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*A Policy Research Partnership  
for Healthier Youth Behavior*

# **Adult Obesity and the Price and Availability of Food in the United States**

**Lisa M. Powell**  
**University of Illinois at Chicago**

**Euna Han**  
**University of Illinois at Chicago**

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# Obesity Rates

Adults (20+): 32.2%			
Women		Men	
33.2%		31.1%	
White	African American	White	African American
30.2%	53.9%	31.1%	34.0%

Source: Ogden et al. (2006) JAMA -- The National Health and Nutrition Examination Survey 2003-04.

# Objective

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*This study examines the importance of food prices, restaurant availability, and food store availability for adults' BMI using both cross-sectional and panel data estimation methods.*

# Background: Prices, Outlets and Adult Weight

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## Prices

- Limited and mixed evidence on the effect of food prices/taxes on adult weight outcomes, none using longitudinal data (i.e., Chou et al. 2004; Kim and Kawachi 2006; Beydoun et al. 2008; Miljkovic and Nganje 2008; Miljkovic et al. 2008).

## Outlets

- Few studies provide evidence linking outlet availability to weight outcomes of adults (i.e., Chou et al. 2004; Morland et al. 2006).
- Although several studies have found positive associations between supermarkets and diet quality (i.e., Morland et al. 2002; Laraia et al. 2004; Zenk et al. 2005) whereas others find mixed results (i.e., Wrigley et al. 2003; Cummins et al. 2005)

# Models

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The relationship between adult BMI and:

- ❖ Fruit and Vegetable Prices
- ❖ Fast Food Prices
- ❖ Fast Food Restaurants
- ❖ Full-service Restaurants
- ❖ Supermarkets, Convenience Stores, and Grocery Stores
- ❖ Controls (gender, race, age, marital status, family income, education, number of children, and neighborhood characteristics)

## Research Designs and Estimation Models

- 1) Cross-sectional Estimates
- 2) Individual-level Fixed Effects

# Models

Naïve model:

$$BMI_{ist} = \beta_0 + \beta_1 PRICES_{st} + \beta_2 REST_{st} + \beta_3 FS_{st} + \beta_4 N_{st} + \beta_5 X_{it} + \varepsilon_{ist}$$

Models to account for unobserved individual-level heterogeneity:

$$BMI_{ist} = \beta_0 + \beta_1 PRICES_{st} + \beta_2 REST_{st} + \beta_3 FS_{st} + \beta_4 N_{st} + \beta_9 X_{it} + v_i + w_{ist}$$

❖ Fixed Effects Models: Assumes  $v_i$  and independent variables are correlated

# The Panel Study of Income Dynamics

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- Begun in 1968, PSID is a nationally representative longitudinal study of nearly 8000 U.S. families.
- It emphasizes, but not limited to, the dynamic aspects of economic and demographic behavior.
- From 1968 to 1996, PSID interviews took place annually. Since 1997, PSID has been following individuals from families in the core sample biennially.
- We use 1999, 2001, 2003, and 2005 waves of the PSID since the weight and height variables became available in 1999.
- We draw on a sample of 37,226 observations on 12,851 adults aged 18-65.

# Contextual Data - Prices

Fruit/Vegetable and Fast Food Price data obtained from ACCRA:

- ❖ quarterly information on prices across more than 300 US cities
- ❖ 62 different prices are collected for a range of products
- ❖ to create indices, weights are available based on expenditure shares derived from the CES

Food Price Indices:

## 1) Fruit and Vegetable Price Index

(Based on 6 produce items, which are potatoes, bananas, lettuce, sweet peas, peaches, and sweet corn)

## 2) Fast Food Price Index

(McDonald's Quarter-Pounder with cheese, a thin crust regular cheese pizza at Pizza Hut and/or Pizza Inn, and fried chicken (thigh and drumstick) at Kentucky Fried Chicken and/or Church's Fried Chicken)



# Contextual Data – Outlet Density

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## Outlet density measures obtained from D&B:

- ❖ data contain information on more than 14 million businesses
- ❖ data are available by SIC codes
- ❖ data are available by multiple geo code levels
- ❖ data are updated quarterly

## Outlet density measures include:

- 1) Fast Food and Full-service Restaurants
- 2) Supermarkets, Grocery Stores and Convenience Stores

\* Outlets were defined per 10,000 capita per 10 square miles per zip code.

