What Do We Know about the Economics of Obesity, and Where Do We Go From Here?

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Richard Dunn, University of Connecticut
Nathan Tefft, Bates College

Closing Plenary
IHEA 11th World Congress in Health Economics
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Outline

• Background
  – Obesity: definitions and measurement
  – Prevalence and trends worldwide

• Overview of What We Know about the Economics of Obesity
  – Economic causes of obesity
  – Economic consequences of obesity
  – Economic approaches to prevention and treatment

• Richard Dunn: Food Environment

• Nathan Tefft: Food Taxes as Policy Response
Definition and Measurement of Obesity

• Body Mass Index (BMI) = \( \text{kg/m}^2 \)

• Definitions of obesity:
  – Youth: BMI >= historic 95\textsuperscript{th} percentile
  – Adults: BMI >= 30
    • For man of average height (5’9’’), threshold roughly 203 lbs. or 92 kg
    • For woman of average height (5’4’’), threshold roughly 175 lbs. or 79 kg
More Accurate Measures of Fatness

• BMI a limited measure of fatness
  – Ignores body composition: kg of muscle treated the same as kg of fat
  – May exaggerate racial disparities in obesity, predict morbidity and mortality less accurately than direct measures of fatness (Cawley and Burkhauser, 2008; Blundell et al., 2014)

• More accurate measure: percent body fat or fat mass (kg)
  – Measured by various means:
    • BodPod
    • Dual X-ray absorptiometry (DEXA)
    • Bioelectrical Impedance Analysis (BIA)

• Much of the literature uses BMI, so will adhere to that in this review
• Use of self-reports leads to bias that can be upward; Cawley, Maclean et al. (2015)
Recent Rise in the Prevalence of Obesity

Data: NHES I, NHANES I, II, III and Continuous. Source: Cawley (forthcoming)
Trends in Obesity in Selected OECD Countries, Women, 1970-2010

Source: OECD (2010)
Trends in Obesity in Selected OECD Countries, Men, 1970-2010

Source: OECD (2010)
Current Prevalence of Obesity

- World Health Organization (2013) estimates that over 500 million adults (12%) worldwide are obese

- The Institute of Medicine and World Health Organization describe current rates of obesity as “epidemic” (IOM, 2012; WHO, 2011)

- Prevalence varies considerably across countries
Prevalence of obesity*, ages 20+, age standardized
Both sexes, 2008

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Source: WHO (2014)
## Most Obese Nations on Earth, 2008

<table>
<thead>
<tr>
<th>Rank (Males)</th>
<th>Nation</th>
<th>Obesity Prevalence, Adult Males</th>
<th>Obesity Prevalence, Adult Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nauru</td>
<td>67.5</td>
<td>74.7</td>
</tr>
<tr>
<td>2</td>
<td>Cook Islands</td>
<td>59.7</td>
<td>68.5</td>
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<tr>
<td>3</td>
<td>Tonga</td>
<td>49.1</td>
<td>70.3</td>
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<tr>
<td>4</td>
<td>Samoa</td>
<td>45.3</td>
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<tr>
<td>8</td>
<td>Kuwait</td>
<td>37.2</td>
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<td>12</td>
<td>Czech Republic</td>
<td>30.5</td>
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<td>USA</td>
<td>30.2</td>
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<td>18</td>
<td>Argentina</td>
<td>27.4</td>
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<tr>
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<tr>
<td>28</td>
<td>Ireland</td>
<td>25.7</td>
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</tr>
<tr>
<td>31</td>
<td>Australia</td>
<td>25.2</td>
<td>24.9</td>
</tr>
</tbody>
</table>

Source: WHO Global Infobase (2012)
Possible Causes of Obesity

• Breathtakingly broad set of possible explanations (see, e.g. Keith et al., 2006; Ridaura et al., 2013):
  – Decreased sleep
  – Exposure to chemicals called endocrine disruptors
  – Decreased exposure to extreme heat because of air conditioning
  – Increased consumption of pharmaceuticals
  – Increased maternal age at birth
  – Higher rates of reproduction among individuals with a genetic predisposition to obesity
  – Viruses
  – Gut microbes

• We’ll focus on economic explanations; e.g. prices, income, education, peers

• We’ll focus on studies that estimated causal effects
Possible Economic Causes of Obesity

- **Income**
  - Natural experiment of Social Security Benefits Notch: no detectable effect of income on weight for retirees (Cawley et al., 2010)
  - Natural experiment of variation in EITC payments: an extra $1,000/year raises weight of women by average of 1 pound, no effect on men (Schmeiser, 2009)
  - Natural experiment of new casino payments to Native Americans: extra income raises weight of lower-income adolescents but no effect those from higher-income HH (Akee et al., 2013)
Possible Economic Causes of Obesity

