Childhood SNAP Receipt as a Protective Factor Against Adult Obesity: Examining the Interaction of SNAP Participation and Neighborhood Disadvantage

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Childhood SNAP Receipt as a Protective Factor Against Adult Obesity: Examining the Interaction of SNAP Participation and Neighborhood Disadvantage

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Using the Panel Study of Income Dynamics (PSID) with family fixed-effects (FE) models, we explore how neighborhood conditions and time receiving SNAP benefits during childhood interact to relate to time spent obese in adulthood. Results suggest that, for those growing up in less advantaged neighborhoods, SNAP receipt between the ages of 9–13 and 14–18 was associated with subsequently shorter periods of time obese in adulthood. Conversely, for those growing up in more advantaged neighborhoods, SNAP receipt during these same late childhood/adolescent time periods was associated with relatively high proportions of time in adulthood spent obese. SNAP participation during early and middle childhood (ages 0–4 and 5–8) was not associated with time spent obese in adulthood, regardless of childhood neighborhood conditions. These results suggest that for those growing up in disad- vantaged neighborhoods, where study data indicate the vast majority of SNAP-recipient families reside, SNAP participation during adolescence may serve as a protective factor against adulthood obesity. Expanding research in this area of health and public policy is essential to advancing cost-effective, socially responsible food assistance program policies that can help ameliorate health disparities within communities across the country.

Keywords: Obesity, SNAP, Neighborhood Effects, Poverty, BMI
Introduction

The primary U.S. food and nutrition program, known currently as SNAP (Supplemental Nutrition Assistance Program), is designed “...to supplement the food budget of needy families so they can purchase healthy food and move towards self-sufficiency” (U.S. Department of Agriculture Food and Nutrition Service [USDA-FNS], 2019a, para. 1). Both the near-term goal for families (“purchase healthy food”), as well as the more aspirational goal (“move towards self-sufficiency”), have provided grounds for debate about program details, including what foods can be purchased using SNAP and which families, under what conditions, are eligible for receipt (for a list of enacted state-level measures, see National Conference of State Legislatures [NCSL], 2018). Between December 2019 and April 2020, we saw—at the federal level alone—the adoption of rules limiting states’ options for covering “able-bodied adults without dependents” (USDA-FNS, 2019b), and the enactment of the Families First Coronavirus Response Act which expanded access to SNAP in the wake of a global health pandemic (for a list of state-level waivers and extensions, see USDA-FNS, 2020a).

Under both its current and its original name (the Food Stamp Program [FSP]), SNAP has been part of a long history of debate about who deserves aid and who does not, intertwined with concerns that even those deserving of aid may use public benefits in unintended or health-compromising ways (Shimizu, 2020). Such concerns have led to a variety of state and federal policies and policy proposals designed, most directly, to prevent the use of SNAP for purchasing “low-nutrient, energy-dense” (LNED) foods (for a list of enacted state-level measures, see NCSL, 2019). Less directly, these policies and policy proposals have been linked to concerns for the health of recipients based, in part, on a rise in obesity rates among both children and adults (Flegal et al., 2016; Skinner et al., 2018).

Policies and policy proposals that aim to limit SNAP-eligible foods or decrease eligibility or benefit levels more broadly often fail to address mixed or favorable evidence of dietary, weight, and health effects of SNAP participation (Jones & Frongillo, 2006; Vartanian & Houser, 2012). Studies that have attempted to draw causal connections between SNAP use and body weight or obesity have been susceptible to selection bias, or the
possibility that those who receive SNAP may be different in unobservable ways from those who are eligible, but not receiving SNAP, and that these differences may in turn be mistaken for SNAP effects (Yen et al., 2008). By using family fixed effects (FE) models with longitudinal panel data, we hope to disentangle SNAP effects from the effects of other factors, including family and neighborhoods factors. Focusing on four distinct childhood and adolescent age ranges (0-4, 5-8, 9-13, 14-18), we examined whether time spent receiving SNAP within particular types of neighborhoods in childhood/adolescence was associated with time spent obese as an adult.

Background

**SNAP Participation and SNAP Effectiveness**

The years covered by this study—1968 through 2013—saw numerous changes in the United States’ largest food assistance program, including changes in name (from the FSP to SNAP), eligibility rules, participation rules, data collection and tracking methods, and, of course, the economic and cultural conditions within which participation occurred. Although longitudinal data on uptake and expenditures should be viewed with caution, they illustrate the reach of the program over a 45-year period. In fiscal year (FY) 1969, nearly 2.9 million people received $228.8 million in food stamp benefits. By FY1976, the number of participants had risen to 18.5 million, with annual participation numbers then alternately increasing and decreasing for the next 15 years, between 16 million and 22.5 million participants. While the first half of the 1990s saw increases in uptake (from 20 million people in FY1990 to 27.5 million in FY1994), the latter half saw even more precipitous declines (to 17.2 million in FY2000). The next 13 years, however, would yield steady participation increases, peaking, in 2013, at 47.6 million people and $79.9 billion in benefits in FY2013, the final year of data covered by this study. It is noteworthy, however, that following the 2013 period and until recently, we saw declines in participation, with 40.4 million participants at a cost of $65.3 billion in FY2018 (USDA-FNS, 2019c).

SNAP participation has been linked to a number of positive outcomes for recipients. Conducted over a period from 2011–
2013, a study by the USDA-FNS (2016) showed that providing SNAP over the summer to the families of children receiving free and reduced-price school meals during the previous school year reduced “very low” food security by one-third. In a separate study, relative to the time before they started receiving SNAP, families were over 16% less likely to be food insecure, and over 17% less likely to be “very low” food secure, after receiving SNAP for six months (USDA-FNS, 2013). For families with low incomes, using SNAP has been associated with lower health care spending due, in part, to lower levels of food insecurity (Berkowitz et al., 2017). Using the supplemental poverty measure and data from the Current Population Survey in 2016, the Center on Budget and Policy Priorities (2019) showed that SNAP kept 7.3 million people out of poverty, including 3.3 million children.

