NYU WAGNER

SNAP AND THE LOCAL FOOD ENVIRONMENT

Dissertation Proposal

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Contents

Background and Research Objective

Introduction:

Obesity is a major public health issue. As of 2011-2012, approximately 17% of 2 to 19 year olds were obese (Ogden et al. 2014). Being obese as a child increases the likelihood of being obese later in life (Biro and Wien 2010; Freedman et al. 2005; Whitaker et al. 1997). In turn, adult obesity is comorbid with cardiovascular disease, type-2 diabetes, certain cancers, and other diseases (Dixon 2010). Unsurprisingly, the monetary cost of obesity to society is significant. The total medical cost of obesity is estimated to be as high as 16.5% of all United States' medical care spending, about $168 billion (Cawley and Meyerhoefer 2012).

Since a link exists between adulthood obesity and childhood obesity, many public health advocates have proposed interventions focused on reducing childhood obesity rates (Lobstein et al. 2004; Frieden, Dietz, and Collins 2010). The Supplemental Nutrition Assistance Program (SNAP) can be an effective tool to reduce childhood obesity rates (Farley and Sykes 2015; Leung et al. 2013; Institute of Medicine 2009; Frieden, Dietz, and Collins 2010; Alston et al. 2009; White House Task Force on Childhood Obesity 2010; Schanzenbach 2013). This program is particularly appealing because it is the largest of the 15 domestic food and nutrition assistance programs (Laird and Trippe 2014), with enrollment in the program continuing to increase rapidly (Klerman and Danielson 2011; Ganong and Liebman 2013). In addition, nearly half of all U.S. children will be on SNAP at some point between the ages of 1 and 20 (Rank and Hirschl 2009). Finally, the program effectively reaches low socioeconomic status (SES) children as it is, the second largest anti-poverty program for children (Bitler, Hoynes, and Kuka 2014).

According to several prominent SNAP stakeholders, two of the most important remaining research questions related to the program are: (1) what is the effect of SNAP on childhood health

outcomes and (2) how much access to healthy foods do SNAP participants have in their neighborhood (Blumenthal et al. 2014). Similarly, a systemic review of the literature by DeBono et al. (2012) and a report by the Institute of Medicine, recommend researchers assess food access for SNAP participants as a larger evaluation of the program (Caswell and Yaktine 2013; DeBono, Ross, and Berrang-Ford 2012). Each of the three papers I propose has a separate aim related to the important aforementioned questions about the program. The aim of the first paper is to assess the SNAP food environment and access to healthy food for New York City (NYC) public school students. The aim of the second paper is to determine how the SNAP food environment for NYC public school students changes with policy adjustments to SNAP. Finally, the aim of the third paper is to quantify the effect of the local SNAP food environment on childhood weight outcomes for NYC public school students. Combined, these papers are an important contribution evaluating the effectiveness of SNAP.

Problem Statement

Obesity is a complex problem for society. There are extensive health, monetary and economic costs.

The past several decades have seen a large growth in the prevalence of all forms of childhood obesity (Skinner and Skelton 2014). Recently, (i.e. between 2003 and 2012), national rates of childhood obesity have become relatively stagnant (Ogden et al. 2014; Pan et al. 2015). In NYC, there has been a slight decline in childhood obesity rates. However, the declines were disproportionately larger for white children from higher income neighborhoods (Farley and Dowell 2014). Nationally, disparities in childhood obesity rates continue to exist along SES lines (Frederick, Snellman, and Putnam 2014). These differences will likely persist into adulthood

(Baum and Ruhm 2009). As a result, some have argued that future policies looking to reduce childhood obesity rates should focus on lower SES children (Mclaren 2011).

Childhood obesity is problematic because it is associated with adulthood obesity later in life (Biro and Wien 2010; Freedman et al. 2005; Whitaker et al. 1997). Specifically, overweight children between the ages of 10 and 15 had an 80 percent chance of being obese at age 25 (Whitaker et al. 1997). Further, childhood obesity is an important public health concern because it is co-morbid with several serious illnesses in both childhood and adulthood. For example, childhood obesity is comorbid with high blood pressure, type II diabetes, fatty liver disease, and disordered sleep (Daniels 2006; Krebs and Jacobson 2003). In adulthood, historical childhood obesity is associated with heart disease, heart attacks, and stroke (Daniels 2006; Dietz 1998). Ultimately adulthood obesity is related to mortality (Flegal et al. 2013).

Since obesity is comorbid with several illnesses it is a major contributor to domestic healthcare costs. Over the past decade, obesity accounted for an estimated 12 percent of the growth in total U.S. healthcare spending (Ginsburg 2010). By 2018, domestic healthcare spending related to obesity is estimated to reach $343 billion annually, 21 percent of total healthcare spending (Thorpe 2009). Childhood obesity alone is very costly, accounting for approximately $14 billion, in additional prescription drug, emergency room and outpatient visit costs annually (Trasande and Chatterjee 2009). The average lifetime medical costs for an obese child relative to a normal weight child is $19,000 (Finkelstein, Graham, and Malhotra 2014). In sum, obesity is costly to tax payers, amounting to approximately 15 percent of public medical expenditures (MacEwan, Alston, and Okrent 2014).

Study Purpose:

This series of papers will quantify the local SNAP food environment for NYC public school students and assess the effect of the local SNAP food environment on NYC public school student weight outcomes. Food availability is an important component of the local food environment. Different types of store locations stock individual food items differentially. It is frequently hypothesized that the differences in availability are related to the differences in food consumption and in turn obesity rates. According to the USDA, the type of food a store has in stock serves as an appropriate proxy for the availability of affordable and nutritious food items. Supermarkets are predicted to be better stocked with higher priced and less energy dense food items, such as fruits and vegetables, which are negatively related to childhood weight outcomes. In contrast, corner stores and bodegas will be better stocked with lower priced more energy dense food items, such as sugar sweetened beverages and snack foods, which are positively related to childhood weight outcomes. The SNAP food environment is unique, because it is constrained to SNAP-authorized locations. Results from this series of studies will inform policymakers of the role SNAP ultimately plays on childhood weight outcomes. There will be three papers, each with a different, but linked focus.