## Summary Statistics - Outcome and Key Exposure Variables by Year

Outcome and Key Exposure Variables	Mean				
	1999	2001	2003	2005	Total
Body Mass Index	26.5091	26.7841	27.1445	27.4219	26.9682
Price of Fruits & Vegetables	0.7483	0.7524	0.8028	0.7606	0.7665
Price of Fast Food	2.7749	2.6840	2.6710	2.6410	2.6924
Fast Food Restaurants	3.3785	3.1611	3.3172	5.0405	3.7221
Full-service Restaurants	19.5687	17.1584	20.0949	19.6204	19.1267
Supermarket Stores	0.7078	0.7293	0.7474	0.6703	0.7140
Convenience Stores	2.0999	2.0282	2.1273	1.7604	2.0051
Grocery Stores	5.3387	4.7909	4.7331	4.9737	4.9565
N	8,858	9,211	9,699	9,458	37,226

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## Summary Statistics – Control Variables by Gender

Control Variables	Mean / Frequency	
	Men	Women
Age	42.5030	42.8027
White	79.98%	75.39%
African American	10.26%	14.05%
Hispanic	5.88%	6.55%
Other Race	3.89%	4.02%
Married	68.11%	61.50%
Never Married	18.01%	17.54%
Widowed	0.72%	2.90%
Divorced	10.73%	14.89%
Separated	2.43%	3.18%
Number of Children	0.8012	0.8888
Completed Less Than High School	14.96%	14.80%
Completed High School	28.86%	30.03%
Completed Some College	23.14%	24.34%
Completed College or More	30.40%	23.99%
Education Missing	2.65%	6.85%
Urban Area	68.17%	69.20%
Suburban Area	12.84%	13.23%
Rural / Farm Area	18.99%	17.57%
Median Household Income (2000\$)	46,130.62	45,489.14
N	17,479	19,747

# Cross-sectional and Panel Estimates of BMI: Contextual Factors

Dependent Variable: BMI	Men (N=17,479)		Women (N=19,747)	
	Cross Sectional Estimates	Individual Fixed Effects Estimates	Cross Sectional Estimates	Individual Fixed Effects Estimates
Price of Fruits & Vegetables	0.1938	0.2744	0.7623	0.6173**
Price of Fast Food	-0.2090	0.0724	-0.1612	0.2622
Fast Food Restaurants	0.0080	0.0012	0.0007	0.0023*
Full-service Restaurants	-0.0010	-0.0003	-0.0001	-0.0001
Supermarket Stores	0.0080	-0.0022	-0.0049	-0.0050
Convenience Stores	0.0133	0.0016	0.0109	0.0008***
Grocery Stores	0.0012	0.0012	0.0011	0.0007

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Supermarket Stores	0.0080	-0.0022	-0.0049	-0.0050
Convenience Stores	0.0133	0.0016	0.0109	0.0008***
Grocery Stores	0.0012	0.0012	0.0011	0.0007