• Education
  – Natural experiments of legislated increases in minimum schooling
    • Clark and Royer (2013): England
      – No detectable effect of education on obesity, overweight or BMI
      – But point estimates in some cases large (+) and imprecise
    • Brunello et al. (2013): 9 countries of Europe
      – Women: additional year of education reduces risk of obesity by 1.85 ppts (14.83%)
      – Men: no detectable effect
Possible Economic Causes of Obesity

• Peer / neighborhood effects
  – RCT incentivizing poor HH to move to higher-income neighborhoods (Kling et al., 2007; Ludwig et al., 2011)
    • After 5 years, T group 4.8 percentage points less likely to be obese
    • After 12 years, T group 3.4-4.6 percentage points less likely to be morbidly obese
  – Natural experiment of randomly assigned college roommates (Yakusheva et al., 2014):
    • Girls: Heavier roommates cause weight gain; roommates who are higher-status (lighter, from higher-income family) are more influential
    • Boys: no evidence of peer effects
Possible Economic Causes of Obesity

- Richard Dunn will discuss the role of food environment in obesity
Medical Complications of Obesity

Source: CDC (2015)
Consequences of Obesity

• Fat releases hormones that affect:
  – Morbidity: leptin causes CVD, resistin causes Type II diabetes (Trayhurn and Beattie 2001), additional insulin release increases cancer risk
    • Population attributable risks high (Eckel, 2003; Calle and Kaaks, 2004); obesity responsible for:
      – 61% of all Type II diabetes
      – 17.3% of all CVD
      – 24% of all osteoarthritis
      – 42.5% of all kidney cancer…
  – Mortality:
    • WHO (2013) estimates overweight and obesity responsible for 2.8 million deaths per year worldwide
    • In US: 365,000 deaths per year (Mokdad et al., 2005) = 3 jumbo jets crashing daily
The Medical Care Costs of Obesity

- Natural experiment of heritability of weight (Cawley, Meyerhoefer, et al., 2012, 2015)
  - Obesity raises annual medical costs of adults by $3,508
    - Substantially raises costs associated with inpatient care, Rx, outpatient care
  - Aggregate annual costs of adult obesity for the U.S.:
    - $315.8 billion (27.5% of U.S. National Health Expenditures)
• Small increase in medical costs associated with Class 1 obesity
• Exponential increase in medical costs associated with morbid obesity

Source: Cawley, Meyerhoefer et al., *Pharmacoeconomics* (2015)
Obesity Lowers Wages

• Natural experiment of heritability of weight:
  – In US, impact of weight on wages varies by race and gender (Cawley, 2004):
    • Greatest impact for white females, additional 10 lbs lowers wages by 2.8%.
    • No detectable impact for men
  – In 9 European countries (Brunello and d’Hombres, 2007), 10% increase in BMI lowers wages of:
    • Females by 1.86%
    • Males by 3.27%
Why Does Obesity Lower Wages?

• Worse health or lower productivity?
  – Can’t be whole story; women’s wages fall with BMI starting at low levels of BMI (20-23) (Kline and Tobias, 2008; Gregory and Ruhm, 2011)

• Discrimination?
  – Yes; Audit study found obese individuals were 6-8 percentage points less likely to get initial job interview (Rooth, 2009)
Economic Policies to Prevent/Reduce Obesity

• Is this the government’s (our) business?
  – Economics recognizes importance of allowing mutually beneficial trades, not second-guessing consumer decisions

• However, there are market failures
  – Obesity imposes negative externalities
    • Public health insurance (Medicare, Medicaid, SCHIP)
    • Private health insurance
  – May be lack of information
  – Consumers (esp. children) may not act rationally
Economic Policies to Prevent/Reduce Obesity

• Tax high levels of body fat
  – Politically unattractive
  – Singapore’s “Trim and Fit” program; Japan’s “Metabo Law”

• Nathan Tefft will discuss the effects of taxes on energy-dense foods / subsidies for healthy foods
Economic Policies to Prevent/Reduce Obesity

• Financial incentives for weight loss
  – Mixed record of effectiveness
  – Some find substantial weight loss; e.g. Volpp et al. (2008)
  – Others find high attrition and modest weight loss (Cawley and Price, 2011, 2013; Finkelstein et al., 2007)