The first paper, describes the local SNAP food environment in NYC. It will be the first paper to examine the local SNAP food environment within small geographic buffers (several hundred feet) and to study food access to SNAP-authorized stores for NYC public school students. In addition, it will quantify food access to different types of SNAP-authorized store locations (supermarkets, small grocery stores, corner stores, etc.). Finally, this paper will identify differences in access to SNAP-authorized stores by the student's race, ethnicity and household income. Whether or not children from SNAP participating households have access to healthy food items is an important component to the program's success.

The second paper will evaluate how the local SNAP food environment changes as a result of adjustments to the program. There are two types of changes that I am able to examine. The first is an adjustment to the size of monthly benefits. The second is an adjustment in eligibility standards for the program. Presumably both types of changes could affect the number of SNAP-authorized locations. In addition, the distribution in the types of SNAP-authorized locations (i.e. supermarkets versus corner stores) will also change. Shifts in the types of SNAP-authorized retailers will lead to modifications in the local SNAP food environment for NYC public school students and their access to SNAP-authorized locations will also change. Policymakers can use this information to assess if further changes to the program can be made to develop a healthier food environment for children from SNAP participating households.

Finally, the third paper looks at how changes to the local SNAP food environment for NYC public school students cause changes in the body mass index (BMI) of NYC public school students. There are two sets of reasons for changes in the local SNAP food environment for a household. First, the location of the household could change. Second, individual store locations decide to continue or cease accepting SNAP benefits. Similarly, individual store locations that are SNAP-authorized could open and close over time. These types of changes (with various degrees of endogeneity) contribute to identifying the causal relationship between the local SNAP environment and childhood BMI. SNAP is arguably the most important domestic child nutrition program. The entire effect of the program on childhood outcomes has not been determined and as a result these three papers can be key contributions to the literature.

Study Significance

Policymakers have become increasingly interested in both the role that the local food environment plays in the ongoing obesity epidemic and the efficacy of SNAP. Potential adjustments to SNAP focus on where benefits can be redeemed and for what they can be redeemed for (Pomeranz and Chriqui 2015). This study would be the first to use address level panel data for SNAP-authorized locations and student households and its results give insight into the relationship between where a child lives and where their guardian's local SNAP benefits *can* be redeemed. These papers determine whether access to SNAP-authorized stores affects childhood BMI. If access to SNAP-authorized convenience stores, small grocery stores and bodegas causes an increase in childhood BMI, then policymakers should consider restricting what the benefits could be used to buy at these types of food stores. In contrast, if access to SNAP-authorized supermarkets causes a decrease in childhood BMI, policymakers should consider further expanding access to the program to families with children with high BMIs.

Research Questions

This series of papers has three primary research questions, one for each paper.

Research Question 1: What access to SNAP-authorized locations do NYC public school students have?

1.1 Do lower-income children, African American children and Hispanic children have greater access to SNAP-authorized stores in their home environment and what types of stores do they have the most and least access to?

1.2 Is the difference in access to SNAP-authorized convenience stores, small grocery stores and bodegas between lower-income children and higher-income children larger than the difference in access to SNAP-authorized supermarkets?

1.3 Is the difference in access to SNAP-authorized convenience stores, small grocery stores and bodegas between white and minority (African American or Hispanic) children larger than the difference in access to SNAP-authorized supermarkets?

Research Question 2: How does the local SNAP food environment in NYC change with historical changes in SNAP?

2.1 How does a change in eligibility standards for SNAP affect access to SNAP-authorized locations for NYC public school students?

2.2 How does an increase in the benefit size of SNAP affect access to SNAP-authorized locations for NYC public school students?

Research Question 3: What is the effect of variation in access to SNAP-authorized stores on childhood obesity for NYC public school students?

3.1 Do NYC public school students who live closer to a SNAP-authorized large supermarket have a lower BMI than similar students who do not?

3.2 Do NYC public school students who live closer to SNAP-authorized convenience stores, small grocery stores or bodegas have a higher BMI than similar students who do not?

3.3 Is the effect of a SNAP-authorized convenience store, small grocery store or bodega on a NYC public school student's BMI larger than the effect of a SNAP-authorized supermarket?

Literature Review

1.Economic Causes for the Rise in Obesity Rates

Metabolically, obesity is caused by total energy intake being greater than total energy expenditure. Based on work by Weinsier et al. (1998), metabolic factors, food consumption, physical activity and genetic traits are all associated with obesity (Weinsier et al. 1998). Of the four, food consumption and physical activity are the lifestyle factors with the largest contributions to obesity rates. The primary cause for the increase in all forms of obesity is an increase in caloric intake (Bleich et al. 2008). To which there are a multitude of related factors.

Cutler et al. (2003), provides an overview of the economic causes of obesity. There has been a decline in the time costs of food over time. This decline in total food costs led to an increase in food consumption frequency and higher weights (Cutler, Glaeser, and Shapiro 2003). According to Todd et al. (2010), eating food away from home is a contributor to the obesity epidemic because on average, eating food away from home increases the number of calories, saturated fat and sugar consumed and reduces the number of servings from fruit, vegetable and whole grains (Jessica Erin Todd, Mancino, and Lin 2010). Childhood interventions that reduce the frequency of eating food away from home result in improved diet quality, reduced BMI and body fat (Altman et al. 2015). In sum, the opportunity cost of preparing an individual meal has declined, and as a result obesity rates have risen. The role SNAP has played in these declines is not immediately clear and must be investigated.

2.Local Food Environment

In 2008, consumers reported getting 32 percent of their calories from food outside of the household, approximately a 15 percentage point increase from 1977 (Lin and Guthrie 2012). This increase coincides with large changes in the local food environments. As a result, the local

food environment is listed as a potential cause for increases in caloric intake and obesity rates (Chou, Grossman, and Saffer 2004; Cutler, Glaeser, and Shapiro 2003). Based on the literature, the food environment surrounding a child's household appears more important than the one surrounding the child's school (Hippel et al. 2007; Williams et al. 2014). A systematic review of the food environment on children's health ultimately concluded there is no evidence that the local food environment surrounding a child's school is associated with differences in food purchases or consumption (Williams et al. 2014). As a result, the papers in this study focus on the local food environment surrounding the child's household.