# Cross-sectional and Panel Estimates of BMI: Control Variables

Dependent Variable: BMI	Men (N=17,479)		Women (N=19,747)	
	Cross Sectional Estimates	Individual Fixed Effects	Cross Sectional Estimates	Individual Fixed Effects
African American	1.2799***		2.5395***	
Hispanic	0.6126		0.8879*	
Other Race	-1.2594***		-0.5950	
Never Married	-0.4434*	-0.3139**	0.0949	-0.5402***
Widowed	-1.4233	-0.2683	0.2781	0.1566
Divorced	-0.7509***	-0.3629***	-0.2147	-0.1839
Separated	-1.3575***	-0.6324***	0.7081*	-0.2385
Number of Children	0.0879	0.0568	0.0398	0.0853**
Near-Low Income	0.4672***	0.1408*	0.1095	-0.0805
Middle Income	0.4396**	0.2114***	-0.2915	-0.1306
Near-High Income	0.2897	0.2018**	-0.7700***	-0.1325
High Income	0.3097	0.2575***	-1.4879***	-0.1386
Completed high school	0.3488	0.0133	-0.1999	0.2091
Completed some college	0.0295	0.1034	-0.1358	0.3953
Completed college or more	-0.4656*	-0.0599	-0.9793***	-0.0483
Year 2001	0.3588***	0.3612***	0.3648***	0.5405***
Year 2003	0.5563***	0.6462***	0.6405***	0.9488***
Year 2005	0.7571***	0.9008***	0.9850***	1.4830***

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Year 2001	0.3588***	0.3612***	0.3648***	0.5405***
Year 2003	0.5563***	0.6462***	0.6405***	0.9488***
Year 2005	0.7571***	0.9008***	0.9850***	1.4830***

# Fixed Effects Estimates of BMI by Poverty Status

Dependent Variable: BMI	Men		Women	
	Poor	Non-poor	Poor	Non-poor
Price of Fruits & Veg.	-1.0617	0.3684	3.5553***	0.3970
Price of Fast Food	-0.2981	0.1307	-0.1594	0.1613
Fast Food Rest.	0.0183	0.0010	0.0121	0.0023*
Full-service Rest.	0.0038	-0.0002	0.0002	-0.0002**
Supermarket Stores	-0.1340	-0.0003	-0.1343*	0.0005
Convenience Stores	-0.0211	-0.0001	0.0039	0.0007***
Grocery Stores	-0.0306**	0.0017	-0.0062	0.0011**
N	1,786	15,693	3,234	16,513

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Dependent Variable: BMI	Men		Women	
	Poor	Non-poor	Poor	Non-poor
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Price of Fast Food	-0.2981	0.1307	-0.1594	0.1613
Fast Food Rest.	0.0183	0.0010	0.0121	0.0023*
Full-service Rest.	0.0038	-0.0002	0.0002	-0.0002**
Supermarket Stores	-0.1340	-0.0003	-0.1343*	0.0005
Convenience Stores	-0.0211	-0.0001	0.0039	0.0007***
Grocery Stores	-0.0306**	0.0017	-0.0062	0.0011**
N	1,786	15,693	3,234	16,513

# Fixed Effects Estimates of BMI by Presence of Children

Dependent Variable: BMI	Men		Women	
	Children Not Present	Children Present	Children Not Present	Children Present
Price of Fruits & Veg.	0.1521	0.5454	-0.1859	1.0950***
Price of Fast Food	0.0156	0.1309	-0.0311	0.4053
Fast Food Rest.	0.0009	0.0340*	0.0047**	-0.0036
Full-service Rest.	-0.0002	-0.0020	-0.0003*	0.0012
Supermarket Stores	-0.0012	-0.0457	-0.0060**	-0.0057
Convenience Stores	-0.0002	0.0063***	0.0007***	0.0079
Grocery Stores	0.0004	0.0087	0.0014***	-0.0081
N	8,492	8,987	8,249	11,498

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Price of Fast Food	0.0156	0.1309	-0.0311	0.4053
Fast Food Rest.	0.0009	0.0340*	0.0047**	-0.0036
Full-service Rest.	-0.0002	-0.0020	-0.0003*	0.0012
Supermarket Stores	-0.0012	-0.0457	-0.0060**	-0.0057
Convenience Stores	-0.0002	0.0063***	0.0007***	0.0079
Grocery Stores	0.0004	0.0087	0.0014***	-0.0081
N	8,492	8,987	8,249	11,498

