Supermarket Access and Childhood Obesity: Natural Experiments of Store Openings and Closings

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United States Department of Agriculture
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Motivation

- **Childhood obesity is a major public health issue in the United States.**
  - Roughly 17 percent are obese (Ogden et al., 2014).
  - Increased health risks extend into adulthood (Serdula et al., 1993; Biro and Wien, 2010).
  - Results in huge fiscal burden (Trasande and Chatterjee, 2009).
- **There is a need for improved understanding of the causal factors.**
  - Obesity is inadequately explained by individual factors (Garner and Wooley, 1991).
  - The social/physical context where decisions are made could play a role (Cummins and Macintyre, 2006).
  - The commercial food environment is one context faced by all people.
- **Grocery stores (e.g. supermarkets) are the major provider of daily foods.**
  - 91.0 percent share of total food store sales (US Census Bureau, 2011)
  - Provision of fresh fruits and vegetables
  - Lower food prices
- **Access to grocery stores can affect the bodyweight of children.**
  - Existing observational studies find difficulties in establishing causality.
  - There is a need for experimental/quasi-experimental investigations.

Data

- **Annual Body Mass Index (BMI) screening of public schoolchildren**
  - Started in the 2003/2004 school year to monitor childhood obesity.
  - All schoolchildren were measured between 2003/2004 and 2006/2007 school years.
  - Only even graders up to tenth grade were measured after 2006/2007 school years.
  - BMI is measured using an age- and gender-specific z-score.
  - Data also include the gender, age, race and free/reduced price school lunch qualifications of students, and geo-referenced residential addresses.
- **Food store location data from Dun and Bradstreet business lists**
  - Year-specific archival data were obtained to identify supermarket openings and closings.
  - Store types were identified using standard industrial classification (SIC) codes.
  - Inspections company names/trade styles were implemented to minimize misclassifications.
  - We also used phone calls and/or Google street-images to verify store formats in questionable cases.
- **The food store location data were matched to each student's residence by year.**
  - Supermarket openings/closings around each residence were identified.

Natural Experiment Design

- **Supermarket openings**
  - Comparison of the BMI z-scores of children who observed new supermarket openings and those of children who never had access to supermarkets.
- **Supermarket closings**
  - Comparison of the BMI z-scores of children who observed supermarket closings (and therefore lost supermarket access) and those of children who always had access to supermarkets.
- **Residences are defined as having access to supermarkets if the distance from residence to the nearest supermarket is less than one (five) mile(s) in an urban (rural) setting.**
  - The binary supermarket access indicator equals one in this case; or zero otherwise.
  - 56.93% (46.80%) children had access to supermarkets under these best available midpoints.
- **The sample was restricted to include children with four consecutive years of observations.**
  - Kept observations between 2003/2004 and 2006/2007 school years (Table 1).
  - Considered supermarket openings/closings between 2004/2005 and 2005/2006.
  - There are two rounds of observations before treatment and another two rounds after treatment.
  - Supermarket openings were observed for 1,019 children.
  - Supermarket closings were observed for 1,210 children.

Table 1. Grade structure of restricted sample

Year	2003/2004	2004/2005	2005/2006	2006/2007
Cohort 1	Pre-Kindergarten	Kindergarten	1	2
Cohort 2	Kindergarten	1	2	3
Cohort 3	1	2	3	4
Cohort 4	2	3	4	5
Cohort 5	3	4	5	6
Cohort 6	4	5	6	7
Cohort 7	5	6	7	8
Cohort 8	6	7	8	9
Cohort 9	7	8	9	10
Cohort 10	8	9	10	11
Cohort 11	9	10	11	12

Empirical Results

- **Specification: difference-in-difference (DID) model (child i in community c in year t).**

$$BMI_{ict} = \beta_0 + \beta_1(Treatment_i \times Post_t) + \beta_2 Treatment_i + \beta_3 Post_t + \mathbf{X}'_{it}\beta_4 + \mathbf{X}'_c\beta_5 + \epsilon_{ict}$$

- **Impact estimates (* significant at 5% level; ** significant at 1% level)**

		Openings	Closings
Baseline DID regression		-0.038 (0.032)	0.001 (0.030)
Robustness: DID matching		-0.023 (0.027)	0.003 (0.034)
Impact heterogeneity	Younger children (up to 120 months)	-0.076 (0.036) *	0.004 (0.034)
	Older children (over 120 months)	-0.023 (0.047)	0.049 (0.042)
	Rural children	-0.083 (0.046)	-0.065 (0.041)
	Urban children	-0.005 (0.045)	0.075 (0.045)
	High vehicle ownership rate (above average)	-0.012 (0.046)	0.019 (0.048)
	Low vehicle ownership rate (below average)	-0.090 (0.045) *	0.001 (0.039)
	High income (above median)	-0.024 (0.056)	-0.003 (0.044)
	Low income (below median)	-0.096 (0.034) **	-0.021 (0.034)

Discussion

- **There is little population-wide evidence that access to supermarket matters to the BMI of children.**
- **Supermarket openings reduce the BMI of younger children (<=120 months).**
  - Younger children follow the development stage of adiposity rebound where increased BMI after early childhood is generally observed.
  - Supermarket access partially offsets the increasing trend.
- **Supermarket openings reduce the BMI of children from low-income communities and communities with low vehicle ownership rates.**
  - Access to healthy foods significantly matters for disadvantaged families.

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