A component of the local food environment is food access, the ability for an individual to reach a local food retail outlet using a convenient mode of transportation. According to a report by the Institute of Medicine (2013), distance matters. The further the distance that a low-income household has to travel to purchase food, the lower the frequency of healthy food purchases (Caswell and Yaktine 2013). The relationship between food access and adulthood obesity rates has been investigated extensively. Based on the evidence, there appears to be a relationship between the two (Baum and Chou 2011; Chen, Florax, and Snyder 2012; Currie et al. 2009; Gamba et al. 2014; Lhila 2011; Marlow 2014; Spence et al. 2009; Viola et al. 2013). As described above, recent increases in caloric intake are likely due to an increase in access to energy dense food items at reduced prices. This is exhibited by the difference in the role of food access on obesity rates depending on the store type (Chen, Florax, and Snyder 2012; Currie et al. 2009; Gibson 2011; Lhila 2011; Powell and Bao 2009; Gamba et al. 2014; Cobb et al. 2015).

Each type of store has a different distribution in the proportion of (un)healthy foods for sale. This affects food access. Farley et al. (2009) found that in Los Angeles and southern Louisiana county convenience stores located in urban census tracts devoted almost 30 times as

much shelf space to unhealthy snacks and sugar sweetened beverages to fruits and vegetables. A much higher ratio relative to supermarkets (Farley et al. 2009). Coincidentally, energy dense foods are also offered at a lower price in convenience stores relative to other types of stores (Galvez et al. 2009; Neckerman et al. 2010). Convenience stores and small grocery stores in NYC have been cited as the most common source of unhealthy food for NYC public school students (Neckerman et al. 2010).

Differences between individual store types translate to differences in consumer behavior and rates of obesity. According to a systematic review by Gamba et al. (2014), convenience stores are persistently hypothesized to increase consumption of unhealthy food and obesity rates. In contrast, supermarkets are hypothesized to increase the consumption of fruits and vegetables and promote healthy weight (Gamba et al. 2014). These assertions are supported by the existing literature. Greater access to convenience stores, small grocery stores and bodegas is predicted to lead to lower diet quality (He et al. 2012; Larson, Story, and Nelson 2009; Rummo et al. 2015). A result found in 71% of studies examining the relationship (Gamba et al. 2014). Supermarket access has been associated with lower BMI in children (Fiechtner et al. 2015; Galvez et al. 2009; Powell and Bao 2009; Timperio et al. 2008; Larson, Story, and Nelson 2009). This result has been found in 38% of studies examining the relationship (Gamba et al. 2014). Thus, there is evidence that the type of store matters.

The local food environment differs by SES factors (Fiechtner et al. 2015; Handbury, Rahkovsky, and Schnell 2015; Moore and Diez Roux 2006). Nutritious food items are normal goods. Low income neighborhoods will have fewer stores that offer nutritious food because the demand will be lower relative to higher income neighborhoods (Bonanno and Li 2012). Furthermore low-income or racial minorities have greater transportation barriers and travel costs

as they have less ability to take off work to take the additional steps to purchase healthier foods (Barr-Anderson et al. 2011; Caswell and Yaktine 2013). Taken together, children in low income and/or minority neighborhoods have different forms of food access and availability than children who do not live in low income and/or minority neighborhoods (Fiechtner et al. 2015; Morland et al. 2002; Morland and Filomena 2007; Neckerman et al. 2010; Zenk et al. 2005; Hosler et al. 2008). Predominantly, white areas contain more supermarkets and have a greater variety of produce (Morland and Filomena 2007; DeBono, Ross, and Berrang-Ford 2012). Food availability is also different. Stores in high SES neighborhoods offer healthier products than stores in low SES neighborhoods, even within the same retail chain (Handbury, Rahkovsky, and Schnell 2015). In NYC, majority African American or Hispanic neighborhoods have lower access to healthy food and supermarkets (Bader et al. 2010). Also, in NYC, higher poverty zip-codes have a higher proportion of unhealthy food outlets (Stark et al. 2013). These reported differences in food access or availability, should lead to differences in food consumption and disparities in BMI and childhood obesity rates. Modifications to SNAP could be used to alleviate these disparities.

3. Overview of SNAP

SNAP's central goal is to reduce food insecurity. Presumably, increasing the resources available to low income individuals also increases the resources they use to purchase food. A secondary goal for the program is to improve the quality of diet for low income households. There are three federal SNAP eligibility rules, a gross income (cash income, excluding non-cash income or in-kind benefits), a net income and an asset threshold. Households must have a net monthly income at or below 100 percent of the federal poverty line to be eligible for the

program. Gross income must be less than 130 percent of the poverty line. The net income threshold is determined by subtracting allowed deductions from gross income. Finally the asset test requires income-eligible households to have less than $2,000. Even with these requirements, SNAP is the only universal safety-net program available to low-income individuals of any age or family type (Bitler and Karoly 2015). Because it is a federal program, states have relatively little leeway in how they administer the program.

SNAP participating households are given monthly Electronic Benefit Transfer (EBT) cards which can be used at select locations. Benefits of the program are entirely federally funded. The goal is for participants to purchase food items and prepare meals at home. The size of the monthly benefit is also based on the size of the household, total assets for the household and gross and net income. It is calculated by subtracting 30 percent of the net income for the household from the maximum benefit amount the household is entitled to. The formula is based off of the "Thrifty Food Plan," which estimates the expenditure levels needed to maintain adequate diets, and has been considered outdated by some (Hoynes and Schanzenbach 2015). In 2014, the average benefit was $257 per month per household, and in 2012, approximately 45% of SNAP participants had a child in the household (Hoynes and Schanzenbach 2015).

4.SNAP and the Local Food Environment .

