Does the Neighborhood Food Environment Influence the Relationship between SNAP Participation and the Food Purchase Decisions and Weight Status of Low-Income Women?

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Executive Director, New York Census Research Data Center – Baruch RDC
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The findings and conclusions in this paper are those of the author and do not necessarily represent the views of the Research Data Center, National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention.

All results in this paper have been cleared for release by the NCHS Research Data Center.
A few things to know about the NCHS proposal process:

1. Fairly extensive time commitment up-front.
   a. In the proposal you have to tell NCHS the exact variables you want to use (both restricted access variables and publicly available variables).
   b. You have to provide NCHS with the publicly available data you plan to use.

2. Proposal review times tend to be quick.
A few tips for the NCHS proposal process:

1. Request all the variables you think might possibly be needed for your project.

2. Ask for an estimate of the NCHS file creation fee for your project before you start work on the proposal.
Approximately 47 million low-income individuals in the United States participated in the Supplemental Nutrition Assistance Program (SNAP) in 2012.

One of the goals of the SNAP is to improve the diet-related outcomes of SNAP participants.
There is a lot of previous research on SNAP and diet-related outcomes…

There is quite a bit of research on the neighborhood food environment and diet-related outcomes…

However, little research attention to date on whether the neighborhood food environment plays a role in explaining the associations between SNAP participation and diet-related outcomes.
Research Questions:

1. Do the neighborhood food environments encountered by SNAP participants differ from those of low-income non-participants?

2. Are estimates of the relationship between SNAP participation and diet-related outcomes from models that exclude measures of the neighborhood food environment biased?

3. Do the associations between the neighborhood food environment and diet-related outcomes differ with SNAP participation?
**Data:**
Restricted-access data on low-income women in the United States from the 2007-2008 National Health and Nutrition Examination Survey (NHANES) combined with 2007-2008 ZIP Code Business Patterns data.

**Outcomes:**
Weight status: BMI and obesity
Food purchase decisions: monthly food spending and where and how frequently food is purchased
Han, Powell, & Igor, *Social Science and Medicine*, 2012. “Supplemental Nutrition Assistance Program and Body Weight Outcomes: The Role of Economic Contextual Factors”

**Data**: Panel Study of Income Dynamics (PSID)

**Outcomes**: BMI and obesity

**Economic contextual variables**: fruit and vegetable price index, fast food price index, combined supermarket and smaller grocery store density per capita per square mile in ZIP Code.

**Preferred specifications**: longitudinal models with individual fixed effects
Findings of Han et al. (2012):

BMI:
*Main SNAP effect:* not significant for women, negative for men
*SNAP*(supermarket + grocery) *dens:* negative for both women and men
*SNAP*fruit and vegetable *price index:* not significant for women or men
*SNAP*fast food *price index:* not significant for women, + for men

Obesity:
*Main SNAP effect:* not significant for women, negative for men
*SNAP*(supermarket + grocery) *dens:* not significant for either women or men
*SNAP*fruit and vegetable *price index:* not significant for women, + for men
*SNAP*fast food *price index:* not significant for women, + for men
Concerns with Han et al. (2012)

Masking different interactions between supermarket density and smaller grocery store density with SNAP participation?
  – previous research has found that supermarket density and smaller grocery store density have different relationships with weight status (Gibson 2011, Morland et al. 2006, Wang et al. 2007).

Other omitted neighborhood food environment variables?
  – previous research has found that the neighborhood availability of convenience stores and restaurants were also associated with weight status (Boone-Heinchen et al. 2011, Currie et al. 2009, Moore et al. 2009, Morland et al. 2006).

Accurate price indices?
  – ACCRA data for only ~300 cities in the U.S. Poor match for many PSID respondents.
Previous research on SNAP participation and diet-related outcomes especially relevant for this paper:

- SNAP & weight status
- SNAP & energy intake
- SNAP & food expenditures
- SNAP & establishment choices
Weight Status

• Much of the previous research has found a positive and significant relationship between SNAP participation and obesity or BMI for low-income women.
  

• Is this because of failure to control for measures of the neighborhood food environment? (Ver Ploeg and Ralston 2008).