In addition to research on proximal measures of impact and effectiveness, such as food security and poverty, researchers have addressed more distal indicators, including health and obesity. Such studies have become especially important in recent years because of the ways in which rising obesity rates in the United States (Flegal et al., 2016; Skinner et al., 2018) have been rhetorically tied to poverty and poverty programs. While some have questioned both the framing of obesity indicators as an “epidemic,” as well as the consistency of evidence for both causes and consequences (Moffat, 2010; Sanabria, 2016; Wachs & Chase, 2013), the fact remains that isolating and addressing causes of overweight and obesity is a significant focus of research and policy. According to Ward et al. (2019), nearly half of the U.S. adult population will be obese by 2030. High body weight has been linked to a number of health consequences, including high blood pressure and cancer among adults (Freedman et al., 2007; Lauby-Secretan et al., 2016) and psychosocial problems among children (Rankin et al., 2016).

**SNAP and Obesity: Relationship Mechanisms**

Researchers have used a variety of theories to explain relationships between food assistance program participation and obesity. One view posits that because SNAP funds are inflexible income that must be used to purchase food, SNAP recipients will purchase more food than people with similar income
levels but without SNAP (Fox et al., 2004; Leung & Villamor, 2011). This is known as the *income effect*. Based on the results of four “cashout” demonstrations in three U.S. states (in which FSP benefits were issued to some families via checks rather than food vouchers), Fraker et al. (1995) found that those who received vouchers spent 18% to 28% more on food than those who received benefits in the form of cash. Based on a study of county-level FSP rollout from 1963 to 1975, Hoynes and Schanzenbach (2009) concluded that program implementation was linked to decreased cash (non-FSP) spending on food but to increased total food expenditures. More recently, however, Kim and Shafer (2015) found no increase in food expenditures for SNAP recipients in the month they began to receive SNAP, relative to the month prior to SNAP receipt.

A second theoretical explanation for a SNAP/food stamp and obesity connection is the “food stamp cycle;” because SNAP funds are distributed at the beginning of the month, they may run out before the end of the month (Council of Economic Advisors, 2015; Ver Ploeg & Ralston, 2008). A 2011 report issued by the Office of Research and Analysis of the USDA’s Food and Nutrition Service (USDA-FNS, 2011) showed that, in recipient households, nearly 80% of SNAP funds were used within the first 14 days of the month, leaving relatively little for the final half of the month. The resulting “feast and famine” cycle has been positively associated with BMI among adults (Smith et al., 2017; Yanovski, 2003), and food insecurity itself has been linked to obesity in women (Dinour et al., 2007) and, albeit less consistently, in children (Casey et al., 2006; Dinour et al., 2007). In a 2016 review paper, Dhurandhar (2016) theorized that a resource scarcity hypothesis (i.e., higher calorie consumption in response to food supply threats) may explain relationships sometimes observed between food insecurity and obesity.

Another possible mechanism underlying an association between SNAP participation and obesity is a sort of “protective income effect;” specifically, that increased food income in the form of SNAP benefits may enable recipients to buy healthier foods, such as fresh fruits and vegetables, thus decreasing caloric intake overall (Anderson & Butcher, 2016). Several studies have suggested that additional cash funds help low-income families living in areas with limited access to food stores, to afford regular travel to larger grocery stores, and, subsequently,
to access healthier and more affordable, nutritious and/or fresh foods (Ford & Dzewaltowski, 2011; Jennings et al., 2011).

The relationships modeled in our current study extend from childhood circumstances (primarily household SNAP receipt and residential neighborhood conditions) to adult obesity. According to Simmonds et al. (2016), overweight and obesity in childhood increase risks for overweight and obesity in adulthood. Therefore, while the outcome modeled is the proportion of adulthood spent obese, any observed relationships between extent and timing of SNAP participation, neighborhood conditions, and adult obesity may capture both time-specific and cumulative (from childhood into adulthood) factors.

**Literature Review**

Using two research databases (Academic Search Premier, SocIndex), we reviewed articles published over the roughly 15-year period from January 1, 2004, through March 31, 2020. For the first review, we searched article abstracts for [(obesity OR overweight OR BMI) AND (SNAP OR food stamps)]. For the second review, we searched article abstracts for [(obesity OR overweight OR BMI) AND (neighborhood) AND (food OR nutrition OR diet) AND (United States)]. For both sets of results, we retained only those studies that: (1) examined relationships between SNAP participation (first review) or neighborhoods (second review) and some measure of overweight as their primary focus; (2) reported on either original analyses or systematic reviews of original analyses; and (3) contained clearly defined samples and methods. While we included studies focusing on subsets of the U.S. population related to gender, age, and geographic location, we excluded studies focusing on other subpopulations such as immigrants. We then reviewed the references for each included article, applying to each the inclusion criteria labeled (1) through (3) above and retaining those referenced articles meeting the criteria.

Studies varied by participant age (children, adolescents, adults), data type (cross-sectional, longitudinal), data source (primary, secondary; regional, national), and method (e.g., ordinary least squares and logistic regression, propensity score matching). Below, we summarize findings and gaps from the 28 articles retained for the first review, 89 articles retained for the
second review, and four articles selected in both reviews (due to space constraints, we cite only a subset of articles; full article lists are available upon request).

**SNAP and Obesity**

The majority of studies we reviewed examined SNAP participation and body weight outcomes measured at either the same or similar periods of time (e.g., during adulthood or during adolescence/childhood). We therefore grouped the studies reviewed by these broad age categories. Research reviews by Ver Ploeg and Ralston (2008), Debono et al. (2012), and Gunderson (2015) each found consistent evidence for a positive relationship between SNAP participation and body weight indicators for adult women but not for adult men. However, two more recent studies reported evidence of non-significant or negative associations between adult SNAP participation and weight (Almada & Tchernis, 2018; Nguyen et al., 2015). Using cross-sectional data from the 2003-2010 National Health and Nutrition Examination Survey (NHANES), Nguyen et al. (2015) found that, in households with marginal food security, adult SNAP participation was associated with lower adult BMI, lower probability of obesity, and better diets; in households with low or very low food security, adult SNAP participation was not associated with weight measures but was associated with better diets. More recently, Almada and Tchernis (2018) used a quasi-experimental approach with data from 1985 to 2008 to determine that increases in SNAP benefit amounts were not related to adult obesity levels; indeed, in households with one or more young children, the probability of obesity for adults decreased by about 10%.

