Revisiting the SNAP cycle of food intake:
Investigating Heterogeneity and Diet Quality

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Abstract

 Previous research, using data from 1989-91, found that Supplemental Nutrition Assistance Program (SNAP) recipients experienced a decline in caloric intake at the end of the benefit month. This study uses data from the 2007-10 National Health and Nutrition Examination Survey (NHANES) to revisit the question of cyclic dietary intake and quality. Identification of the effect of time since benefits were received is achieved by exploiting the across and within-state variation in distribution of SNAP benefit each month, as well as exogenous variation in NHANES interview dates. Adults and children are considered separately to test for heterogeneity in the relationship between time since benefits were received and food intake. Other subgroups are also examined.

Keywords: SNAP, diet quality, nutrition cycle, NHANES, food stamps

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Introduction

Many recent news articles have discussed the role of the Supplemental Nutrition Assistance Program (SNAP)[1] in the retail grocery market and the increasing importance to consumers' food budgets. Midnight lines at the end of the month and all-day rushes on the first of the month have been described in Woonsocket, Rhode Island (Saslow, 2013), North Bergen, New Jersey (Farzad, 2011), Idaho (Hopper, 2011), and Virginia (Kennedy, 2012). These anecdotes highlight two issues related to the SNAP benefit distribution schedule. The first is that beneficiary households may not have sufficient resources for food each month, or have difficulty managing their resources to smooth consumption over the month. The second is that food retailers may face difficulty responding to the SNAP-related peak in demand at grocery stores and other food outlets. This supply side issue affects not only SNAP beneficiaries, but also non-SNAP households that live in areas where these conditions occur.

While these issues are likely not new in recent years, they are most likely exacerbated by the increase in unemployment and poverty, and the corresponding rise in SNAP participation. During the first half of the 2000's, the poverty rate hung at about 12 percent, but between 2006 and 2011, it increased from 12.3 percent (36.5 million people) to 15 percent (46.2 million people) in 2011 (U.S. Census Bureau, 2013). Participation in SNAP has increased similarly. In 2006, the monthly SNAP roster averaged 26.5 million people, receiving about $95 each per month, for a total benefit outlay of $30.2 billion, while in 2012, SNAP delivered nearly $74.6 billion in benefits—an average of $133 dollars per month to approximately 46.6 million people (FNS, 2013a) The American Recovery and Reinvestment Act increased the maximum SNAP benefit by 13.6 percent, but the remainder of the 40 percent rise in average per capita benefit is most likely due to falling incomes among participants. The result of rising poverty and higher

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[1] The SNAP program was previously called the Food Stamp Program, but was renamed in 2008.

SNAP participation is that in 2012, five states had more than 20 percent of the population receiving SNAP, and in some localities the percentage was even greater (Saslow, 2013).

In states where all SNAP recipients receive their benefits on the same day each month, retailers have reported difficulties in maintaining constant stocks of perishable and high quality foods, particularly in areas with a large proportion of the population receiving SNAP (Kennedy, 2012; Associated Press, 2006). This SNAP-related surge in demand at grocery stores is also documented in SNAP redemption records. In fiscal year 2009, SNAP households redeemed about 20 percent of their monthly benefit amount on the first day that benefits were received. By day seven, the average household had redeemed 60 percent of their monthly benefit, and at the end of two weeks, 80 percent (USDA/FNS, 2011). This cyclic demand is not unique to SNAP, as other research has documented an increase in spending following the receipt of Social Security checks and paychecks (Stephens, 2003; 2006), and increased hospitalization and mortality following receipt of cash assistance and other income (Dobkin and Puller, 2007; Evans and Moore, 2011) which is likely linked to surges in economic activity.

In an attempt to minimize the effects of SNAP-related demand surges and troughs, the grocery industry lobbied to have SNAP households receive half of their benefit early and the other half later in the month (Associated Press, 2006). However, the 2008 Farm Bill expressly prohibited splitting a household's SNAP benefit over the course of the month. Most hypothesize that this prohibition was intended to insure that beneficiaries were able to minimize the cost of shopping over the month and to take advantage of bulk discounts.

Another way that the demand cycle can be minimized is for benefit distribution to be staggered, with only a portion of the beneficiary roster receiving their benefits on any given day. Most states employ some sort of stagger, and the number that do and the period over which

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benefits are distributed, has been increasing in recent years. Staggering may help smooth aggregate demand at grocery stores and help food retailers provide a more consistent stock of high quality perishable food, but it is not likely to eliminate the cycle of food stocks within SNAP households caused by too few resources or poor resource management.