  Findings of Han et al. (2008) do not support this argument with respect to obesity because the economic contextual variables were not significant in models of obesity. Not enough information about BMI.
Household energy availability
• Some evidence of a positive relationship between SNAP participation and energy availability at the household level (Fox et al. 2004 summarizes previous research).

Food expenditures
• SNAP participants tend to spend more on food than eligible non-participants (Fox et al. 2004 summarizes previous research).
Establishment choice

- Supermarkets and supercenters accounted for 64% of all purchases made with SNAP benefits and 84% of the dollar value of SNAP benefits redeemed (Castner and Henke 2011).

- SNAP recipients reported consuming significantly fewer meals away from home than low-income non-participants (Jilcot et al. 2011).
Why might the associations between SNAP participation and diet-related outcomes differ with the neighborhood food environment?

Each of the following could plausibly lead to a variety of reactions to the neighborhood food environment:

- SNAP participants have more total resources available to spend on food than otherwise identical non-participants,

- SNAP recipients can only use their benefits at establishments that accept SNAP,

- Stigma felt by SNAP recipients when using benefits may vary with the type of establishment.
For example, additional resources to spend on food

• could lead SNAP participants to go to supermarkets more often since the larger amount to spend could make it more worthwhile to take the time to travel to a supermarket.

– OR –

• could make SNAP participants feel like they have less need to economize and they may shop at smaller more convenient stores more frequently.

SNAP could in turn influence the type of food chosen at a given type of establishment.
This leaves the associations between the interaction of SNAP and the neighborhood food environment variables with weight status and food purchase decisions as empirical questions…
Contributions of this paper

• Uses a large set of outcomes that include a woman’s weight status as well as a variety of aspects of food purchase decisions.

• Uses measured height and weight to construct BMI and obesity.

• Considers measures of the neighborhood food environment in addition to the density of supermarkets and smaller grocery stores.

• Does not combine supermarkets and grocery stores into one category as in Han et al. (2008).

• Uses multiple approaches to measure the neighborhood food environment.
Data

2007-2008 National Health and Nutrition Examination Survey (NHANES)

NHANES collects data through interviews, physical examinations and lab tests.

The samples are designed to be nationally representative of the U.S. non-institutionalized civilian population.
Sample

Low-income non-pregnant women aged 20 to 65

“Low-income”: gross family income less than or equal to 130% of the federal poverty guideline (Han et al. 2012, Jilcott et al. 2011).

Excludes observations:
- missing information on any of the outcomes
- missing information on any of the explanatory variables
- with outlier values for neighborhood size and establishment densities

Final sample: n=558
**Outcome Measures**

“Consumer behavior” questions

Family food spending variables used as outcomes (includes purchases made with SNAP benefits):

- Average food spending per family member in the past month
- % of the monthly family food budget spent at grocery stores
- % of the monthly family food budget that was allocated to eating out or on carryout or delivered food
Other consumer behavior variables used as outcomes:

- # of meals eaten at fast-food or pizza places in the past 7 days

- “Infrequent grocery shopper” indicator
  =1 for respondents who reported one or no major food shopping trips per month and =0 otherwise.

- Travel time for a one-way trip to the grocery store most frequently used for food shopping.
Weight and height were measured as part of the 2005-2008 NHANES medical exam.

Weight status variables used as outcomes:

• Body mass index (BMI) - weight in kilograms divided by the square of height in meters

• Obese: BMI \( \geq 30 \text{ kg/m}^2 \)
Explanatory Variables

• Neighborhood Food Environment Variables

• SNAP Participation

• Other individual-level characteristics:
  family income-to-needs ratio, age, race/ethnicity, educational attainment, family size, and marital status

• Other neighborhood-level variables:
  land area of ZCTA of residence, poverty rate and population density in census tract of residence
Measurement of the Neighborhood Food Environment

Neighborhood of residence defined as ZCTA of residence.

Restricted-access information on census block group of residence used to match respondents to ZCTAs.

There are no publicly-available geographic identifiers in the 2005-2008 NHANES data.
U.S. Census Bureau’s 2007-2008 ZIP Code Business Patterns Data

- Contains counts of the number of establishments in each ZIP Code Area in the United States.