## Price Elasticities – Fixed Effects Estimates

<b>Dependent Variable: BMI</b>	<b>Men</b>		<b>Women</b>	
	<b>All</b>		<b>All</b>	
Price of Fruits & Veg.	0.0076		0.0178**	
Price of Fast Food	0.0070		0.0263	
	<b>Poor</b>	<b>Non-poor</b>	<b>Poor</b>	<b>Non-poor</b>
Price of Fruits & Veg.	-0.0290	0.0102	0.0939***	0.0116
Price of Fast Food	-0.0290	0.0127	-0.0148	0.0164
	<b>With Children</b>	<b>No Children</b>	<b>With Children</b>	<b>No Children</b>
Price of Fruits & Veg.	0.0150	0.0042	0.0314***	-0.0054
Price of Fast Food	0.0127	0.0015	0.0405	-0.0031



## Price Elasticities – Fixed Effects Estimates

Dependent Variable: BMI	Men		Women	
	All		All	
Price of Fruits & Veg.	0.0076		0.0178**	
Price of Fast Food	0.0070		0.0263	
	Poor	Non-poor	Poor	Non-poor
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	With Children	No Children	With Children	No Children
Price of Fruits & Veg.	0.0150	0.0042	0.0314***	-0.0054
Price of Fast Food	0.0127	0.0015	0.0405	-0.0031

# Summary and Policy Implications

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- No evidence that fast food prices are related to adult BMI.
- Higher fruit and vegetable prices are related to higher BMI among women, in particular poor women and women with children.
- With respect to outlet availability, the only statistically significant effect of noteworthy magnitude is found for the availability of supermarkets for poor women.
- Thus, the results by subpopulations suggest that targeted subsidies to fruits and vegetables may be somewhat effective in reducing weight. Evidence that supermarket availability is also important.

# Policy Landscape - Subsidies

- Food in the U.S. is subsidized for low-income individuals and families through a number of programs such as *Food Stamps*, the *Women, Infant and Children Nutrition Program*, the *Child and Adult Care Food Program*, and the *National School Lunch and Breakfast Programs*.
- Recently, food subsidies directed at the consumer for fruits and vegetables through the WIC program.
- California “Healthy Purchase” pilot program where for each dollar of food stamps spent on fresh produce, participants will be subsidized a portion of the cost

# Policy Landscape - Taxes

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- Food taxes have not generally been introduced with the aim of modifying consumption behavior as they have been used in other public health areas such as tobacco.
- Food taxes are currently imposed on selected categories of food such as soft drinks, candy and snacks in grocery stores and vending machines but at quite low tax rates (e.g., mean rate for soda is 3.4% in grocery stores).

# Where we are and what we need ...

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- We aren't doing much currently in terms of fiscal pricing interventions.
- The evidence base is still thin.
- Need further research using longitudinal data.
- Need better price measures.
- Need evaluations of pilot projects that subsidize healthful foods – link to weight outcomes.
- Evidence as we go ... jurisdictions that adopt higher taxes on unhealthy energy dense foods will provide natural experiments for new research on the effectiveness of these efforts in promoting healthy eating and curbing the obesity epidemic.

## Economic, Lifestyle, and Social Influences on Obesity

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### Project Overview

The overall goals of this integrated project are: 1) to provide a comprehensive empirical examination of the influences of economic, lifestyle, and social factors on obesity by combining detailed individual-level survey data with regional economic and environmental information on food and fast food prices, local area food store, eating places and physical activity-related outlet density measures, and area crime data and, 2) to provide an extensive outreach program that will use the findings from our research to inform both policy makers and households of which policies, programs, and practices are effective at combating obesity.

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# **Economic, Lifestyle and Social Influences on Obesity**

<http://www.impactteen.org/obesity>

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