An Economic Look at the Rise in Obesity

Fall 2018

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Introduction

- Rapid increase in obesity since 1970
  - In 1970, 14% of the population was obese
  - Today, rates are 36%
- During most of our history, long terms trend are such that improvements in body size have been health improving (Fogel)
- Now the average BMI is in dangerous range

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Definitions

- Obesity based on Body Mass Index
- BMI = weight (kg)/(height in cm)^2
- = 703 x weight (pounds)/(height in inches)^2
- BMI < 20 Underweight
- 20 ≤ BMI < 25 Ideal
- 25 ≤ BMI < 30 overweight
- 30 ≤ BMI obese

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Two primary sources of BMI data

- National Health Interview Survey
  - Annual survey of 160K people
  - Self reported health conditions (including height and weight)
  - Tend to overstate height, understate weight
- National Health Examination and Nutrition
  - Frequent surveys of 6K-12K people
  - Detailed physical exams (including blood tests)

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Obesity Rates Over Time

	% Obesity		% Overweight	
Group	1971/74	2011/14	1971/74	2011/14
All	14.6	36.4	47.7	69.5
Males	12.2	33.9	54.7	73.0
Females	16.8	35.5	41.1	66.2
Black F.	29.7	54.0	60.5	82.0

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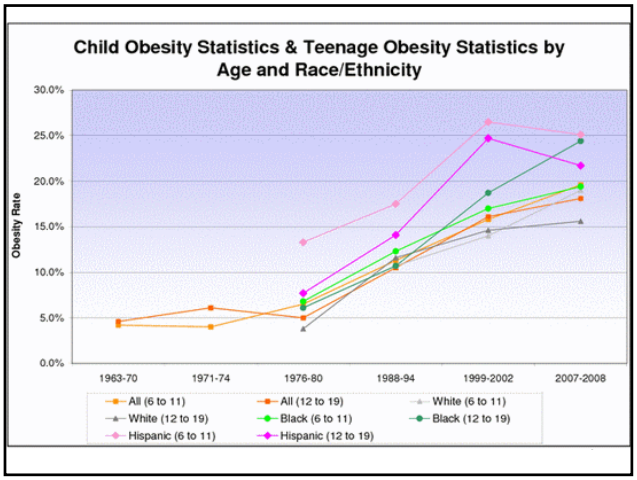