In addition to studying relationships between SNAP participation and body weight for adults, researchers have looked for evidence of SNAP participation effects in children and adolescents (Hudak & Racine, 2019; Kreider et al., 2012; Leung et al., 2013; Schmeiser, 2012; Simmons et al., 2012). Studies of food assistance and BMI/obesity in adolescents generally find small or no associations between SNAP participation and weight measures (Schmeiser, 2012). Similarly, both national and regional studies conducted over the past 15 years, including those by Kreider et al. (2012; ages 2–17), Leung et al. (2013; ages 4–19), Schmeiser (2012; ages 5–11), and Simmons et al. (2012; ages 3–5)
observed null or negative relationships between SNAP participation and BMI/obesity. However, in a recent review of 23 studies of household SNAP participation and child body weight, Hudak and Racine (2019) concluded that, while the majority of studies found null or inverse relationships between SNAP use and children’s weight, several of those that addressed selection bias observed positive associations between SNAP use and overweight for some groups of children.

A smaller number of studies have modeled the impact of program participation during child and adolescent years on outcomes observed in adulthood. For example, using family fixed effects models with nationally representative longitudinal data from the Panel Study of Income Dynamics, Hoynes et al. (2016) linked childhood access to food stamps to a lower likelihood of metabolic syndrome (i.e., “a cluster of conditions including obesity, high blood pressure, heart disease, and diabetes”) in adulthood (p. 905).

Neighborhoods and Obesity

The selection, purchase, and consumption of food take place within local contexts. Any observed connections between SNAP program participation and obesity could be related to the places in which SNAP funds are used (e.g., food store type and proximity) (Jilcott Pitts et al., 2012; Sanjeevi et al., 2018). In the current study, we explicitly examined the socioeconomic environment, which includes the individual and socioeconomic characteristics of neighborhood residents. However, our review of studies associating neighborhood conditions with BMI, overweight, or obesity, revealed three intersecting dimensions of neighborhood environments: what Carroll-Scott et al. (2013) summarized as socioeconomic, built, and social environments.

Socioeconomic Environment

Researchers have linked neighborhood socioeconomic conditions to obesity risk (Greves Grow et al., 2010), risk of overweight (Kowaleski-Jones & Wen, 2013), and BMI scores (Burdette & Needham, 2012). In models of relationships between neighborhood environments and weight-related outcomes (i.e., soda consumption, BMI, and obesity risk), Wong et al. (2018)
noted that residents’ educational attainment was significantly and inversely associated with one or more outcomes for participants of all racial and ethnic groups, but particularly for non-Hispanic Whites. Consistent with Wong et al.’s conclusion that neighborhood environments may impact residents differently by their individual sociodemographic characteristics, several recent authors have found that neighborhood segregation is associated with higher odds of obesity for Black women (Bower et al., 2015; Kershaw et al., 2013) and Hispanic adults (Corral et al., 2014), and with lower odds of obesity for Mexican-American women (Kershaw et al., 2013).

In a longitudinal examination of neighborhood effects, Lippert (2016) found that, while residing in poor neighborhoods during adolescence increased the likelihood of obesity in adulthood, moving out of a high-poverty neighborhood to a low-poverty one during the transition to adulthood reduced this likelihood.

**Built Environment**

The built environment refers to the ways space is designed and used (Carroll-Scott et al., 2013). Overall, evidence for a relationship between body weight and characteristics of the built environment (e.g., food store type and quality, presence of green space, perceived neighborhood attractiveness, neighborhood safety, and outlets for physical activity) has been mixed, with some variation by whether settings are urban, suburban, or rural and by region of the country (Adachi-Mejia et al., 2017). Numerous researchers have observed, however, that low-resource or high-poverty neighborhoods tend to have fewer large grocery stores and more convenience or fast food stores than other neighborhoods (Larson et al., 2009; Powell et al., 2007). In addition, researchers have found relationships between access to food stores abundant in nutrient-rich foods and BMI (Carroll-Scott et al., 2013; Jennings et al., 2011), obesity risk (Black et al., 2010; Bodor et al., 2010; Larson et al., 2009; Zick et al., 2009), the purchase of fresh and nutrient-rich foods (Jilcott Pitts et al., 2015), and healthier diets (Larson et al., 2009). Food prices in general, including prices for fruits and vegetables, have also been positively associated with BMI (Sturm & Datar, 2005). It is, however, noteworthy that, in a national study of low-income
women with young children, Ford and Dzewaltowski (2011) found that supermarket availability was not directly related to women’s BMI in urban or rural areas.

Cooksey-Stowers et al. (2017) examined the effects of so-called “food deserts”—areas lacking in large-scale grocery stores—and “food swamps”—areas with a high proportion of fast food and other sources of LNED foods, and found that those living in a food swamp were more likely to be obese than those living in a food desert.

Social Environment

The social environment refers to relationships between groups and individuals within particular neighborhoods (Carroll-Scott et al., 2013). There are a number of mechanisms within the neighborhood social environment that may be associated with physical activity, food purchase, and consumption, which may then be related to body weight. These mechanisms include social modeling, social ties, social capital, and collective action (Carroll-Scott et al., 2013). Studies that have examined relationships between social modeling and food choice and consumption have shown mixed results. In their review of these studies, Cruwys et al. (2014) found evidence that individuals are influenced in their food choices by others seen as similar to themselves. In a Philadelphia-based study of shopping behaviors, Cannuscio et al. (2014) observed that individuals actively selected food stores for safety, ease of access (e.g., parking), convenience of location, friendliness, and extent to which other store patrons shared their perceived race, ethnicity, education, and/or income.