- Establishments categorized by North American Industry Classification System (NAICS) codes.
A respondent was assigned the establishment counts of the 5-digit ZIP Code number that matched the respondent’s 5-digit ZCTA number


ZCTA land area used in establishment density calculation.
Separate variables were created for the neighborhood density per square mile of each of the following:

- **Supermarkets**
  
  Supermarket: grocery store with 50 or more employees

- **Small grocery stores**
  
  Small grocery store: grocery store with fewer than 50 employees

- **Convenience stores**

- **Limited-service restaurants** ("fast food")

- **Full-service restaurants**
The separate neighborhood food establishment density variables were highly correlated (correlations ranging from 0.53 to 0.85).

Factor analysis was used to create neighborhood food environment composite variables (Wall et al. 2012).
Principal factors factor analysis with promax oblique rotation of the neighborhood establishment density variables.

- Factors derived from a ZCTA-level data set that was comprised of one observation for each ZCTAs that was represented in the sample of low-income women (n=211).

- ZCTA-level factor scores were calculated and merged with the NHANES data.
Table 1: Factor Loadings Relating Neighborhood Establishment to Two Neighborhood Composite Factors

<table>
<thead>
<tr>
<th>Factor Loadings</th>
<th>Supermarket and Restaurant Density Factor</th>
<th>Small or Quick Establishment Density Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supermarket density per sq. mile</td>
<td>0.783</td>
<td>0.083</td>
</tr>
<tr>
<td>Small grocery store density per sq. mile</td>
<td>0.089</td>
<td>0.763</td>
</tr>
<tr>
<td>Convenience store density per sq. mile</td>
<td>0.199</td>
<td>0.637</td>
</tr>
<tr>
<td>Fast food restaurant density per sq. mile</td>
<td>0.697</td>
<td>0.329</td>
</tr>
<tr>
<td>Full-service restaurant density per sq. mile</td>
<td>0.769</td>
<td>0.034</td>
</tr>
</tbody>
</table>
SNAP Participation

Main SNAP participation measure:
• household SNAP participation in the past year

Alternate SNAP participation variables:
• household SNAP participation in the previous month
• amount of SNAP benefits received by the household in the previous month.
Statistical Analysis

Descriptive statistics and OLS regression models were estimated taking into account the complex design features of the NHANES (Centers for Disease Control 2005).

Taylor series linearization was used for variance estimation.
• It is assumed that choices about food purchase decisions and weight status were made simultaneously.

The explanatory variables are identical for 6 of 8 outcomes, only one additional explanatory variable for the 2 other outcomes.

Results of seemingly unrelated regression models do not differ in a meaningful way from those using equation-by-equation OLS (Baum, 2006).

• Equation-by-equation OLS results are presented in this paper.
Four models were estimated for each weight-related outcome:

**Model (1):** SNAP participation + other individual-level characteristics

**Model (2):** Model (1) + separate neighborhood establishment density variables and other neighborhood characteristics

**Model (3):** Model (1) + neighborhood food environment factors and other neighborhood characteristics

**Model (4):** Model (3) + interactions between each neighborhood food environment factor and household SNAP participation
**Table 2:** Description of Low-Income Women in the 2007-2008 NHANES, all estimates weighted