• Subsidize physical activity
  – We do this with public-school sports teams, gyms, PE/recess, public parks
  – For many grades, little evidence school PE reduces kids’ weight; Cawley et al. (2007, 2013)

• At a minimum, government could stop subsidizing bad diets
  – Could reform agriculture policy, which generally lowers prices of energy-dense foods (Cawley and Kirwan, 2011); exceptions are milk and sugar
  – Cease to allow food stamps (SNAP) to be used to purchase energy-dense foods
Other Economic Rationales for Government Intervention

- Imperfect information
  - Require nutrition labels, soon menu labels too
    - Nutrition Facts panel led to declines in sales of high-fat products; Mathios (2000)
    - NYC menu label law (relative to control cities):
      - Starbucks: calories purchased fell 5.8%; Bollinger et al. (2011)
      - Fast food: no change in calories purchased; Elbel et al. (2009)
    - After label laws there can be healthful reformulations of products (Bruemmer et al., 2012; Vesper et al., 2012)
Other Economic Rationales for Government Intervention

• Protect consumers if failures of rationality
  – Ban/limit advertising of food to children: Quebec, Norway, Sweden, South Korea
  – In U.S., obstacle is concept of “commercial speech”
• At minimum, could end the USDA’s checkoff program that promotes development and marketing of energy-dense commodities
Summary

• **Causes:** no single dominant economic cause of obesity; many factors (e.g. income, peer effects) may have modest effects

• **Consequences:** Clear economic consequences of obesity: higher medical care costs of morbid obesity, lower wages for women

• **Prevention and treatment:** no magic bullet. Taxes on energy-dense foods, financial incentives for weight loss, menu labels may have modest effects
Review Article

An economy of scales: A selective review of obesity’s economic causes, consequences, and solutions

John Cawley
What Do We Really Know About the Economics of Obesity, and Where Do We Go From Here?

The Food Environment

Richard A. Dunn (University of Connecticut, USA)

Presented to the 11th World Congress in Health Economics
Milan, Italy
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Food Environment

Availability
- Healthy Food Sources
- Unhealthy Food Sources

Prices

Advertising

Peers
Food Environment

- Availability
  - Healthy Food Sources
  - Unhealthy Food Sources
- Prices
- Advertising
- Peers
Availability: the time, effort, monetary resources needed to have the opportunity to purchase a particular basket of food items
What do we (economists) know?
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1) There are lots of articles finding lots of correlations.
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2) Remarkably little using an explicit identification strategy that sets out to establish causality.
What do we (economists) know?

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White
Miles to nearest restaurant  0.013 (0.017)
Restaurants within 1 mile     0.043 (0.060)
Restaurants within 3 miles 0.011 (0.015)

Black
Miles to nearest restaurant  0.146** (0.071)
Restaurants within 1 mile 0.233*** (0.053)
Restaurants within 3 miles 0.067*** (0.024)
What do we (economists) know?


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What do we (economists) know?


**Research Area 1:** New approaches to estimate the causal effect of the food environment.
Why do we care?
Why do we care?

**Model Predictions**

1. If we increase the availability of fresh-fruits and vegetables, households will consume more of these foods and less of prepared, processed foods.

2. If we decrease the availability of fast-food, households will consume less of these foods, and more of other (perhaps healthier) foods.

*Perhaps, potential policy levers exist!*
Claim

• The average effect of a large change in food environment is likely very small.
Claim

• The average effect of a large change in fast-food exposure is very small.

• Question: What would need to be true for an economically meaningful relationship to arise?
  • How much would exposure need to change?
  • How much would time cost have to increase or decrease?
  • How much would the value of time need to be worth?
Research Areas

**Research Area 2:** Systematically identifying subpopulations that are likely to respond to the food environment.
Research Areas

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The Time-Poor: A New Look at Poverty*

Clair Vickery

Research Area 3: The intersection of time-use, household resources, the food environment, and eating behavior.
Research Areas

The effect of fast-food availability on fast-food consumption and obesity among rural residents: An analysis by race/ethnicity

Richard A. Dunn\textsuperscript{a,*}, Joseph R. Sharkey\textsuperscript{b}, Scott Horel\textsuperscript{c}

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\end{itemize}

\textbf{Research Area 4:} Improving our measures of exposure to take account of the geography of daily activities.
Characterising food environment exposure at home, at work, and along commuting journeys using data on adults in the UK

Thomas Burgoine1* and Pablo Monsivais1,2
Environmental correlates of adiposity in 9–10 year old children: Considering home and school neighbourhoods and routes to school

Flo Harrison \textsuperscript{a,\*}, Andrew P. Jones \textsuperscript{a}, Esther M.F. van Sluijs \textsuperscript{b}, Aedín Cassidy \textsuperscript{c}, Graham Bentham \textsuperscript{a}, Simon J. Griffin \textsuperscript{b}
Research Areas

Other Methodology Issues

- Incomplete proprietary business listings, e.g., Dun and Bradstreet.