SNAP Participation, Neighborhoods, and Obesity by Age

A child’s age may influence relationships between SNAP participation, neighborhood environment, and body weight in a number of ways, including the extent to which they eat at home, purchase their own foods, and are influenced by caregivers or peers. As such, many researchers have opted to examine relationships between SNAP participation and obesity in samples of children divided by age. For example, Gibson (2004) observed relationships between long-term SNAP participation and obesity for children ages 5–11 (in a positive direction for girls and
a negative direction for boys), but not for children ages 12–18. Studies of neighborhoods and child obesity have also acknowledged important age-related distinctions. For example, Singh et al. (2010) found that factors in the built environment are related to obesity likelihoods differently at different ages, with the greatest impacts on the youngest children.

The Current Study

Our study aimed to examine the relationship between SNAP participation during various childhood ages and adult obesity risk, while accounting for childhood poverty and attending to the context of socioeconomic neighborhood environment.

Hypotheses

We examined whether the interaction between receiving SNAP benefits and living in disadvantaged areas during particular periods of childhood had positive relationships with the amount of time spent obese as an adult. These relationships may be due to the food stamp cycle or to the income effect and, in turn, may be accentuated in distressed neighborhoods where low-cost, nutrient-rich foods are less available. Alternatively, as a “protective income effect,” SNAP income may provide families the additional funds necessary to buy more expensive, healthful foods in disadvantaged areas or may supplement their income enough to enable travel to areas where food costs are lower.

To determine how children in various age ranges are impacted by SNAP participation and neighborhood environment, we examined ages that correspond roughly to birth to preschool (ages 0–4 years); primary school age (ages 5–8 years); early adolescence (ages 9–13 years); and late adolescence (ages 14–18 years). Past studies have used these or similar age ranges and found relationships between childhood conditions and adult outcomes, including completed schooling and adult income (Duncan et al., 1998; Levy & Duncan, 2000; Vartanian & Buck, 2005).
Data and Methods

Study Samples

The data for our study are from the Panel Study of Income Dynamics (PSID) from the University of Michigan. Funding for the PSID comes from the National Science Foundation, the National Institute on Aging, and the National Institute of Child Health and Human Development. When weighted, the PSID is a representative longitudinal sample of the non-institutionalized U.S. population with an initial sample of 5,000 families and 18,000 individuals within those families in 1968. With each wave of data collection, information is collected about all sample members, including children. Over time, the children and the subsequent generations of children of the original PSID members have also been included in the sample. Currently, there are over 9,000 families and over 26,000 individuals within those families that are followed in the PSID, with as many as six generations within sample families. The PSID surveyed respondents annually from 1968 through 1997, then biennially from 1999 through 2013. We examined 0 to 18-year-olds for neighborhood, household income, and SNAP participation data from the 1968 to 2013 PSID. We then examined those who are age 20 or above and who became heads of households or spouses (who are asked weight/height questions) in years 1999 to 2013 (the sample years where weight and height information is available) and determined their proportion of time spent obese.

We merged the PSID data sets with Census tract data in order to obtain neighborhood information. For data years 1968 to 1975, we used 1970 Census information; for years 1976 to 1985, we used 1980 Census information; for years 1986 to 1995, we used 1990 Census information; for years 1996 to 2005, we used 2000 Census information; and for years 2007 to 2013, we used information from the 2006 to 2010 American Community Survey, which gives average census tract data over this five-year period. We have previously tried alternatives to this type of linking of Census and PSID data but found that these alternative approaches made little difference to our results.
Dependent Variable

We used the proportion of adult time spent obese (adult BMI at or above 30) as the dependent variable. We believe that this is a better measure of obesity than whether an individual becomes obese at some point in adulthood or whether an adult’s BMI falls, on average, in the “obese” range, because, as a measure of cumulative risk, duration of time spent obese has been positively associated with multiple adult health outcomes, including hospital stays (Schafer & Ferraro, 2007), self-rated health (Zajacova & Burgard, 2010), and cancer risk in women (Arnold et al., 2016).

Independent Variables

Program Participation and Household Income. The primary independent variables were measured as the proportion of time receiving certain public benefits, living in particular economic conditions, and a combination of these two elements. In order to isolate the effects of using SNAP benefits, we focused on the proportion of time during childhood receiving only SNAP and refer to this variable as proportion of time on SNAP. Because the majority of households with dependent children that receive SNAP are also eligible for cash assistance (TANF), we included the variable proportion of time on SNAP/TANF to capture time spent enrolled in both programs. We also included the variable proportion of time on TANF, for those who spent time receiving TANF without receiving SNAP. The primary comparison is between individuals’ proportion of time receiving SNAP during childhood and the proportion of their time in poverty without SNAP or TANF receipt during childhood.

Measures of household economic conditions included the proportion of childhood time growing up in households with income less than 150% of the federal poverty level (FPL) and not receiving any SNAP or TANF income; this variable, called proportion of time with low income, served as the reference group in our regression analyses. We included the variables proportion of time with income at 150%-200% of the FPL and proportion of time with higher income, both without SNAP or TANF receipt, to designate proportions of time in childhood with household incomes between 150–200% and above 200% of the FPL, respectively.
In order to determine program participation and income during each year of childhood, we first examined whether there was any childhood participation in SNAP, TANF, or both programs, and if there was not, we then examined whether the family’s income was above or below 150% of the FPL, or within the other income categories. We then examined the proportion of childhood time in each of these different categories.

Each of our models included the proportion of time within particular conditions for particular age categories. For example, when we examined children ages 0 to 4, we were examining only the proportion of time spent in particular conditions during childhood ages 0 to 4.