<table>
<thead>
<tr>
<th>Food Purchase Decisions and Weight Status</th>
<th>Low-Income Women</th>
<th>SNAP Participants</th>
<th>Low-Income Non-Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ of food spending per month per family member, mean (SE)</td>
<td>166.6(7.8)</td>
<td>162.0(8.1)</td>
<td>171.0(14.7)</td>
</tr>
<tr>
<td>% of monthly food spending at grocery stores, mean (SE)</td>
<td>73.8(0.9)</td>
<td>75.8(1.6)</td>
<td>71.9(1.5)</td>
</tr>
<tr>
<td>% of monthly food spending allocated to eating out, mean (SE)</td>
<td>16.7(0.7)</td>
<td><strong>13.5(0.9)</strong></td>
<td><strong>19.6(1.2)</strong></td>
</tr>
<tr>
<td>Fast food meals consumed in past week, mean (SE)</td>
<td>1.5(0.1)</td>
<td>1.6(0.1)</td>
<td>1.3(0.2)</td>
</tr>
<tr>
<td>Infrequent grocery store shopper, % (SE)</td>
<td>24.0(3.4)</td>
<td><strong>28.8(3.0)</strong></td>
<td><strong>18.8(4.7)</strong></td>
</tr>
<tr>
<td>Minutes to main grocery store, mean (SE)</td>
<td>16.2(1.0)</td>
<td>17.6(1.6)</td>
<td>14.9(0.9)</td>
</tr>
<tr>
<td>Body Mass Index, mean (SE)</td>
<td>30.0(0.4)</td>
<td><strong>31.6(0.7)</strong></td>
<td><strong>28.5(0.7)</strong></td>
</tr>
<tr>
<td>Obese, % (SE)</td>
<td>42.3(2.4)</td>
<td><strong>48.3(3.3)</strong></td>
<td><strong>36.7(3.5)</strong></td>
</tr>
<tr>
<td>ZCTA of Residence Neighborhood Food Retail Environment</td>
<td>Low-Income Women</td>
<td>SNAP Participants</td>
<td>Low-Income Non-Participants</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>------------------</td>
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<td>---------------------------</td>
</tr>
<tr>
<td>Supermarket density per sq. mile, mean (SE)</td>
<td>0.20(.05)</td>
<td>0.19(.06)</td>
<td>0.21(.04)</td>
</tr>
<tr>
<td>Small grocery store density per sq. mile, mean (SE)</td>
<td>0.72(.26)</td>
<td>0.85(.37)</td>
<td>0.60(.17)</td>
</tr>
<tr>
<td>Convenience store density per sq. mile, mean (SE)</td>
<td>0.40(.13)</td>
<td>0.40(.18)</td>
<td>0.39(.10)</td>
</tr>
<tr>
<td>One or more supermarket in ZCTA, % (SE)</td>
<td>74.3(4.4)</td>
<td>75.8(7.0)</td>
<td>72.9(3.5)</td>
</tr>
<tr>
<td>One or more small grocery store in ZCTA, % (SE)</td>
<td>89.8(2.8)</td>
<td>86.7(4.4)</td>
<td>92.6(2.4)</td>
</tr>
<tr>
<td>One or more convenience store in ZCTA, % (SE)</td>
<td>77.2(6.1)</td>
<td>76.5(6.8)</td>
<td>77.8(6.0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ZCTA of Residence Neighborhood Food Service Environment</th>
<th>Low-Income Women</th>
<th>SNAP Participants</th>
<th>Low-Income Non-Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast food restaurant density per sq. mile, mean (SE)</td>
<td>2.0(0.4)</td>
<td>1.8(0.5)</td>
<td>2.2(0.4)</td>
</tr>
<tr>
<td>Full-service restaurant density per sq. mile, mean (SE)</td>
<td>2.0(0.5)</td>
<td><strong>1.5(0.5)</strong></td>
<td><strong>2.5(0.5)</strong></td>
</tr>
<tr>
<td>One or more fast food restaurant in ZCTA, % (SE)</td>
<td>95.5(2.4)</td>
<td><strong>92.8(4.5)</strong></td>
<td><strong>98.0(1.0)</strong></td>
</tr>
<tr>
<td>One or more full-service restaurant in ZCTA, % (SE)</td>
<td>97.7(1.9)</td>
<td><strong>96.6(2.7)</strong></td>
<td><strong>98.6(1.2)</strong></td>
</tr>
<tr>
<td></td>
<td>Low-Income Women</td>
<td>SNAP Participants</td>
<td>Low-Income Non-Participants</td>
</tr>
<tr>
<td>--------------------------</td>
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</tr>
<tr>
<td><strong>Neighborhood Establishment Density Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supermarket and restaurant factor, mean (SE)</td>
<td>-0.14(.17)</td>
<td>-0.19(.22)</td>
<td>-0.10(.14)</td>
</tr>
<tr>
<td>“Small or quick” establishment factor, mean (SE)</td>
<td>0.05(.08)</td>
<td><strong>0.16(.12)</strong></td>
<td><strong>-0.06(.07)</strong></td>
</tr>
<tr>
<td><strong>Other Neighborhood Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% HHs poor in census tract, mean (SE)</td>
<td>20.5(1.3)</td>
<td><strong>22.9(1.4)</strong></td>
<td><strong>18.4(1.6)</strong></td>
</tr>
<tr>
<td>% HHs received SNAP in census tract, mean (SE)</td>
<td>14.6(1.1)</td>
<td><strong>17.9(1.1)</strong></td>
<td><strong>11.5(1.7)</strong></td>
</tr>
<tr>
<td><strong>Personal characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH SNAP participation in past year, % (SE)</td>
<td>48.4(3.3)</td>
<td><strong>100</strong></td>
<td>0</td>
</tr>
<tr>
<td>$ of SNAP benefits in prev. month, mean (SE)</td>
<td>111.9(6.6)</td>
<td><strong>234.8(16.4)</strong></td>
<td>0</td>
</tr>
<tr>
<td>Family income-to-poverty ratio, mean (SE)</td>
<td>0.78(.02)</td>
<td><strong>0.68(.02)</strong></td>
<td><strong>0.87(.03)</strong></td>
</tr>
<tr>
<td>Family size, mean (SE)</td>
<td>3.4(0.1)</td>
<td>3.5(0.2)</td>
<td>3.3(0.2)</td>
</tr>
<tr>
<td>Married, % (SE)</td>
<td>29.3(2.3)</td>
<td><strong>24.2(3.8)</strong></td>
<td><strong>34.1(3.0)</strong></td>
</tr>
</tbody>
</table>
Table 3: Coefficients (Standard Errors) from Ordinary Least Squares Models of Food Purchase Decisions and Weight Status Outcomes, Low-Income Women, NHANES 2007-2008

