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

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Natural Experiments of Store Openings and Closings

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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 (Gamer and Woolley, 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 56.93% (46.80%) children had access to supermarkets under these best available midpoints.
• Obesity is inadequately explained by individual factors  (Garner and Wooley, 1991).

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.

• 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).
  • 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. Structure grade of restricted sample

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<thead>
<tr>
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<tbody>
<tr>
<td>Cohort 1</td>
<td>Pre-Kindergarten</td>
<td>Kindergarten</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Cohort 2</td>
<td>Kindergarten</td>
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<td>Cohort 3</td>
<td>2</td>
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<td>Cohort 4</td>
<td>3</td>
<td>4</td>
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<td>Cohort 5</td>
<td>4</td>
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<td>Cohort 6</td>
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<td>Cohort 9</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Cohort 10</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

Empirical Results

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

\[
BMI_{ict} = \beta_0 + \beta_1 (Treatment_{c} \times Post_{t}) + \beta_2 Treatment_{c} + \beta_3 Post_{t} + X_{ict} \beta_4 + \epsilon_{ict}
\]

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

<table>
<thead>
<tr>
<th></th>
<th>Cohort&lt;br&gt;Matched</th>
<th>Cohort&lt;br&gt;Regression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline DID regression</td>
<td>-0.038 (.002)</td>
<td>0.001 (.003)</td>
</tr>
<tr>
<td>Robustness: DID matching</td>
<td>-0.023 (.026) *</td>
<td>0.004 (.034)</td>
</tr>
<tr>
<td>Impact heterogeneity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Younger children (up to 120 months)</td>
<td>-0.076 (.026) *</td>
<td>0.004 (.034)</td>
</tr>
<tr>
<td>Older children (over 120 months)</td>
<td>-0.023 (.047)</td>
<td>0.049 (.042)</td>
</tr>
<tr>
<td>Rural children</td>
<td>-0.083 (.046)</td>
<td>0.065 (.044)</td>
</tr>
<tr>
<td>Urban children</td>
<td>-0.005 (.045)</td>
<td>0.075 (.045)</td>
</tr>
<tr>
<td>High vehicle ownership rate (above average)</td>
<td>-0.012 (.046)</td>
<td>0.019 (.048)</td>
</tr>
<tr>
<td>Low vehicle ownership rate (below average)</td>
<td>-0.090 (.045) *</td>
<td>0.001 (.039)</td>
</tr>
<tr>
<td>High income (above median)</td>
<td>-0.024 (.056)</td>
<td>-0.003 (.044)</td>
</tr>
<tr>
<td>Low income (below median)</td>
<td>-0.096 (.034) **</td>
<td>-0.021 (.034)</td>
</tr>
</tbody>
</table>

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.

References


Acknowledgement

This project is supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-68001-30014 from the USDA National Institute of Food and Agriculture under the program title “Childhood Obesity Prevention: Integrated Research, Education, and Extension to Prevent Childhood Obesity”, program code A2101.

Data

• Annual Body Mass Index (BMI) screening of public school children
  • Started in the 2003/2004 school year to monitor child health 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.

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