**Childhood Neighborhood Conditions.** Because most neighborhood variables are highly correlated, we created separate indices of neighborhood conditions during childhood and adulthood. These indices were constructed by using principal components (PC) analysis with a variety of neighborhood conditions that are similar to those used by previous researchers (Burdette & Needham, 2012; Vartanian & Houser, 2012). These measures included, by census tract, the percentage of female-headed households, the percentage receiving public assistance income, the unemployment rate, the poverty rate, the percentage of people with incomes greater than $60,000 (2011 dollars), and the percentage of White and Black residents. We found that most neighborhood variables were highly correlated with the PC variable for both child and adult periods, with absolute values of .76 or above for all child neighborhood scores and .68 or above for all adult neighborhood scores. The child neighborhood PC variable explained 74.52% of the variation in the original child neighborhood variables, while the adult PC variable explained 66.73% of the variance for the original adult neighborhood variables (results not shown). The PC variables were positively correlated with the percentage of incomes greater than $60,000 (.76 in childhood and .79 in adulthood) and the percentage White (.89 in childhood and .87 in adulthood), and negatively associated with all other neighborhood variables (in childhood and adulthood, respectively, percentages for poverty rate [-.90 and -.91], public assistance receipt [-.90 and -.69], female-headed households [-.90 and -.68], unemployment [-.78 and -.87], and Black [-.88 and -.85]). The direction of the income indicators suggest that higher PC values
correspond to more advantaged neighborhoods and lower values indicate less advantaged neighborhoods.

We examined the child neighborhood advantage index (created as described above) in conjunction with the SNAP program participation and income variables to determine whether SNAP use during childhood influences adult time spent obese differently in varied neighborhood contexts. To do this, we interacted the neighborhood advantage variable with the variable proportion of time on SNAP.

In order to examine the independent effects of each of the seven neighborhood conditions (e.g., neighborhood poverty rate and neighborhood unemployment rate), we also ran separate models for each neighborhood condition along with all control variables. Each separate neighborhood variable was also interacted with time participating in SNAP.

Control Variables

Our statistical models controlled for a number of childhood factors, averaged over the individual’s examined childhood age period (0–4; 5–8; 9–13; 14–18). These included family and head of household variables: age; marital status and changes in marital status; average family income-to-needs and the variance of family income-to-needs; whether the residence was owned; value of the residence if owned; whether the residence was in a rural area; whether the residence was in the south; number of household moves; number of children in the household; hours worked; and work limits. We also controlled for gender and birth order of the child, whether the child dropped out of high school, and the beginning year for the child entering the survey.

Each model also controlled for variables observed in individuals’ adult years, including all income and public assistance measures (e.g., proportion of adult time on SNAP; proportion of adult time with low-income) and the adult neighborhood advantage index.

Statistical Methods

We examined the relationships between SNAP program participation, neighborhood conditions, and obesity in adulthood using a number of modeling strategies: Ordinary Least Squares
(OLS) regression with the full sample, OLS regression with the siblings-only sample, and family fixed effects (FE) regressions. We applied these modeling strategies first using the neighborhood conditions index. Then, to examine which neighborhood indicator(s) might be driving an overall index effect, we examined family FE models for each neighborhood indicator separately. We used Stata (version 15) to analyze the data.

Self-selection may confound estimates of the effects of both government assistance programs and neighborhood conditions. For example, people who live in less advantaged neighborhoods may be more prone to obesity relative to those who “choose” to live in more advantaged neighborhoods for reasons that are unobserved or are not captured by the current set of control variables. To control for these types of unobservable shared attributes that do not vary among siblings, we used family FE models (Vartanian & Houser, 2012).

To estimate the FE models, we examined individuals from multi-child families, and used a family dummy variable for all families except the reference family. Variation among siblings is needed for neighborhood conditions, time using SNAP, and all other variables to estimate the effects in FE models. Variation between siblings in their neighborhood advantage index values can come from household moves, from developments and changes in the neighborhood over time, or from movements of individual siblings into and out of households. We found that almost all siblings within families in our sample showed variation in their neighborhood index values.

There are several limitations to FE models. Such models exclude those children without siblings or without siblings in the sample. Hence, sample sizes are smaller than in those studies using all children within the sample. FE models lose many degrees of freedom because a separate dummy variable is used for each family except for one (the reference family). FE models are only able to additionally control (above standard regression models) for unobservable factors that do not vary among the siblings, such as unvarying characteristics of their parents or shared genetic makeup. We examined whether the sibling sample and the all-child sample differed from each other by examining mean values for the key variables and by running OLS regression analyses on both samples and looking for differences in effects. If the effects are similar for these two OLS models, we
can have greater confidence that FE models are not being driven by the sibling restriction.

Results

Descriptives

Table 1 shows the types of neighborhoods where the sample of children, both with and without siblings, grew up, including the mean, standard deviation, and the 25th and 75th percentiles of the neighborhood advantage index (which is standardized to a mean of 0 and a standard deviation of 1). We examined those who spent more than 25% or 50% of their childhood time on SNAP, those with low income (less than 150% of the FPL without SNAP or TANF assistance), and those with income above 200% of the FPL (also without SNAP or TANF assistance). We found that those who received SNAP for a considerable amount of their childhood tended to live in less advantaged neighborhoods. Table 1 shows that the mean neighborhood advantage value for those who received SNAP income for more than 25% and 50% of their childhoods is .73 and .94 standard deviations (SDs) below the overall neighborhood mean (or in less advantaged neighborhoods), respectively. Those who received SNAP income for more than half of their childhoods and lived in neighborhoods at the 25th percentile of neighborhood advantage for this group were 1.44 SDs below the overall mean neighborhood condition; this places their levels of neighborhood advantage well below those of other children. Table 1 also shows that children who spent longer proportions of their childhoods using SNAP spent longer proportions of their adulthoods obese relative to other groups.