<table>
<thead>
<tr>
<th></th>
<th>One-way Travel Time to Usual Grocery Store (min)</th>
<th>Body Mass Index</th>
<th>Obese (1/0)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model (1)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH SNAP participation in past year</td>
<td>2.2(1.7)</td>
<td>3.0(1.0)**</td>
<td>.09(.04)*</td>
</tr>
<tr>
<td>Family income-to-needs ratio</td>
<td>-1.2(2.0)</td>
<td>2.5(1.0)**</td>
<td>.07(.07)</td>
</tr>
<tr>
<td><strong>Model (2)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH SNAP participation in past year</td>
<td>2.0(1.8)</td>
<td>2.2(1.0)**</td>
<td>.06(.05)</td>
</tr>
<tr>
<td>Family income-to-needs ratio</td>
<td>-1.4(2.0)</td>
<td>2.4(1.0)**</td>
<td>.06(.07)</td>
</tr>
<tr>
<td>Supermarket density per sq. mile</td>
<td>-3.3(4.7)</td>
<td>0.7(2.3)</td>
<td>-.07(.15)</td>
</tr>
<tr>
<td>Small grocery store density per sq. mile</td>
<td>-0.5(0.9)</td>
<td>0.8(0.5)</td>
<td>.01(.03)</td>
</tr>
<tr>
<td>Convenience store density per sq. mile</td>
<td>0.4(2.2)</td>
<td>-0.7(1.2)</td>
<td>.03(.06)</td>
</tr>
<tr>
<td>Fast-food restaurant density per sq. mile</td>
<td>1.8(0.8)**</td>
<td>-0.5(0.3)</td>
<td>-.02(.02)</td>
</tr>
<tr>
<td>Full-service restaurant density per sq. mile</td>
<td>-1.0(0.6)*</td>
<td>-0.3(0.2)</td>
<td>-.02(.01)</td>
</tr>
</tbody>
</table>

Neighborhood food environment variables *jointly* significant? no yes yes
| Model (1) | | | | | |
|---|---|---|---|---|
| HH SNAP participation in past year | -5.4(28.6) | 3.0(2.5) | **-5.5(1.8)** | .16(.26) | .04(.04) |
| Family income-to-needs ratio | -20.1(25.9) | 0.9(3.3) | 2.9(2.1) | -.07(.25) | **-21(0.08)** |