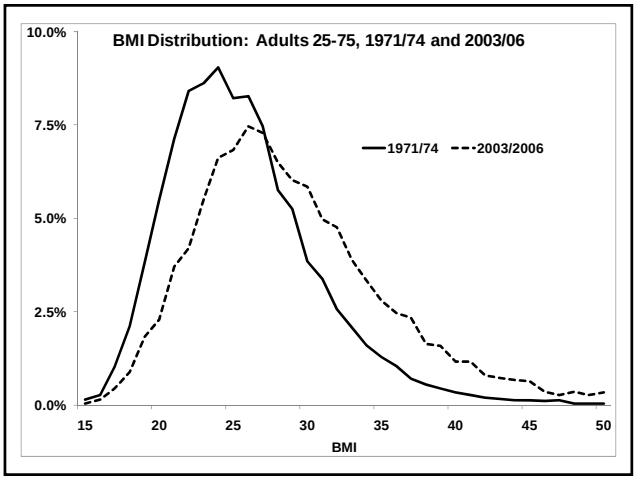

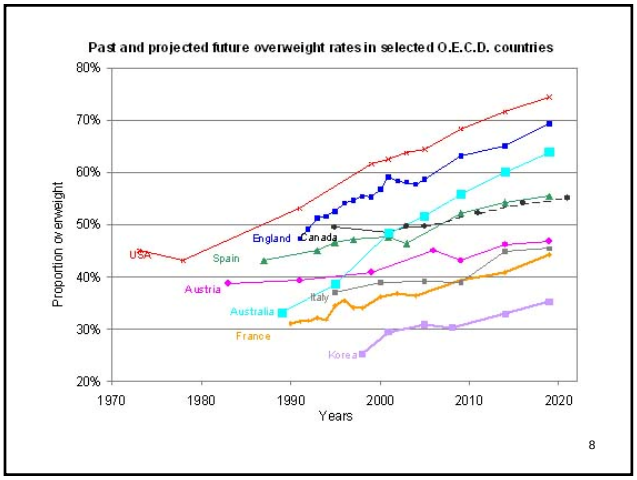

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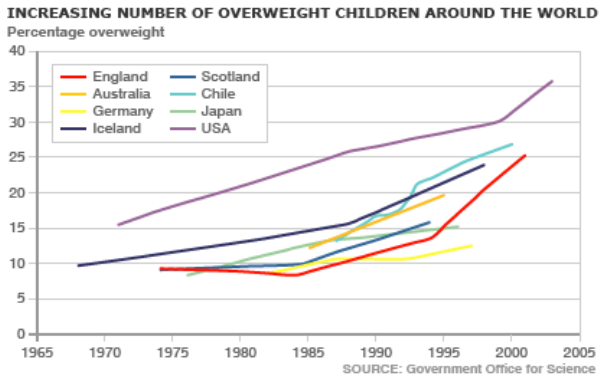

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% Obese for Different Groups

Group	71-75	07/09	Δ(% change)
Single male	8	33	25 (313%)
Married male	12	39	27 (225%)
Single female	18	37	19 (106%)
Married female, working	18	33	15 (83%)
Married female, not working	16	37	21 (131%)

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% Obese for Different Groups

Group	88-94	05-08	Δ(% change)
Male, College	15.6	27.4	11.8 (75.6%)
Male, HS	21.8	34.8	13.0 (59.6%)
Male, <HS	22.6	32.1	9.5 (42.0%)
Female, College	15.3	23.4	8.1 (52.9%)
Female, HS	28.2	39.8	11.6 (41.1%)
Female, <HS	31.7	42.1	10.4 (32.8%)

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% Obese for Different Groups

Group	88-94	05-08	Δ(% change)
Male, PIR≥3.5	18.0	32.9	14.9 (82.8%)
Male, 1.3≤PIR<3.5	22.7	34.6	11.9 (52.4%)
Male, <1.3	21.1	29.2	8.1 (38.3%)
Female, PIR≥3.5	18.6	29.0	10.4 (55.9%)
Female, 1.3≤PIR<3.5	26.8	39.0	12.2 (45.5%)
Female, <1.3	34.5	43.0	8.5 (24.6%)

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% Obese for Different Groups

Group	88-94	05-08	Δ(% change)
Male, white NH	20.3	31.9	11.6 (57.1%)
Male, black NH	21.1	37.3	16.2 (76.7%)
Male, Hispanic	23.9	35.9	12.0 (50.2%)
Female, white NH	22.9	33.0	10.1 (44.1%)
Female, black NH	38.2	49.6	11.4 (29.8%)
Female, Hispanic	35.3	45.1	9.8 (27.7%)

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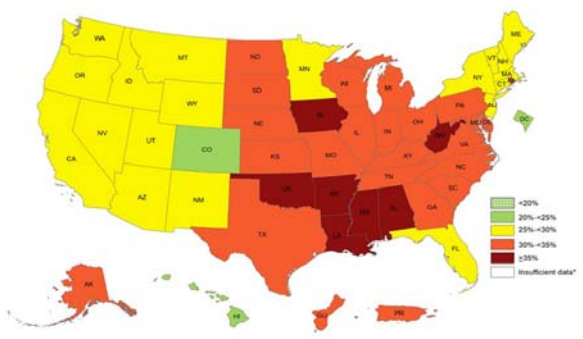

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Facts to explain

- Increase is recent (started in 1970s)
  - Comes at a time when almost all other health measures are improving (blood pressure, cholesterol, smoking, pulse)
- Increase in all segments in the population
- Increase has not been as great in other developed countries

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Usual suspects

- TV
- Lack of exercise
- Super-sized fast food meals
- Working moms
- Decline in smoking
- Built environment

- Can dispose of some of these right away

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- Why is this a difficult problem to disentangle?
- An increase in 100-150 calories/day would explain 10-12 pound increase in weight over past 20 years.
  - Equal to 3 Oreos/day
  - One can of Pepsi/day
  - 8 ounces of orange juice/day

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Basics of the problem

- Cutler et al. show that the problem is a rise in calories consumed, not a fall in calories burned
- Data from a variety of sources
  - Food diaries
  - Time diaries
  - Physiological studies, calories burned by an activity

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Table 2
Changes in Food Consumption, 1977–1978 to 1994–1996

	Meal	Calories[a] 1977–1978	Calories[a] 1994–1996	Change	Percentage of Total Change
Male	TOTAL	2080	2347	268	100%
	Breakfast	384	420	36	13
	Lunch	517	567	50	19
	Dinner	918	859	−59	−22
	Snacks	261	501	241	90
	Calories per meal	575	566	−7	
	Meals per day	3.92	4.53	.61	
Female	TOTAL	1515	1658	143	100%
	Breakfast	286	312	26	18
	Lunch	368	398	31	22
	Dinner	676	602	−74	−52
	Snacks	186	346	160	112
	Calories per meal	422	408	−14	
	Meals per day	3.86	4.44	.58	

Note

- Meals have increased
- Calories per meal has stayed the same
- Big increase in snacks and calories from snacks
- What pathways are eliminated from by this chart?

