</tr>
</tbody>
</table>

Andrieu, Darmon, Drewnowski, EJCN, 2006
Low cost diets: more energy, fewer nutrients

Referent diet

Energy Intake

Energy Density

Vitamin C

Vitamin D

β Carotene

Folates

Vit E

Q1
4.9 €/10MJ
4.5 €/d

Q2
5.9 €/10MJ
5.3 €/d

Q3
6.9 €/10MJ
6.0 €/d

Q4
9.0 €/10MJ
7.4 €/d
Val-de-Marne: Contribution of food groups to diet energy and to diet cost (Drewnowski & Darmon, AJCN, 2005)

The energy/price hierarchy is such that the lowest-cost food groups contribute the most to energy intakes.

- Meat/Fish
- F+V
- Dairy
- Grains
- Sugar
- Fats/oils
Final question:

What about food prices in Seattle?

- We collected food prices in 2004 and 2006
- Same supermarkets, same foods, same package sizes
- The foods were divided by energy density
  - Low ED = vegetables and fruit
  - High ED = grains, sugars and fats
- Manuscript (Monsivais et al.) submitted to JADA
Energy density (kcal/100g) and energy cost ($/1000kcal) – Seattle 2006 Supermarket prices
The rising cost of low-energy-density foods

Monsivais et al. submitted
Access to healthy foods

- **Affordability**
  - Energy-dense foods are cheaper

- **Accessibility**
  - Energy-dense foods are closer

- **Convenience**
  - Fast foods take less time to prepare
What can you get for $100/week for a family of 4.
The USDA Thrifty Food Plan: 1999
Is obesity an economic issue?
A challenge for public health nutrition

- High-fat energy-dense foods are often the cheapest options for the consumer
  • Editorial, The Lancet January 31, 2004

- If a meal of grilled chicken, broccoli and fresh fruit costs more and is less convenient than a burger and fries, the battle against obesity will be lost
  • Editorial, The Lancet January 31, 2004
Money for the Masses
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