| Model (2) | | | | | |
|---|---|---|---|---|
| HH SNAP participation in past year | -6.5(26.1) | 3.1(2.3) | **-5.4(1.8)** | .01(.22) | .005(.04) |
| Family income-to-needs ratio | -21.2(27.4) | 1.0(2.8) | 2.8(2.1) | -.13(.23) | **-22(0.07)** |
| Supermarket density per sq. mile | 77.6(49.4) | **-14.3(5.6)** | 6.8(4.6) | -.25(.61) | -.18(.10) |
| Small grocery store density per sq. mile | 5.1(8.1) | 1.9(1.1) | 0.1(0.7) | .17(.11) | .01(.01) |
| Convenience store density per sq. mile | 6.3(12.7) | 0.5(2.2) | -0.8(1.5) | -.09(.22) | .08(.07) |
| Fast-food restaurant density per sq. mile | -7.3(7.6) | 0.5(0.5) | -0.7(0.4) | -.08(.08) | -.02(.02) |
| Full-service restaurant density per sq. mile | -0.5(4.0) | -0.1(0.4) | **0.4(0.2)** | -.04(.03) | **-01(0.007)** |

| Neighborhood food environment variables jointly significant? | no | yes | no | yes | yes |
Table 4: Coefficients (Standard Errors) from Ordinary Least Squares Models of Food Purchase Decisions and Weight Status Outcomes, Low-Income Women, NHANES 2007-2008

<table>
<thead>
<tr>
<th>Model (3)</th>
<th>Average Monthly Food Spending per Family Member</th>
<th>% of Monthly Food Spending at Grocery Stores</th>
<th>% of Monthly Food Spending Eating Out</th>
<th># Fast Food Meals Consumed in Previous Week</th>
<th>Infrequent Grocery Shopper (1/0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH SNAP participation in past year</td>
<td>-2.2(27.6)</td>
<td>2.6(2.2)</td>
<td><strong>-5.2(1.7)</strong></td>
<td>.03(.23)</td>
<td>.002(.05)</td>
</tr>
<tr>
<td>Family income-to-needs ratio</td>
<td>-20.8(27.5)</td>
<td>0.9(2.9)</td>
<td>2.8(2.0)</td>
<td>-.13(.23)</td>
<td><strong>-.22(0.07)</strong></td>
</tr>
<tr>
<td>Supermarket and restaurant density factor</td>
<td>11.3(10.0)</td>
<td>-0.7(1.6)</td>
<td>1.0(1.1)</td>
<td><strong>-.26(.10)</strong></td>
<td><strong>-.08(.04)</strong></td>
</tr>
<tr>
<td>Small or quick establishment density factor</td>
<td>2.5(9.2)</td>
<td><strong>4.0(1.2)</strong></td>
<td>-1.4(1.2)</td>
<td><strong>.28(.14)</strong></td>
<td><strong>.11(.03)</strong></td>
</tr>
</tbody>
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<td>Supermarket and restaurant density factor</td>
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<td><strong>-1.4(0.5)</strong></td>
<td><strong>-.11(.03)</strong></td>
</tr>
<tr>
<td>Small or quick establishment density factor</td>
<td>0.9(1.9)</td>
<td><strong>1.3(0.5)</strong></td>
<td><strong>.08(.03)</strong></td>
</tr>
</tbody>
</table>
**Table 5:** Coefficients (Standard Errors) from Ordinary Least Squares Models of Food Purchase Decisions and Weight Status Outcomes, Low-Income Women, NHANES 2007-2008

<table>
<thead>
<tr>
<th>Model (4)</th>
<th>% of Monthly Food Spending Eating Out</th>
<th>Body Mass Index</th>
<th>Obese (1/0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH SNAP participation in past year</td>
<td>-5.4(1.5)**</td>
<td>2.4(1.0)**</td>
<td>.05(.04)</td>
</tr>
<tr>
<td>Family income-to-poverty ratio</td>
<td>2.8(2.0)</td>
<td>2.5(1.0)**</td>
<td>.06(.07)</td>
</tr>
<tr>
<td>Supermarket and restaurant density factor</td>
<td>-0.2(1.3)</td>
<td>-1.2(0.6)*</td>
<td>-.08(.04)*</td>
</tr>
<tr>
<td>Small or quick establishment density factor</td>
<td>-4.2(1.7)**</td>
<td>1.5(0.8)*</td>
<td>.10(.04)**</td>
</tr>
<tr>
<td>SNAP*Supermarket and restaurant density factor</td>
<td>0.9(1.5)</td>
<td>-0.4(0.9)</td>
<td>-.05(.05)</td>
</tr>
<tr>
<td>SNAP*Small or quick establishment density factor</td>
<td>5.8(2.5)**</td>
<td>-0.1(1.5)</td>
<td>-.01(.07)</td>
</tr>
</tbody>
</table>
Research Question #1:
Do the neighborhood food environments encountered by SNAP participants differ from those of low-income non-participants?
SNAP participants tended to live in more economically disadvantaged neighborhoods that were higher on the “small or quick” establishment density dimension.