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Table 3
Time Use, 1965–1995
(Minutes per day, age 18–64)

Activity	*1965*	*1975*	*1985*	*1995*
Paid work	290	258	259	266
Eating on the job	11	8	8	—
Breaks	8	4	3	1
Household work	146	128	124	102
Food preparation	44	41	39	27
Meal cleanup	21	12	10	4
Child care	37	31	31	18
Obtaining goods and services	51	45	55	49
Personal needs and care	622	644	634	632
Meals at home	58	54	50	65
Meals out	11	19	19	(meals at home & out)
Sleeping/napping	473	496	479	495
Education and training	12	16	18	23
Organizational activities	20	24	18	17
Entertainment/social	78	65	65	72
Recreation	27	37	43	47
Active sports	5	4	10	13
Outdoor	1	7	5	6
Walking/hiking/exercise	1	2	4	5
Communication	158	191	195	212
TV	89	129	129	151
TOTAL	1440	1440	1440	1440
Kcal per minute per kilogram	1.69	1.57	1.62	1.53
E for 70 kilogram man	16.4	13.5	14.7	12.6
E for 60 kilogram woman	15.1	12.3	13.5	11.3

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Time use in minutes/day

	1965	1975	1985	1995
Paid wk	290	258	259	266
House wk	146	128	124	102
Food prep	44	41	39	27
TV	89	129	129	151
Exercise	27	37	43	47

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Energy

- Big drop in housework
- Slight drop in work
- Increase in exercise
- Increase in sedentary activity (TV)
- Convert into energy index

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Energy used (cal per day)

	1965	1975	1985	1995
Males	1640	1350	1470	1260
Females	1510	1230	1350	1130

Since 1975, the measure of energy burned has not fallen sharply. Calories burned has fallen by (1130-1230)/1230 = -0.081 for females and (1260-1350)/1350=-0.067

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Cutler et al.: A tech. change in food production

- Major advances in food preparation such vacuum packing, microwaves, freezing, preservatives, etc.
- Technology has reduced the time and direct cost of food preparation
- Evidence: time spent on food preparation among non-working mothers has fallen 50% in past 25 years
- Greatly reduced the costs of certain types of higher calorie food

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Example – French fry

- Americans have always consumed lots of potatoes
- Until recently (post WWII), French fry consumption was limited
- High cost of preparation (peeling, cutting, frying)
- Innovations
  - allowed the fry to be cut, peeled fried and frozen at central relocation
  - Reheated in oil or in oven
- From 1977-1995, potato use increased by 30% -- all of it an increase in fries and chips

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Implications

- Greater variety of foods
- Drop in the price of prepared foods

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Relative Price Changes for Certain Foods, 1/1980 – 11/2003

• All consumer prices	137%
• Fresh fruit	276%
• Fresh vegetables	252%
• Dairy products	96%
• Frozen food	83%
• Frozen potatoes	93%
• Potato chips	77%
• Ground beef	90%
• Soda	53%

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Implications

- Increase in food consumption should be greatest in foods with greater processing
- Evidence
  - Look at change in calories based on farm share of cost. Smaller farm share, less processing. We see the biggest increase in calories in those sectors with small farm share
  - Look at change in calories based on brand names. Brand names have more processing

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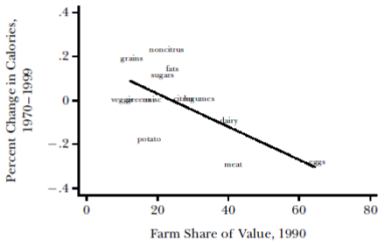
Figure 3
Food Preparation and Changes in Intake



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Implications

- Individuals that take advantage of technology should have biggest increase in obesity
- Ex: People that originally prepared food should shift away from home production
- Ex: People that were originally NOT producing food at home should see less of a change

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Table 4
Time Costs by Demographic Group
(minutes)