To examine whether the all-child sample and the siblings-only sample were noticeably different from each other, we examined mean values for all variables used in our analyses (results not shown), finding that there were generally small or no differences in mean values between the all-child and siblings-only samples. For example, the mean proportion of time obese as an adult was .22 for both the full, all-child sample (i.e., the sample which includes people who did not have a sibling in the sample) and the siblings-only sample. We found similar results for the proportion of time using SNAP, family income-to-needs,
Table 1. Childhood Neighborhood Index Values, by Childhood Time on Public Assistance and Income, and Proportion of Adult Time Spent Obese

<table>
<thead>
<tr>
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<th>Mean Neighborhood Index Value</th>
<th>25th, 75th Percentile for Neighborhood</th>
<th>Prop. of adult time spent obese</th>
<th>N</th>
</tr>
</thead>
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<tr>
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<td>-.73 (.95)</td>
<td>-1.29,-.18</td>
<td>.32 (.48)</td>
<td>755</td>
</tr>
<tr>
<td>% of time on SNAP&gt;50%</td>
<td>-.94 (.90)</td>
<td>-1.44,-.39</td>
<td>.30 (.48)</td>
<td>258</td>
</tr>
<tr>
<td>% of time w/low income&gt;25%</td>
<td>-.08 (.98)</td>
<td>-.60,.69</td>
<td>.25 (.45)</td>
<td>2,318</td>
</tr>
<tr>
<td>% of time w/low income&gt;50%</td>
<td>.05 (.89)</td>
<td>-.46,.77</td>
<td>.24 (.45)</td>
<td>1,770</td>
</tr>
<tr>
<td>% of time w/income&gt;200% of the FPL&gt;25%</td>
<td>.40 (.71)</td>
<td>.19,.87</td>
<td>.18 (.39)</td>
<td>2,741</td>
</tr>
<tr>
<td>% of time w/income&gt;200% of the FPL&gt;50%</td>
<td>.48 (.64)</td>
<td>.27,.90</td>
<td>.16 (.38)</td>
<td>2,206</td>
</tr>
</tbody>
</table>

Note: Neighborhood index values are standardized, with a mean of 0 and a standard deviation of 1 for the entire sample.
Note: FPL=Federal Poverty Line. SNAP=Supplemental Nutrition Assistance Program. Low Income=household income less than 150% of the federal poverty line without using Food Stamps/Supplemental Nutritional Assistance Program or Aid to Families with Dependent Children/Temporary Assistance for Needy Families.
the neighborhood poverty rate, and other important variables in the study.

Table 2 shows the weighted mean values and standard deviations for some of the key independent variables for the siblings-only sample. (The full set of results is available upon request.) Overall, and within the four age categories for children, we found similar amounts of time spent obese, with all groups spending 20% to 21% of their adult period obese. Those in the younger age groups tended to spend a little more time using SNAP relative to those in the older age groups. We also found that the neighborhood poverty rates for all age groups of children were close to 13%.

Regression Results

Table 3 shows the estimated effects for adult time spent obese by regression method, for the siblings-only sample. (The full set of coefficient estimates for these models is available upon request.) In results not shown, we did not find differences in our statistical analyses between the OLS models using all children (including those without siblings) and the OLS models using siblings only. We also ran our models without adult neighborhood, SNAP and poverty measures, and found similar results to what we present here.

While the interaction coefficients for childhood time receiving SNAP and neighborhood advantage during ages 9–13 and 14–18 were positively but not significantly related to adult obesity in the OLS models, the coefficients increased in size and were statistically significant at the .05 and .01 levels, respectively, in the FE models. These interactions indicate that the longer someone receives SNAP in more advantaged neighborhoods during these childhood age periods, the more time they will spend obese as an adult relative to those who grow up with low incomes without SNAP participation. Conversely, the more time children receive SNAP while living in a less advantaged neighborhood, the less time they will spend obese as an adult relative to those who grow up with low income without SNAP receipt. This suggests that SNAP participation helps those who grow up in disadvantaged neighborhoods—settings wherein most who receive SNAP for extended periods of time tend to live. In fact, in results not shown, we found that, of the group of people
Table 2. Mean Values for Proportion of Adult Time Obese, Childhood Time in Public Assistance and Income Categories, and Neighborhood Poverty Rate, for All and by Age

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Ages 0-4</th>
<th>Ages 5-8</th>
<th>Ages 9-13</th>
<th>Ages 14-18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prop. adult time obese weight</td>
<td>.21 (.43)</td>
<td>.20 (.42)</td>
<td>.21 (.42)</td>
<td>.21 (.43)</td>
<td>.21 (.43)</td>
</tr>
<tr>
<td>Prop. of time of time on SNAP</td>
<td>.07 (.19)</td>
<td>.08 (.24)</td>
<td>.08 (.25)</td>
<td>.07 (.25)</td>
<td>.06 (.24)</td>
</tr>
<tr>
<td>Prop. of time on both SNAP/TANF</td>
<td>.05 (.20)</td>
<td>.06 (.24)</td>
<td>.06 (.25)</td>
<td>.05 (.24)</td>
<td>.04 (.22)</td>
</tr>
<tr>
<td>Prop. of time w/income&gt;200% of the FPL</td>
<td>.59 (.40)</td>
<td>.59 (.44)</td>
<td>.59 (.45)</td>
<td>.58 (.45)</td>
<td>.60 (.45)</td>
</tr>
<tr>
<td>Prop. of time 150%&lt;w/income&lt;=200% of the FPL</td>
<td>.12 (.16)</td>
<td>.12 (.22)</td>
<td>.12 (.23)</td>
<td>.13 (.23)</td>
<td>.12 (.22)</td>
</tr>
<tr>
<td>Prop. of time w/income=&lt;150% of the FPL</td>
<td>.15 (.24)</td>
<td>.13 (.27)</td>
<td>.14 (.22)</td>
<td>.16 (.24)</td>
<td>.16 (.31)</td>
</tr>
</tbody>
</table>

N = 4,577, 2,646, 3,239, 4,053, 4,423

Note: FPL=Federal Poverty Line; SNAP=Supplemental Nutritional Assistance Program; TANF=Temporary Assistance for Needy Families.
Note: Those in the categories of income above 200% of the FPL, between 150% and 200% of the FPL, and income greater than 200% of the FPL, do not have any SNAP or TANF income.
Table 3. OLS and FE Models for the Proportion of Time Obese for Adults, from Childhood and Adulthood Characteristics, by Age (Siblings Only)