SNAP benefits can be redeemed at supermarkets, grocery stores (defined by the United States Department of Agriculture (USDA) and stores that contain at least three of the four staple food categories; (1)meat, poultry or fish, (2)bread or cereal, (3)vegetables or fruits and (4)dairy products), convenience stores or stores that have over 50 percent of its total gross sales come from staple foods (does not count coffee, tea, cocoa, soda, candy, condiments, spices and

prepared ready-to-eat foods) (*Training Guide for Retailers* 2014). The 2014 Farm Bill made slight modifications as to which types of retailers are SNAP-authorized. Retailers are now required to include at least seven food items in each of four basic food categories: fruit and vegetables, grains, dairy and meat. Perishables have to be offered for at least three of the categories. The above changes were made to increase nutrition and is projected to cause significant changes to local food access for SNAP participants (Pomeranz and Chriqui 2015). As of 2011,the Centers for Disease Control reports that approximately 63% of supermarkets, large grocery stores, supercenters and warehouse clubs, and fruit and vegetable specialty stores were SNAP-authorized nationally (Grimm, Moore, and Scanlon 2013).

The consumption habits of NYC SNAP participating households are different. In 2009, the vast majority (84%) of national SNAP benefits were redeemed at supermarkets or supercenters. New York State SNAP participants were less likely to spend their benefits at supermarkets or supercenters. Less than half (48%) of all New York State SNAP transactions occurred in a supermarket or supercenter (5 transactions per month). Instead, New York State SNAP participants were more likely to redeem their benefits at grocery stores or specialty food stores (defined by the USDA as stores that specialize in specific products). The average New York State SNAP participant shopped at a small grocery store or convenience store, the closest equivalents to a corner store/bodega, three times per month, representing 29% of their transactions (five times the national average) and 13% of their SNAP expenditures (highest in the nation) (Castner and Henke 2011).

According to the 2012 SNAP Food Security Survey, the most common reasons SNAP participants chose where they redeemed their benefits were: (1) based on low prices or sales, (2) close to home, convenient or easy to get to, and (3) quality or variety of food. The distance a

SNAP participant has to travel is important (Cole 1997). That being said, SNAP recipients tend to travel farther from home to redeem their benefits than non-recipients (Cole 1997; Mabli 2014; Ohls et al. 1999; Ploeg et al. 2009; Ploeg et al. 2015). There are two prominent theories for this phenomenon. First, SNAP participants are more likely to reside in a food desert, and as a result, will have to travel farther to purchase food items (Ohls et al. 1999; Rigby et al. 2012). For urban SNAP participants, the median distance to the closest supermarket, superstore, or large grocery store was 0.6 miles and to the closest convenience store was 0.3 miles (Mabli 2014).

Second, SNAP participants may shop around (Cole 1997). According to Ohls et al. (1999), the most common reasons low income households do not go food shopping in their neighborhood are high prices, a lack of food selection and a dearth of stores (Ohls et al. 1999). Compounding this issue is that SNAP-authorized supermarkets are more expensive than other locations to purchase food items (Leibtag, Barker, and Dutko 2010). One of largest barriers to SNAP participants improving their nutrition, is the high cost of healthy food items (Blumenthal et al. 2014). Where a family redeems its SNAP benefits is a predictor of childhood weight outcomes. Parents that prefer to redeem their SNAP benefits at a closer SNAP-authorized convenience store or bodega rather than a more distant SNAP-authorized supermarket could make more unhealthy purchases on average. As a result, these children will also have higher BMIs on average.

There isn't a consensus in the literature of the effect of local food access on childhood obesity (Cobb et al. 2015; Lee 2012). However, researchers are now giving greater thought as to how changes to SNAP can affect the local food environment and improve dietary outcomes. According to the Institute of Medicine report (2013), SNAP benefits should be adjusted to take into account differences in local food prices and food access (Caswell and Yaktine 2013).

Andrews et al. (2013) goes a step further. They argue that SNAP benefits should increase to promote food access. Expanding benefits should encourage SNAP participants to shop at healthier SNAP-authorized outlets and improve dietary outcomes (Andrews, Bhatta, and Ploeg 2013). However, few studies have tested the validity of these claims.

5.Historical Changes to SNAP

5.1 Broad Based Categorical Eligibility

The number of individuals who are eligible to enroll in SNAP has an effect on the local food environment. There have been multiple changes in eligibility for the program. Historically, modifications in the income and asset requirements for the program have influenced enrollment for the program and total spending on the program. One such policy is broad based (non-cash) categorical eligibility. A household with members who are authorized to receive cash assistance from a welfare program (Temporary Assistance to Needy Families (TANF), Supplemental Security Income, or General Assistance) is considered categorically eligible for SNAP benefits. Meaning, the household is exempt from the federal SNAP asset and income eligibility test. A broad-based program substantially reduces the size of the benefit a family below a certain income threshold must receive from TANF (Falk and Aussenberg 2014). In fact, a family can receive a noncash TANF benefit (i.e. a brochure) and then apply for SNAP without taking the federal asset and income test.

New York state implemented a broad based categorical eligibility program as of January 1, 2008 (Trippe and Gillooly 2010), with an income limit 130% of the federal poverty guideline (Falk and Aussenberg 2014). As of July 2014, 43 states have implemented a broad-based categorical eligibility program and there is evidence that this type of change increases the

number of SNAP participants (Tiehen, Jolliffe, and Gundersen 2012a; Ziliak 2013). Such a policy could affect the local food environment as well. A decline in eligibility standards leads to an increase in the number of SNAP participants, which, in turn, leads to an increase in demand for SNAP-authorized stores.

5.2 Benefit Size

Benefit size is also an important factor for SNAP participants and the local food environment. The real average benefits per person for SNAP has increased from $94 in 2000 to $105 in 2008 (Tiehen, Jolliffe, and Gundersen 2012b). More recently, take-up in SNAP by eligible consumers (Ganong and Liebman 2013; Hardy, Smeeding, and Ziliak 2015) and authorized stores (Andrews, Bhatta, and Ploeg 2013) has increased because of a 20 percent rise in benefits under the American Recovery and Reinvestment Act (ARRA). The increase in benefit size also coincided with an increase in total food expenditures by SNAP participants (Beatty and Tuttle 2015). Furthermore, the benefit expansion from ARRA also caused an increase in the numbers of SNAP-authorized stores. Nationally, the number of SNAP-authorized convenience stores and SNAP-authorized grocery stores rose after the benefit increase (Andrews, Bhatta, and Ploeg 2013). However, no study has examined how the local food environment changed as a result of the benefit increase.