A lack of sufficient resources for food—or the inability to manage food resources to ensure sufficient food availability throughout the month—may lead to periodic food insecurity or even limited intake at the end of the month. Two previous studies, using data on daily individual dietary intake from 1989-91, observed small declines in caloric intake among SNAP recipients at the end of the benefit month (Wilde and Ranney, 2000; Shapiro, 2005). Such periods of food scarcity are of concern not only because of the physical and emotional hardship experienced at the time of the shortage, but also because of the potential for longer term impacts. Short periods of deprivation may lead to binge eating upon receipt of SNAP benefits at the beginning of the benefit month. Such cyclic intake may cause weight gain and perhaps have other adverse effects, beyond the discomfort and stress associated with lower intake and food insecurity (see Townsend et al., 2001).

Given the increasing importance of SNAP, in low-income households and in many local economies, as well as the continued rise in overweight, obesity, and poor nutritional status among Americans, I reexamine whether individual food intake follows the SNAP distribution schedule. I first describe the economic and cognitive/behavioral factors that could lead to cyclic food intake and provide a brief overview of the SNAP program and how it has changed in recent years. The 2007-10 National Health and Nutrition Examination Survey (NHANES) data are described next, along with my identification strategy. I expand on previous studies by examining other measures of intake, including the share of calories from fat and saturated fat, total fiber and

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sodium intake, and the share of calories from food away from home (FAFH), schools, and other food assistance, such as food pantries. In addition, I consider various subgroups separately such as adults and children, adult men and women, and by the household's usual shopping frequency. Children, who have access to school meals and are often protected from food insecurity by their parents, may experience less cyclic intake than adults. Moreover, parents may prioritize the quality of children's food intake over their own, which may lead to even greater cyclicity in diet quality among adults as compared to children. There may also be differences in intrahousehold allocation of food across gender in times of shortage.

Conceptual framework and related literature

Mainstream economic theory assumes that consumers are rational and have perfect information and access to credit. When managing resources over time, this means that consumers will account for future needs when deciding on what to consume today, and will incorporate future expected income into their budget constraint along with the interest rate for borrowing against that income. An individual's discount rate measures the value that they place on future consumption and correspondingly, how much they are willing to forgo current consumption to bolster future consumption. Mainstream economic theory assumes that discount rates are constant over time and over various time-horizons (e.g. today versus next week as compared to next year, or next year versus ten years from now). This means that consumption will track average lifetime (permanent) income because individuals will borrow against future higher income during the early part of their working years, will save when income is highest, and will draw down that savings in old age. In short, this Life-Cycle/Permanent Income Hypothesis states that in general, consumption will be unrelated to when expected income is actually received

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(Friedman, 1957; Hall, 1978). Empirical evidence indicates however, that, in many cases individuals fail to smooth consumption over the lifetime, and even over shorter periods of time. Credit market failures and unexpected events can help explain the lack of smoothing over the lifetime (Zeldes, 1989), but evidence of cyclic consumption over shorter periods, such as over a month, can be more difficult to explain using traditional economic theory with perfectly rational consumers.

A number of different studies have found evidence that some individuals are present-biased (quasi- or hyperbolic discounters), where they discount tomorrow's consumption more than they would discount two different days much further in the future. Recent evidence suggests that these present-biased individuals do not smooth consumption over short time horizons and also, not surprisingly, have little savings or wealth. For example, Hurst (2003) finds that households whose food expenditures are sensitive to when expected income is received (expenditures spike just after receiving expected income) reach retirement with little savings. Taking the opposite approach, Mastrobouni and Weinberg (2009) confirm that Social Security (SS) recipients with no more than $5000 in savings in retirement ("nonsavers") see dramatic declines in food intake at the end of the month. Mastrobouni and Weinberg focus their analysis on recipients for whom SS makes up at least 80 percent of total income, but also find a decline at the end of the month among nonsavers for which SS makes up 60 percent or more of total income. Thus, it appears that having low income from few sources is not the critical issue in smoothing consumption, but instead it is the present-biased nature of these individuals. Along the same lines, Aguiar and Hurst (2005) find that consumption patterns among those with little wealth are least like the Permanent Income Hypothesis would predict. These findings suggest that a SNAP cycle in food intake would most likely occur in present-biased households.