	1965		1995	
	Meal Prep.	*Meal Prep. + Cleanup*	*Meal Prep.*	*Meal Prep. + Cleanup*
Adults				
Single male	13.6	18.1	15.5	17.3
Married male, nonworking spouse	6.5	9.4	13.2	14.4
Married male, working spouse	8.1	11.9	13.2	14.4
Single female	38.1	60.1	28.9	33.1
Married female, working	58.3	84.8	35.7	41.4
Married female, not working	94.2	137.7	57.7	68.8
Elderly				
Male	16.6	26.3	18.5	20.2
Female	65.9	10.4	50.1	60.3

Source: Authors' calculations from Americans' Use of Time Survey Archives, 1965 and 1995.

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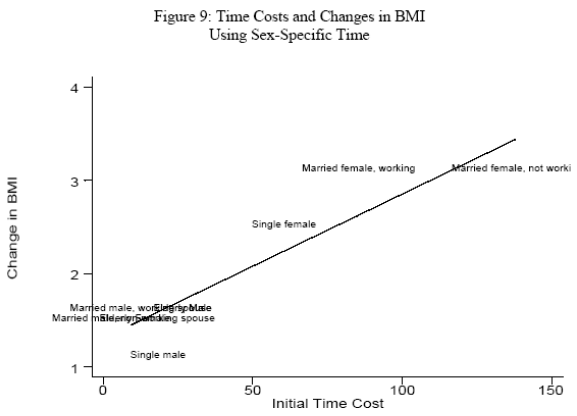

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Some questions for the theory

- Why did the authors say Europe is NOT subject to this technological shift?
- Does the theory fall apart now that the rest of the world uis facing rising obesity rates?

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Can snack taxes solve obesity problem?

- Success of cigarette tax has encouraged some to look to taxes to solve the obesity problem
- At least 40 states have some form of sales tax on soda (excise, sales or special tax)
- 55% of adults surveyed favored a junk food tax to pay for health care reform
- 1 cent/can raises $1.5 billion

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Some examples

- IN has 6% sales tax on soda (vending machine/stores), chips/pretzles (vending)
- DC 5.75% sales tax on snack food and soft drinks purchases via vending machines
- MD and LA repealed junk food taxes in 1990s for Frito Lay plants
- ME had 5.5% sales tax on snacks/soda – repealed after 10 years – during that time, obesity rates doubled

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- Plus
  - Demand curves slope down
  - Good experience w/ alcohol/cigs
- Minus
  - Snacks are small component of consumption
  - benefits on BMI may take years to be realized
    - Not like alcohol/cigarettes where benefits are realized right away
  - Tax could shift to other high calorie drinks

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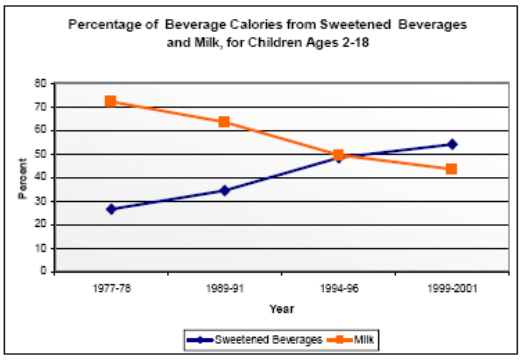

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Empirical question

- What will price changes do to the demand for snacks?
- As people substitute away from snacks, what will they drift towards
  - Will calories decline or will they shift?

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Soda facts

- ½ pop/ consumes sugared drinks daily
- 7% adult calories, 10% for kids
- Calories increased 30% last decade, 500% over past half century
- $93 billion industry

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Fletcher et al.

- Consider impact of soft drink taxes
- Elast. Of demand ~ -1
- Big potential for impact – could also be big revenue source
- What are the unintended consequences?

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Taxes

- 3 sources
  - Excise, sales, special soda taxes
- Authors turned the soda tax into rate (% of revenues)
  - Mix excise and sale taxes
  - Is this a good idea?
- 53 tax hikes in sample

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Table 1
Summary statistics: soft drink tax rates, 1989–2006.