Kaushal and Gao (2011) look at historical changes in SNAP and their effect on food consumption. The authors conclude changes in SNAP that expand access into the program do not have any effect on total food expenditures but do cause a slight increase on total expenditures on food away from the household (Kaushal and Gao 2011). Similarly, using scanner data from over 400 grocery stores in Los Angeles, Atlanta and Columbus, Ohio, Bruich (2014) finds that for every one dollar cut in SNAP benefit levels, there is a $0.37 decline in grocery store spending

(Bruich 2014). Finally, Todd (2015) and Waeher et al. (2015) concludes that the expansion of benefits under ARRA did not change diet quality for SNAP participants but did smooth consumption food intake over the month (Todd 2015; Waehrer, Deb, and Decker 2015). There has yet to be a study examining how changes in the benefit level or eligibility standards of SNAP affect the number of SNAP-authorized store locations or the types of SNAP-authorized store locations. Nor are there any studies that examine how those program changes affect the local food environment and childhood obesity rates.

6.The Effect of SNAP on Childhood Obesity

The relationship between SNAP and obesity is complex. One of the more prominent theories for why SNAP participation is associated with obesity rates is the income effect theory (DeBono, Ross, and Berrang-Ford 2012; Gundersen 2015; Meyerhoefer and Yang 2011). Participation in SNAP expands the consumer's budget constraint, while the prices of food items remain the same. Presumably, because of the income effect, SNAP participants will spend more money on normal goods (i.e. food). The increase in spending should coincide with an increase in food consumption and in turn weight. Food expenditures using EBT are greater than food expenditures using cash (Fraker, Martini, and Ohls 1995). Official estimates from the USDA (2011) predict raising the benefit size for SNAP participants by a single dollar increases the participant's spending on food by between 17 and 47 cents (USDA 2011). This is consistent with Engel's law, as a household's income rises, the amount of income allocated to food also rises but at a decreasing rate (Caswell and Yaktine 2013).

Receiving SNAP benefits as opposed to cash benefits can affect what food is purchased. There are very few restrictions on what SNAP benefits can redeem (Pomeranz and Chriqui

2015). At present, it is unclear how the program is related to the types of food consumed. Recent work by Nguyen and Powell (2015) finds that SNAP participants on average consumed more sugar sweetened beverages than SNAP-eligible nonparticipants (Nguyen and Powell 2015). Other studies show no significant difference in the amount of calories (Andreyeva, Tripp, and Schwartz 2015a; Leung et al. 2013) or nutrients (Yen 2010; Andreyeva, Tripp, and Schwartz 2015b) consumed between low income children in SNAP participating households and children not in SNAP participating households. Although, children from SNAP participating households consistently fail to meet national dietary recommendations or guidelines (Leung et al. 2013; Andreyeva, Tripp, and Schwartz 2015b). Bitler's (2014) review of the literature shows SNAP recipients, on average, have worse diets and nutritional intake, higher levels of obesity and worse child health than non-recipients or income eligible non-recipients (Bitler 2014).

Only a few studies have looked at the relationship between SNAP participation and childhood obesity. Early research found that SNAP participation does not have an effect on childhood weight outcomes (Bhatacharya and Currie 2001; Boumtje et al. 2005; Jones et al. 2003; Ploeg, Mancino, and Lin 2007). Of those earlier studies, only Gibson (2003) found that for young girls less than 12 years of age, an additional year SNAP participation led to a greater probability of being overweight. The Gibson (2003) study is particularly strong because it accounts for selection into the program and uses the National Longitudinal Survey of Youth (NLSY). Therefore, the study can include individual and family fixed effects (Gibson 2003). The other early studies use cross-sectional data without controlling for selection bias. A persistent problem in the literature.

Subsequent work has resorted to using more advanced statistical and econometric techniques. Schmeiser (2012) also uses the NLSY and the expansion of the Earned Income Tax

Credit to instrument for changes in SNAP participation. He ultimately concludes that household SNAP participation reduces the BMI of boys between the ages 5 and 18 and females between the ages of 5 and 11 (Schmeiser 2012). Similarly, Burgstahler et al. (2012) uses county level SNAP participation rates to instrument for individual SNAP participation. The authors using cross sectional data, find that SNAP participation leads to a lower BMI in children from low income counties (Burgstahler, Gundersen, and Garasky 2012). Fan and Jin (2014) use a difference-in-difference design with propensity score matching again with the NLSY. Ultimately they find no relationship between SNAP participation and childhood obesity (Fan and Jin 2014). Clearly, the evidence on the effect of SNAP participation on weight outcomes is currently mixed and is sensitive to the sample, data and methods used.

Identifying the effect of SNAP on childhood weight outcomes is difficult because SNAP participation is endogenous. Food insecurity, poor health, financial stability, and other human capital characteristics are all likely to be associated with the decision to participate in the program (Kreider et al. 2012). An additional problem is the frequent misreporting of SNAP participation. Similar to most welfare programs, there is a stigma associated with SNAP enrollment, and redemption of benefits (Breunig and Dasgupta 2005; Gundersen 2015).

To my knowledge, there is only one study that has looked at the link between having access to SNAP-authorized retailers and *individual* childhood obesity rates. This is surprising since stakeholders in the program care about how the program affects access to healthy foods and obesity rates (Blumenthal et al. 2014). Carroll and Andreyeva (2013) use The Early Childhood Longitudinal Study and USDA SNAP retailer data from 40 states to evaluate how access to food stores that are SNAP-authorized is related to body weight. Models were stratified by the type of store that was SNAP-authorized (convenience store, supermarket, specialty stores,

and liquor stores), and the type of area that the child resides in (urban, suburban and rural). The authors conclude that there is a weak association between access to SNAP-authorized food stores and childhood BMI. The further the distance a SNAP-authorized supermarket was from an adolescent in a SNAP participating household, the lower the adolescent's BMI z-score (Carroll and Andreyeva 2013).