<table>
<thead>
<tr>
<th>Childhood Characteristics</th>
<th>Ages 0-4</th>
<th>Ages 5-8</th>
<th>Ages 9-13</th>
<th>Ages 14-18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS Model</td>
<td>FE Model</td>
<td>OLS Model</td>
<td>FE Model</td>
</tr>
<tr>
<td>NBHD Advantage*SNAP</td>
<td>-.03 (.04)</td>
<td>-.08 (.09)</td>
<td>-.03 (.04)</td>
<td>-.05 (.05)</td>
</tr>
<tr>
<td></td>
<td>.04 (.04)</td>
<td>.12 (.05)*</td>
<td>.03 (.03)</td>
<td>.13 (.05)**</td>
</tr>
<tr>
<td>NBHD Advantage</td>
<td>.02 (.02)</td>
<td>-.00 (.03)</td>
<td>-.00 (.03)</td>
<td>-.01 (.05)</td>
</tr>
<tr>
<td>% of time on SNAP only</td>
<td>.06 (.16)</td>
<td>.08 (.12)</td>
<td>.06 (.06)</td>
<td>.05 (.07)</td>
</tr>
<tr>
<td></td>
<td>.01 (.04)</td>
<td>.08 (.07)</td>
<td>.01 (.02)</td>
<td>.01 (.02)</td>
</tr>
<tr>
<td>Adjusted R2/within R2</td>
<td>.09</td>
<td>.06</td>
<td>.07</td>
<td>.04</td>
</tr>
<tr>
<td># of families</td>
<td>1,111</td>
<td>1,111</td>
<td>1,324</td>
<td>1,324</td>
</tr>
<tr>
<td></td>
<td>1,589</td>
<td>1,589</td>
<td>1,713</td>
<td>1,713</td>
</tr>
<tr>
<td>N</td>
<td>2,646</td>
<td>2,646</td>
<td>3,239</td>
<td>3,239</td>
</tr>
<tr>
<td></td>
<td>4,053</td>
<td>4,053</td>
<td>4,423</td>
<td>4,423</td>
</tr>
</tbody>
</table>

Note: models include all child and adult control variables. Models are for those with siblings. +p<.10; *p<.05; **p<.01; ***p<.001
Note: OLS=ordinary least squares regression. FE=fixed effects.
Note: SNAP=Supplemental Nutrition Assistance Program.
spending at least 25% of their childhoods receiving SNAP, 36% lived in neighborhoods that are at least 1 SD below the overall neighborhood mean, and 10% in neighborhoods that are at least 2 SDs below the overall neighborhood mean (i.e., in less advantaged areas). Less than 1% of this group lived in neighborhoods that are 1 SD above the overall neighborhood mean (i.e., in more advantaged areas).

In the models for SNAP participation at child ages 0-4 and 5-8, we found no statistically significant relationships between any of the primary coefficients and adult time spent obese. Regardless of neighborhood advantage index score, SNAP participation during childhood years 0-4 and 5-8 had no relationship with the proportion of time individuals spent obese in adulthood.

As noted above, all models controlled for adult SNAP use and adult neighborhood advantage. Neither the proportion of adult time spent with SNAP, nor the adult neighborhood advantage index score, nor the interaction between the two were significantly associated with proportion of adult time spent obese in any of our models.

Using the FE model coefficient estimates for the 9–13 and 14–18 year-old models (where the interaction between SNAP use and neighborhood advantage was significantly related to adult obesity), we predicted time spent obese as an adult at different levels of childhood SNAP use (25%, 50%, and 0%), different levels of childhood time spent with low income without SNAP or TANF use (75%, 50%, and 100%), and for different types of neighborhood conditions (1 SD above and below the mean neighborhood). These results are shown in Figure 1. For those who, from ages 9–13, received SNAP for 25% of the period and lived in a relatively disadvantaged neighborhood (1 SD below the mean), our models predicted that they would spend around 4% of their adulthood obese. For those who, from ages 14–18, received SNAP for 25% of the period and lived in a relatively disadvantaged neighborhood, our models predicted that they would spend around 5% of their adulthood obese. These predicted adult times spent obese go up by a small amount—to 5% and 7%, respectively—when we increase the childhood time spent on SNAP to 50%, keeping all other conditions the same. These predictions are notably lower than those for individuals who, at ages 9–13 and 14–18, had low income with neither SNAP nor TANF benefits and lived in a relatively disadvantaged
neighborhood (with predictions of adult time spent obese at 15% and 17%, respectively). When we estimate results for those who received SNAP for 25% or 50% of their childhood time and lived in areas one SD above the mean for neighborhood advantage during childhood, predicted adult time spent obese rises to 27% and 31% for those aged 9–13 and 14–18, respectively. For those who spent all of the 9–13 and 14–18 period with low income and neither SNAP nor TANF benefits, and who lived in areas one SD above the mean for their childhood neighborhood, we predict that they will spend 14% and 15% of their adult time obese, respectively.

When we ran the individual neighborhood conditions, both in childhood and adulthood, in separate models (an approach taken to account for the high collinearity among the neighborhood variables), and interacted them with the time on SNAP variable, we found similar results to those shown in Table 3.

Figure 1. Proportion of Adult Time Obese, by Childhood Neighborhood Advantage, Time on SNAP, and Income

Note: Predictions are derived from the fixed effects coefficient estimates for both childhood and adult variables in Table 3. Neighborhood values above the mean are more advantaged neighborhoods while neighborhood values below the mean are more disadvantaged neighborhoods. SNAP=Supplemental Nutritional Assistance Program, LI=Low Income (Income<=150% of the federal poverty line without SNAP or TANF income).
Most of the interactions of the childhood neighborhood variables and the time on SNAP variable were statistically significant for the 9–13 and 14–18 year old models, while none of these interactions were statistically significant in the models for the younger children. These significant interactions included neighborhood poverty rate, unemployment, and income over $60,000 for both older age groups, public assistance receipt for the 9–13 year old age group, and female-headed families and percent Black for the 14–18 year old age group.

**Discussion and Conclusion**

Several state governments and the federal government are considering ways to reduce eligibility for SNAP or limit SNAP-eligible foods (Dewey, 2017), with references to limiting obesity as one justification for such changes. However, the evidence that SNAP is positively associated with obesity is mixed.