Year	All states		States with a positive tax rate		
	Mean tax rate	Standard deviation	Count	Mean tax rate	Standard deviation
1989	1.623	2.335	20	4.139	1.841
1990	1.839	2.526	21	4.465	1.906
1991	1.971	2.591	22	4.569	1.882
1992	2.067	2.587	23	4.583	1.776
1993	2.334	2.919	24	4.960	2.220
1994	2.334	2.919	24	4.960	2.220
1995	2.084	2.618	23	4.621	1.822
1996	2.076	2.608	23	4.604	1.815
1997	2.076	2.608	23	4.604	1.815
1998	1.954	2.603	21	4.745	1.742
1999	1.934	2.584	21	4.698	1.748
2000	1.875	2.544	20	4.783	1.549
2001	1.758	2.488	19	4.718	1.564
2002	1.728	2.550	18	4.897	1.642
2003	1.755	2.589	18	4.974	1.663
2004	1.895	2.676	19	5.087	1.661
2005	1.888	2.667	19	5.067	1.658
2006	1.890	2.674	19	5.074	1.677

Note: Column variables represent means or percents across all states for the given year.

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NHANES

- National survey of health and nutrition
- Detailed diet survey – anthropomorphic data – full medical exam
- NHANES II 34K people in 1988-94 period
- Starting in 1999 survey 5000/year
  - Use 1999-2006
- Keep data on kids 3-18

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Dietary recall

- Keep diary of food intake
  - What they ate and how much over 24 hour period
  - Info for younger children reported by adult
- NCHS converts into calories

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Econometric model

$$Y_{istq} = \beta_1' X_{istq} + \beta_2 T_{stq} + \mu_s + \delta_t + \gamma_q + \varepsilon_{istq},$$

i=person, s=state, t=year, q=quarter

X = vector of individual characteristics

μ, δ, γ are state, year and quarter effects

T = the state tax in that quarter/year

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Table 2
Descriptive statistics.
Sources: NHANES 1989–1994 and 1999–2006.

Variable	Mean	Standard error	Sample size
BMI *Z*-score	0.418	0.011	22,132
Obese	0.148	0.004	22,132
Overweight	0.297	0.005	22,132
Underweight	0.033	0.002	22,132
Total calories	2063.071	11.293	21,040
Total calories from soft drinks	115.247	2.531	21,040
Consumed any soft drink	0.564	0.006	21,040
Total grams of soft drink consumption	314.876	6.645	21,040
Total calories from juice	51.626	1.270	21,040
Consumed any juice	0.338	0.006	21,040
Total grams of juice consumption	110.739	2.621	21,040
Total calories from juice drinks	66.414	1.613	21,040
Consumed any juice drinks	0.369	0.006	21,040
Total grams of juice drinks consumption	170.059	4.713	21,040
Total calories from whole milk	58.617	1.525	21,040

Table 3
The impact of soft drink taxes on soft drink consumption and calories consumed from soft drinks.

	Consumed a soft drink	Total grams of soft drink consumption	Calories from soft drinks
Soft drink tax rate	−0.005	−18.052**	−5.920**
	(0.005)	(7.333)	(2.834)
Observations	21,040	21,040	21,040
R-squared	0.089	0.169	0.161

Notes: Heteroskedasticity-robust standard errors in parentheses that allow for clustering within states. Additional variables include female, age, age squared, black, other race, weekday, state, year, and quarter. All regressions utilize NHANES survey weights.

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Table 4
The impact of soft drink taxes on non-soft drink beverage consumption and calories consumed from non-soft drink beverages.

	Juice consumption	Juice drink	Whole milk
Panel A: Caloric intake			
Soft drink tax rate	−0.058	1.857	7.670***
	(1.521)	(2.332)	(2.156)
Observations	21,040	21,040	21,040
R-squared	0.033	0.032	0.066
Panel B: Grams of consumption			
Soft drink tax rate	1.312	5.499	11.153***
	(3.099)	(6.830)	(3.532)
Observations	21,040	21,040	21,040
R-squared	0.031	0.034	0.064

Table 5
The impact of soft drink taxes on total caloric intake.

	Total caloric intake
Soft drink tax rate	−7.840
	(12.353)
	[−32.944, 17.264]
Observations	21,040
R-squared	0.145

Table 7
The impact of soft drink taxes on BMI, obese, and overweight.

	BMI Z-score	Obese	Overweight	Underweight
Soft drink tax rate	0.015	0.009	0.002	−0.002
	(0.016)	(0.006)	(0.011)	(0.003)
Observations	22,132	22,132	22,132	22,132
R-squared	0.028	0.022	0.027	0.008

Notes: Heteroskedasticity-robust standard errors in parentheses that allow for clustering within states. Additional variables include female, age, age squared, black, other race, state, year, and quarter. All regressions utilize NHANES survey weights.

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