The three papers I outline below can improve on the work done by Carroll and Andreyeva. First, the authors did not know the street address of the child's residence. As such, the authors used the centroid of the student's zip-code, a coarse geographic measure, to evaluate the distance to the closest SNAP-authorized retailer and the number of each type of store within a one mile buffer zone. This paper improves on their measure by having access to the actual address of the student over time. Having the student's address helps with identification of the effects of the local SNAP food environment within a few hundred feet on the child's BMI. Second, this paper will have a much larger sample size and will be better powered to detect statistically significant effects.

Methods

Research Design

Identifying the causal effect of access to SNAP-authorized store locations on body weight outcomes is challenging for several reasons. First, it is difficult to design a randomized controlled study that assigns benefits to some individuals and withhold benefits to others. Second, it is difficult to experimentally alter the local food environment. Third, SNAP is a federal program with little variation at the local level. This makes finding exogenous variation for natural experiments more difficult (Bitler and Karoly 2015). This study avoids many of these issues by using panel level data within small geographic distances to identify causal effects.

The majority of studies in the food environment literature use cross-sectional data (Gamba et al. 2014; Cobb et al. 2015), which fails to track changes in the food environment over time. In addition, the relationship between obesity and the local food environment is susceptible to reverse causality. Due to the limitations listed above, an ideal dataset would track the home location of every child, the opening and closing dates for every SNAP-authorized store, and track food consumption patterns. These data would also include objective measures of height and weight, family-level factors and local environmental factors. Although the data in the present papers do not include food consumption patterns, it does contain the other components.

Reviews examining the relationship between food access and childhood weight outcomes stress that researchers who use cross-sectional granular data are subject to bias (Cobb et al. 2015; Gamba et al. 2014). Effect sizes could be exaggerated since the food environment is likely associated with dietary choice and weight outcomes (Mancino et al. 2014). This study will control for the reverse causality between the local food environment and obesity by leveraging the longitudinal nature of both datasets. The SNAP Retailer Database have the exact date when the store became SNAP-authorized. In addition, the FITNESSGRAM data include both the specific date of measurement, as well as the home address of the child. As such, I will be able to track changes in residences of the child as well as openings and closings of local SNAP-authorized locations. Depending on the model, I will use child fixed effects to control for child and family invariant characteristics and tract fixed effects to control for geographic invariant characteristics. The key identification assumption is that within-neighborhood variation in SNAP-authorized store proximity is exogenous to the choice of the neighborhood. Because the study is focused on small geographic distances, this seems a legitimate assumption.

Description of Key Variables and Datasets

Main Independent Variables: Local Food Access

The USDA provides retailer data for all food stores that are SNAP-authorized. The database includes information on the store's name, ownership, street address, city, zip-code and a categorical indicator for the type of store. Of particular interest is that the data contain information on the initial date of authorization and verification that the location was SNAP-authorized as of January 1st of each following year.

Currently, there is no consensus for the best measure of food access within a geographic area. This study will have the benefit of having access to the exact location where the student lives and all SNAP-authorized locations. Geographic buffers will be created surrounding the child's household in one hundred feet intervals, the equivalent of several city blocks. Within the buffer there are two measures of interest. The first is for the presence of a SNAP-authorized location within the buffer. The second is the number of SNAP-authorized locations within the buffer. The combination of both measures evaluates the intensive and extensive effect of living close to a SNAP-authorized store on childhood weight outcomes. Separate analyses will be run for subgroups of SNAP-authorized stores. Based on the literature, convenience stores, small grocery stores and bodegas are associated with an increase in weight outcomes, and supermarkets are associated with a decrease in weight outcomes. Each of the regression models will be run simultaneously for each of the food access measures and for each of the store types.

Main Dependent Variable: Student BMI

The primary outcomes of interest are a continuous measure of z-BMI, BMI percentile and a dummy indicator for the child’s BMI qualifying as being either overweight or obese. All

measures will come from the FITNESSGRAM data, which is a national physical fitness assessment. Participation in the FITNESSGRAM reports is part of a compliance checklist for a school's overall report card. Students in all grades are assessed for their body composition by the school nurse or physical education teacher. There is great confidence in these measures with one study determining that their reliability and validity was close to 100% and unrelated to school or student characteristics (Morrow, Martin, and Jackson 2010).

The FITNESSGRAM data will be merged to administrative student-level data from the Department of Education (DOE). The combination of the FITNESSGRAM data and the DOE data is a census of NYC public school students from kindergarten to 12th grade and includes measures of race, gender, age, country of origin, eligible for reduced or free lunch, recent immigration status and language spoken at home. This is particularly important because children from a SNAP participating household are automatically registered for free school meals. Hence, I will be using participation in the free school meals program as a measure for household SNAP participation, or a household qualified to participate in SNAP. This data also includes the student's exact location of residence, which is updated each year.

Covariates

Previously, Rundle et al. (2012) used two years of the NYC FITNESSGRAM data to identify possible predictors of childhood obesity. They find obesity varies by race/ethnicity, receipt of reduced-price or free lunch, nationality (defined by being born in the United States or not), and the percentage of the student's grade cohort that accepts free lunch (Rundle et al. 2012). I will include each of these measures in my regression models, along with the child's gender. In addition, depending on the model, I will include different sets of fixed effects. Specifically,

census tract fixed effects and child fixed effects. Each set of fixed effects will be controlling for a different source of variation and thus will be used in a different model, depending on the variation of interest. The census tract effects will control for characteristics of families within the same census tract. Controlling for this variation compares students who live in the same tract, who do and do not live in close proximity to a SNAP-authorized store. To estimate the effect of within-child variation, individual child fixed effects are included. These models estimate the change in the local SNAP food environment that the child is exposed to over time. It is likely that over the course of the panel, some of the children will move over time, changing their local SNAP food environment. These models capture those changes.