Higher neighborhood density of “small or quick” establishments was significantly associated with

- spending more of the family food budget at grocery stores,
- eating more fast food meals,
- less frequent major grocery shopping trips,
- higher BMI, and a
- higher likelihood of obesity.
Suggests that “small or quick” establishments are used more frequently as their density increases, which results in more fast food meals and less frequent major grocery shopping trips.

These behavior changes are accompanied by increased BMI and an increased likelihood of obesity.

SNAP participants are expected to have a higher average BMI and a greater likelihood of obesity than low-income non-participants.

This pathway is NOT because of SNAP participation per se, but instead due to differences in neighborhood food environments.
Research Question #2:
Are estimates of the relationship between SNAP participation and diet-related outcomes from models that exclude measures of the neighborhood food environment biased?
Results suggest YES.

Smaller magnitude of SNAP coefficients in models of the % of the monthly food budget allocated to eating out, BMI, and obesity.

However, SNAP still significantly related to the % of the monthly food budget allocated to eating out and BMI.
Research Question #3:
Do the associations between the neighborhood food environment and diet-related outcomes differ with SNAP participation?
In general, NO.
For most food purchase decisions, SNAP participants and low-income non-participants appear to respond similarly to a given neighborhood food environment (i.e. interactions NOT significant)

However,
+ and significant interaction between SNAP participation and the “small or quick” establishment density factor in the model of the % of the monthly food budget allocated to eating out.
SNAP benefits may free up cash resources for non-grocery spending.

- Perhaps additional resources are more likely to be allocated to eating out when the neighborhood density of “small or quick” establishments rises.

- Meals eaten away from home tend to have more calories than meals eaten at home (Lin et al. 2009),
Han et al. (2012) also found that interactions between contextual variables and SNAP participation were not significantly related to obesity for low-income women. However, the interaction between the density of the combined number of supermarkets and smaller grocery stores and SNAP participation was negatively and significantly related to BMI.
Other findings of interest:

• Few significant associations in models with separate neighborhood establishment density variables.

• However, the neighborhood establishment density variables were jointly significantly associated with 5 of the 8 outcomes.

• Highly correlated neighborhood food environment variables may be one reason why findings have been inconsistent across previous studies.

  (see Feng 2010, Papas et al. 2007, and Ver Ploeg et al. 2009 for a summary of previous research).
Weaknesses of analysis:
Potential problems with reverse causality or omitted variable bias?

The models do not include measures of local food prices, long-term SNAP participation, long-term neighborhood food environment exposures or measures of the food environments encountered outside a person’s neighborhood of residence.

(Han et al. 2012, Gibson 2011, Gibson 2003).
Pending improvement

Use state-level SNAP policies as instrumental variables for individual SNAP participation (Schmeiser 2010, Meyerhoefer and Pylypchuk 2008, Baum 2007).
Other projects using restricted-access data

Extensions of paper just presented
  – sample not limited to low-income individuals
  – separate urban and rural samples

Related project using data from the National Health Interview Survey linked to establishment data.
Gibson, D. “Associations between the Availability of Eye Care Providers and Realized Access to Eye Care among Individuals with Diabetes, Diabetic Retinopathy, or Age-Related Macular Degeneration,” forthcoming in *JAMA Ophthalmology*.

- 2005-2008 NHANES data, with restricted-access information on county and census tract of residence

Merged with:
- Number of ophthalmologists and optometrists in each county from the Area Health Resource File
- Census tract characteristics from the 2005-2009 American Community Survey.