- Classification schemes that do not account for variation in the quantity or quality of foods.

- Self-reported consumption information from Food Frequency Questionnaires (FFQ) and 24-48 hour dietary recalls.
Research Areas

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Research Area 5: Better collaboration with other disciplines to improve the quality of data used in empirical studies.
Research Areas
Summary

• Zoning policy that changed the food environment is a potential policy lever to influence obesity.

• Unlikely to find large average effects, but may identify vulnerable populations that are on the margin.

• Distributional consequences of policy are perfectly reasonable motivation for conducting economic research.

• Important methodological challenges often requiring interdisciplinary cooperation.
What Do We Really Know About the Economics of Obesity, and Where Do We Go From Here?

Food & Beverage Price Policies

Nathan Tefft (Bates College, Maine, USA)

Presented to the 11th World Congress in Health Economics
Milan, Italy
July 15, 2015
Overview

• Case study: sugar-sweetened beverage (SSB) taxes
  – How has economics contributed to knowledge about SSB taxes?
    • How did our knowledge evolve?
  – What is coming?
    • In policy and in research?
  – Summary thoughts
Why an SSB tax?

• SSBs offer relatively little non-caloric nutrition
• Represent a non-trivial portion of per capita calorie intake in Mexico and the United States (Brownell et al., 2009)
• NEJM: penny-per-ounce excise tax on SSBs (Brownell et al., 2009)
  – Would combat obesity through reduced consumption and increased revenue
Evolution of contributions from economics

1. Modeling behavior contributing to body weight production

2. Simulation based on food demand systems

3. Quasi-experimental studies of real-world policies
Theoretical models of behavior

• Economic theory can inform thinking about the comprehensive effects of SSB taxes
  – Taxes and subsidies yield ambiguous effects depending on structure of substitutes and complements (Schroeter et al., 2008)
  – Time use important since (presumably healthier) food at home and physical activity compete for time (Yaniv et al., 2009)
Dynamic models of biology and behavior

• Moving beyond linear extrapolation to dynamic steady states approaches
  – Estimating weight production at 3,500 calories per pound (energy content) overestimates food price change effects (Cutler et al., 2003; Lin et al., 2011)
  – Short- and long-term effects of price changes may vary for biological and behavioral reasons (Goldman et al., 2011)
Modeled price responses

• QUAIDS model accounting for cross-product (beverage) substitution (Dharmasena and Capps, 2012)

• May be more efficient to adjust prices broadly (through taxation)
  – Of nutrients (Harding and Lovenheim, 2014; Miao et al., 2012)
  – Or of calories (Okrent and Alston, 2012)
Tax quasi-experiments

• Historical tax changes show small obesity impact, at best
  – Among adults (Fletcher, Frisvold, & Tefft, 2010, CEP)
    • Studied weight outcomes using state and time variation in U.S. soft drink taxes
  – Among children & adolescents (Fletcher, Frisvold, & Tefft, 2010, JPubEcon)
    • Studied weight outcomes and consumption
    • Found reduction in self-reported soft drink consumption but increase in consumption of other caloric beverages
Would larger, more salient taxes work?

• Historical differential tax rates only modest and substitution blunts their effects (Fletcher, Frisvold, & Tefft, 2011, JPAM Point-Counterpoint)

• We studied largest and most salient
  – Ohio and Arkansas in the early 90s
  – Non-linear models of existing taxes
  – Still no substantial evidence of obesity effects (Fletcher, Frisvold, & Tefft, 2015, HE)
Recent developments in policy

• Mexico: 7 cents per liter tax on SSBs in 2014
  – Preliminary analysis by Mexico’s National Institute of Public Health shows 10% decrease in taxed purchases during Q1 2014

• Berkeley, California: penny per ounce tax on SSBs in 2015
  – First such tax in the United States

• Both offer opportunities to directly study large, visible SSB taxes
Food for thought

• Think big (and broad)
  – Tax calories or caloric sweeteners, more generally
  – Subsidize healthy foods (Klerman et al., 2014; Sturm et al., 2013)
  – Could targeted taxes backfire?

• Distribution of welfare effects
  – SSB taxes likely regressive in SSB markets
    • But what about long-term health effects?
  – Could a broader tax build support through shared burden?