Statistical Analysis

Paper 1: Local Food Environment for SNAP Participating Children

The purpose of this paper is to describe the local SNAP food environment for NYC public school students. Access will be defined two ways. The first is a count of the number of store locations that are SNAP-authorized within a network buffer from the child's home (0-100 feet, 101-200 feet, 200-300 feet, 301-400 feet, 401-500 feet). The second is the average minimum distance traveled to reach a SNAP participating store from the child's home. In addition, I will look at these measures, broken down by the type of SNAP participating store. Specifically, I will look at both forms of defined access for BMI reducing locations (supermarkets) and BMI increasing locations (convenience stores, small grocery stores and bodegas). Total access measures and stratified access measures will be calculated for all students and along SES characteristics. Access measures will be calculated for income subgroups (high income versus low income), race subgroups (white versus non-white) and ethnicity subgroups

(Hispanic versus non-Hispanic). Statistical testing will be done to compare the minimum distance and the distribution of types of stores for each of the groups. Comparisons will be done using t-tests and chi-squared tests for across group differences.

The following hypotheses were reached based on the literature. It is expected that lower-income children, African American children, and Hispanic children will have greater access (more stores and lower travel distance) to SNAP-authorized stores in their home environment (**H1)**. The difference in access to SNAP-authorized convenience stores, small grocery stores and bodegas between lower-income children and higher-income children will be greater than the difference in access to SNAP-authorized supermarkets (**H2)**. After controlling for differences in household income and local economic conditions, the difference in access to SNAP-authorized convenience stores, small grocery stores and bodegas between minority (African American and Hispanic) children and white children will be greater than the difference in access to SNAP-authorized supermarkets **(H3)**.

Paper 2: The Effect of Changes in the SNAP on the Local Food Environment for SNAP Participating Children

The purpose of this paper will be to assess how the local SNAP food environment changes as a result to changes in SNAP. There will be three groups of outcome measures. First, the minimum distance a child must go to reach any SNAP-authorized location. Second, the minimum distance a child must go to reach a SNAP-authorized supermarket. Third, the minimum distance a child must go to reach a SNAP-authorized small grocery store, a SNAP-authorized convenience store, or a SNAP-authorized bodega. Each of these three outcomes will also be examined by whether the store location is independently owned or part of a chain.

The methods will follow closely to those of Bruich (2014) and Gaynor et al. (2013) who slightly modify the traditional difference in difference (DiD) design. A traditional DiD analysis framework compares two groups, the treatment and the comparison, over multiple time periods. The treatment group is exposed to an exogenous policy shock and the comparison group is not. Because SNAP is a federal program, it is difficult to identify a valid comparison and treatment group, since both will be affected by any exogenous change to the program. However, the intensity of the treatment from the exogenous policy change, will vary for different groups. In the Bruich (2014) study, the author observes changes in the percentage of sales attributed to SNAP participating customers at a supermarket before and after the phasing out of the aforementioned ARRA benefit expansion. Each supermarket had a different percentage of sales from SNAP customers and thus each supermarket would be affected differently due to the phasing out of the benefit expansion. For this study, I will look at the introduction of broad based categorical eligibility and the ARRA benefit expansion. Introducing broad based categorical eligibility will increase the number of SNAP participants. The ARRA benefit expansion will increase the amount of spending by SNAP participants. Different geographic locations and the stores within those locations will respond differently to these adjustments to SNAP.

In the case of this study, the effect of the treatment will be defined as the fraction of store locations that are SNAP-authorized out of all store locations within a given census tract. The critical assumption here, the parallel trends assumption, is that census tracts with a higher proportion of SNAP-authorized locations at baseline and census tracts with a lower proportion of SNAP-authorized locations at baseline would have behaved similarly had either policy not gone into effect.

The effect of both the introduction of the broad based categorical eligibility and the ARRA benefit expansion will be different for census tracts that have a lower percentage of SNAP-authorized stores and census tracts with a higher percentage of SNAP-authorized stores. Based on the hypotheses of the first paper, I would expect census tracts with fewer SNAP-authorized stores to be disproportionately white, and have a higher median income. Census tracts with a higher percentage of SNAP-authorized stores will have a higher percentage of minorities (African Americans and Hispanics) and have a lower median income. However, once the ARRA benefits are dispensed, I would expect that the benefit expansion would increase the number of store locations that are SNAP-authorized within all census tracts. This increase will differ across census tracts depending on the percentage of store locations that were SNAP authorized before the exogenous policy changes and characteristics of the census tract. Higher income census tracts will remain relatively unaffected or see a slight increase in the percentage of SNAP authorized locations due to the policy change. All other census tracts (middle and low income) will likely see a sizeable increase in the percentage of SNAP authorized locations. Similarly the effects within a census tract will differ depending on the type of store location. Chain store locations will be more responsive than independently owned locations. In addition supermarkets and other large food stores will be more responsive to the policy change relative to convenience stores, small grocery stores and bodegas.

The regression will take the below form. The models will be run for census tract k, during time period t. Y_{kt} will be the change in the average minimum distance to a SNAP-authorized store location for a child within a census tract. $SNAP_k$ is the average number of store locations that are SNAP-authorized out of all store locations within the census tract. Post is an indicator for the introduction of either policy. The interaction term is the coefficient of interest. It can be

interpreted as the measure of the policy change on the minimum distance that a child would have to travel to get to a SNAP-authorized location. Following Bruich (2014), in the extreme case a census tract with $SNAP_k$=0 can be interpreted as a location with zero percent of locations being SNAP-authorized. Also in the extreme case, value of one would correspond to all of the store locations being SNAP-authorized. The vector X represents census tract characteristics. These characteristics include: age, gender, percent in poverty, race and ethnicity. Finally, census tract fixed effects will also be included. The error term for the model is represented by e.