This study poses the question of whether SNAP participation and neighborhood conditions during childhood are associated with weight during adulthood. In our descriptive statistics, we found those who used SNAP for relatively long periods of childhood time spent a longer time obese in adulthood relative to those who had low income but did not receive SNAP or TANF assistance (see Table 1). However, in the FE models, where we were able to control for both observable and unobservable factors, we found no relationships between SNAP participation during ages 0–4 and 5–8 and adult obesity. Moreover, we found positive and statistically significant relationships for the interaction of time receiving SNAP benefits during ages 9–13 and 14–18 and neighborhood advantage, and time spent obese in adulthood. These results indicate that the longer adolescents living in disadvantaged neighborhoods participated in SNAP, the less time they spent obese as an adult, relative to adolescents living in similarly disadvantaged neighborhoods who are income eligible but do not receive SNAP benefits, as well as relative to similar SNAP participants living in more advantaged neighborhoods.

As we have highlighted, the great majority of those receiving SNAP benefits for extended periods of time live in disadvantaged neighborhoods. These results showing the inverse relationship between SNAP and BMI/obesity align with those from Almada and Tchernis (2018) and Nguyen et al. (2015).
As previous research has noted, there may be a few factors that account for these findings. Food deserts and food swamps are prevalent within disadvantaged, low-income communities and have been linked to the development of increased BMI scores amongst those who reside in these areas (Jennings et al., 2011; Liu et al., 2012). SNAP may moderate or prevent this outcome for people residing in disadvantaged areas in three ways. First, additional SNAP income may be used by families to purchase the more expensive, healthier food items that may be found in smaller neighborhood grocery and convenience stores more prevalent within disadvantaged communities. Second, SNAP income may free up other cash income to be used to travel to larger grocery stores where fresh whole foods are more abundant. Third, if, as Dhurandhar (2016) suggested, food insecurity can lead to overconsumption in the face of threatened scarcity, SNAP may reduce BMI and obesity risk via reductions in food insecurity (Casey et al., 2006; Dinour et al., 2007). Each of these mechanisms may explain how SNAP influences family patterns of food purchasing and consumption to establish health-promoting purchasing and eating habits—which contribute to weight maintenance—to carry through into adulthood. SNAP benefit receipt may allow families to engage in healthful food purchasing habits that are then maintained by children as they transition into adulthood and begin to purchase and prepare their own food (Anderson & Butcher, 2016; D’Angelo et al., 2011; Laska et al., 2010).

Shannon (2014) found that in suburban, more economically robust areas, SNAP benefits tend to be spent at grocery stores with an abundance of fresh foods at higher rates relative to less economically robust areas. As previously discussed, researchers have observed that, in economically disadvantaged areas meeting food desert criteria where healthful food choices are few, inflexible SNAP income is subsequently spent on the available low-nutrient and energy-dense foods. These findings point to the importance of funding low-income families sufficiently to enable them to buy healthier foods, and ultimately to avoid adverse long-run health outcomes.

Our results indicate that increasing SNAP funding for low-income families with children is likely to improve the long-run health outcomes of those children. One way to limit the nearly 50% of adults predicted to be obese by 2030 (Ward et al., 2019) is
by providing more funding for low-income families to buy the types of nutrient-rich food for children that will make them less likely to be obese as adults (Carlson, 2019). Given that roughly half of all SNAP households are still food insecure (Carlson, 2019), and that 80% of SNAP funds are spent within 14 days of receiving these funds (Center on Budget and Policy Priorities, 2019), increasing SNAP funding would increase the ability of families to afford nutrient-rich foods on a consistent basis. SNAP funds would need to be raised substantially—by roughly 70%—so that SNAP funds can last through an entire month. Such a change has the potential to help not only low-income, SNAP-eligible families but also those living in neighborhoods with high proportions of low-income residents, as household income no longer needed for food purchasing can be reallocated towards quality housing, necessary health care (including medication adherence), and other necessities (Carlson & Keith-Jennings, 2018; Pooler & Srinivasan, 2018). The potential multiplier effects of increased SNAP funding—estimated to be $2 for every additional dollar of SNAP funding—would help communities expand their economic base, which may improve employment possibilities within poor areas (Canning & Stacy, 2019).

Expanding SNAP funding during the summer, when children no longer have access to free or reduced-price school breakfast and lunch programs, can help families to avoid food insecurity during these months. While the USDA has summer food programs for school-aged children, these sites are less often used than on-site school programs, with roughly 22 million children getting free or reduced-price meals during the school year versus 3.76 million during the summer (Feeding America, n.d.). SNAP and child nutrition program expansions, such as those enacted in response to the global novel coronavirus health pandemic (USDA-FNS, 2020b), have the potential to close the gap between school year and summer food access for families with children.

In 2019, the USDA initiated a pilot program in New York City that allowed SNAP recipients to buy food online (Cohen, 2019). This program expands SNAP recipients’ access to food sources, hopefully reducing the prices they pay for healthful, nutrient-rich foods. Expansion of this program would be especially helpful for those living in the most disadvantaged neighborhoods, where large grocery stores, which often have
the lowest food prices, tend to be less prevalent (Larson et al., 2009; Powell et al., 2007). For SNAP recipients who do not have access to a private vehicle, and therefore have difficulty traveling to large grocery stores, this type of program can provide the type of assistance necessary to purchase healthful foods. Even if some without private vehicles can get to large grocery stores by using public transportation, hauling back the food when buying in bulk (which can be the least expensive way to buy food) can be difficult and time consuming. Programs like the pilot adopted in New York City, along with policies that subsidize the purchasing of healthful foods for SNAP families could dramatically improve the consumption of nutrient-rich foods for those who can currently least afford and access them.

While researchers have generally examined low-income households, often SNAP households, where the income limit for receiving SNAP is 130% of the federal poverty line, little research has examined households with slightly higher incomes and their ability to buy healthful, nutrient-rich foods. Future research should examine whether those that have incomes well beyond the current income limit lines are able to afford such foods and whether raising the SNAP income maximum will improve the quality of food purchases for those in these slightly higher income groups.

Overall, our study indicates that, for the vast majority of children in households receiving SNAP, those in disadvantaged neighborhoods, childhood SNAP use has no negative association with obesity in adulthood and may, in fact, serve as protection against obesity.
References