Stratified regression models will be run for different SNAP-authorized store types. For example, the percentage of supermarkets that are authorized to accept SNAP benefits, and the percentage of corner stores or bodegas that are authorized to accept SNAP benefits. In addition models will be run for chain locations and independently owned locations. These models will describe whether specific store types are sensitive to the different policies and whether the minimum distance that needs to be traveled is sensitive to the type of store.

$$Y_{kt} = B_0 + B_1SNAP_k + B_2post_t + B_3SNAP_k \times post_t + B_4X + B_5tract + e_{kt}$$

The following hypotheses have been constructed based on the existing literature. Modifications to SNAP that increase the number of people who enroll in the program will increase food access to SNAP-authorized stores for lower-income, African American and Hispanic NYC public school children **(H4)**. A statistically significant negative coefficient on the interaction term will signify that as the percentage of stores that are SNAP-authorized increases, the minimum distance needed to travel to reach a SNAP-authorized store will decline. Changes to SNAP that increase the benefit size will increase food access to SNAP-authorized stores for

lower-income, African American and Hispanic NYC public school children **(H5)**. Again, a statistically significant negative coefficient on the interaction term will signify that as the percentage of stores that are SNAP-authorized increases, the minimum distance needed to travel to reach a SNAP-authorized store will decline.

Paper 3: The Effect of Access to SNAP Participating Stores on Childhood BMI Outcomes

Finally, the third paper evaluates the effect of having access to a SNAP-authorized location on childhood BMI outcomes. The core regression model is specified below for child i, during time period t. The outcome measure, BMI_{it}, is a linear measure of the child's BMI percentile, or a dichotomous measure, where the child is overweight and/or obese. In both cases, ordinary least squares will be used to estimate the model.

The main variables of interest are the indicators S_1 and S_2. They represent dummy indicators for a SNAP-authorized store location within a specific geographic buffer. S_1 represents the first 100 feet surrounding the child's household. S_2 then represents the second 100 feet surrounding the child's household and is a concentric geographic band. There will be five bands in five intervals created up to 500 feet from the child's household. The S_1 dummy can be interpreted as the effect of having a SNAP-authorized store location within the first 100 feet surrounding the child's home.

The other controls in the model are as follows. X is the vector of student-level characteristics associated with obesity. These include gender, race/ethnicity, age, nationality and receipt of either reduced price or free lunch. The free lunch indicator will be the proxy for whether or not the student is on SNAP or not. All children from a household that accepts SNAP benefits is automatically qualified to receive free lunch from their school. Y will be a vector of

tract-level characteristics or tract-level fixed effects depending on the model. Z will be the percentage of students in the same grade and school who receive free lunch. To control for changes over time, D_t is included in the models as individual year fixed effects.

Again, the key identifying assumption here is that a child's family can choose their neighborhood, and not their household's location. In addition, the reason for choosing a specific neighborhood is uncorrelated with both the local SNAP food environment and obesity. The distance this study is focused on is so small, it is unlikely that a family decides where they move based on family characteristics linked to obesity.

$$BMI_{it} = B_0S_{1it} + B_1S_{2it} + B3S_{3it} + B_4S_{4it} + B_5S_{5it} + B_6X + B_7Y + B_8Z_{st} + d_t + e_{it}$$

The following findings are expected. NYC public school students who live closer to a SNAP-authorized large supermarket will have lower BMIs than similar students who do not (**H6)**. NYC public school students who live closer to a SNAP-authorized convenience store, small grocery store or bodega will have a higher BMI than similar students who do not (**H7)**. The effect of a SNAP-authorized convenience store, small grocery store or bodega on a student's BMI will be greater than the effect of a SNAP-authorized supermarket **(H8)**.

Study Limitations

This study has some limitations. First, the results from this study are limited to NYC public school students. Therefore, they may not extend to NYC private school students, or students who live elsewhere. As described above, New York State SNAP participating households behave very differently compared to others. According to Kimbro and Rigby (2010),

the effect size of SNAP participation on childhood weight outcomes differs in the literature because of differences in contextual factors (i.e. food prices) in different cities and states (Kimbro and Rigby 2010).

Second, the USDA SNAP retailer data does not include information on the exact date that the location closes or is no longer SNAP-authorized. Instead, the measure includes information on the date they are authorized to accept benefits and whether the location is authorized as of the following January 1st. But it is possible that stores that are SNAP-authorized close before they are reauthorized. Third, I do not know whether or not the student is actually enrolled in SNAP. Instead, I have to use household proxies for enrollment (the student receives free lunch). Although all students who are on SNAP are required to be enrolled in free lunch, students who are not on SNAP are potentially able to enroll into the program. At least students will have met the income requirement to enroll into the program. This issue is related to a much larger issue with my study and the literature. Almost all non-experimental studies on SNAP are susceptible to self-selection bias. Essentially not all eligible individuals enroll into the program. The reasons an individual chooses to enroll into the program are likely correlated with body weight. One possibility is that families with higher needs for food participation are more likely to enroll in the program.

Summary

These studies advance the field by clarifying the effect that participation in SNAP has on childhood weight outcomes. In addition, these papers will unpack the relationship between SNAP benefit levels and eligibility standards on access to SNAP-authorized locations. No previous study has combined the USDA SNAP retailer data with the NYC public school

FITNESSGRAM data. Previous studies evaluating the role SNAP has on childhood weight outcome have been limited without access to the student's street address and/or the SNAP-authorized store's street address. The FITNESSGRAM data are longitudinal and collected for all NYC public school students. The data are actual measurements for height and weight. Therefore, my results are not vulnerable to measurement bias from self-reported height and weight estimates (Cobb et al. 2015; Himes 2009; Rendall et al. 2014).

After the recent recession, more households and children are on SNAP than ever before. Public spending on the program peaked at $80 billion in 2013 (Bonanno and Li 2012). However, the full effect of the program on childhood weight outcomes is unknown. With so many children on the program, it is critical that researchers have a better sense of the exact relationship. SNAP is a crucial program for childhood nutrition and is a key contributor to food access and the local food environment for low income individuals. If the program adds to the ongoing childhood obesity crisis, policymakers need to consider alterations to the program to help facilitate healthy food choices.

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