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However, the fact that food intake cycles with income receipt, and cycles repeatedly, is most curious given that individuals and households solve the food budgeting constraint problem repeatedly.

The two previous studies that looked specifically at food intake and receipt of SNAP benefits (Wilde and Ranney, 2000; Shapiro, 2005) both used intake data from the 1989-91 Continuing Survey of Food Intake by Individuals (CSFII), but employed different approaches to understand the evolution of food intake over the benefit month.[2] Wilde and Ranney found that mean caloric intake, relative the Recommended Daily Allowance (RDA), was lower in the fourth week after SNAP was received, but only among the 43.3 percent of individuals that conducted major grocery shopping once per month or less often. For all other individuals, intake did not vary over the course of the benefit month. They then estimate an endogenous switching model to estimate the joint decision of how frequently to shop and how much to eat, finding that once the shopping frequency decision is accounted for, there is no decline in caloric intake at the end of the month. These findings suggest that the effect of time since SNAP benefits were received on food intake is mainly due to the shopping frequency decision, which may be influenced by the negative stigma experienced when participants redeemed their SNAP paper coupons. In an effort to minimize the stigma associated with the program, some participants may choose to shop only once per month, even though this reduces their ability to smooth food intake over the course of the month. This suggests that the replacement of paper coupons with Electronic Benefit Transfer (EBT) cards (explained in more detail below), a smaller share of participants will shop only once

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[2] SNAP was actually the Food Stamp Program at the time that the 1989-91 data were collected and these papers were published, but I use the current name of the program when reviewing their studies for clarity in the text.

per month[3], which would reduce the share of the benefit population that might experience cyclic intake.

Shapiro (2005) used the same 1989-91 CSFII data and regressed the log (and the level) of daily caloric intake on the days since SNAP benefits were received. Unlike Wilde and Ranney, he did not convert daily intake to the share of the RDA. He found that each day, caloric intake declined between 0.32 to 0.4 percent per day after benefits were received. He also estimated the model separately for four different shopping frequencies: more than once a week; once per week; biweekly; and monthly or less often. In contrast to Wilde and Ranney, he found that the decline in caloric intake was only significant for the more frequent shoppers (once a week or more often) and not for the biweekly and monthly shoppers. Shapiro also used data from the 1992-93 evaluation of the Maryland EBT expansion, which asked respondents about their willingness to accept a lesser amount of money now as compared to a higher amount in the near future. He finds that respondents that are further away from having received their SNAP benefit, are more likely to report being willing to accept the lesser amount, which indicates that the marginal utility of money is greater the later in the SNAP month the individual is. Although not conclusive, paired with the findings about greater cyclicity among frequent food shoppers and other findings, he argues that the results are consistent with the idea that the SNAP cycle of intake is attributable to preferences for current over future consumption.

The evolution from the Food Stamp Program to SNAP – more than just a name change

SNAP began as the Food Stamp Program in 1964,[4] but even before its name change in 2008, the program experienced many changes to its design and administration. Many of these

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[3] Monthly shopping would not be expected to completely disappear because other costs associated with grocery shopping (such as transportation and time costs) may also limit the number of trips each month.

factors influence who participates in the program. Correspondingly, estimates of how the program affects consumer decisions are likely to be affected by these design features through their effect on the participant population. Wilde and Ranney (2000) and Shapiro (2005) relied on data from 1989-91 to study the SNAP food intake cycle, which is now more than 20 years (or a generation) ago. Thus, it makes sense to revisit whether SNAP participants experience cyclic dietary intake over the benefit month. While a complete review of all the program design changes is beyond the scope of this paper, I offer a brief summary of some key changes that are likely to be related to cyclic dietary intake. Unless otherwise noted, the information was obtained from the Food and Nutrition Service (FNS, 2013b).

Prior to 1988, all SNAP benefits were issued in the form of paper coupons.[5] Program participants could easily be identified when redeeming their benefits as anyone could see them using the coupons, rather than cash or other forms of payment. Benefit delivery through EBT cards was expected to improve program efficiency, but also to reduce stigma for participants, as using an EBT card looks no different than using a credit or debit card at retail stores. The transition to EBT cards began with 1988 legislation that established pilot programs to test this method to deliver benefits, and the 1996 Personal Responsibility and Work Opportunity Reconciliation Act (also known as welfare reform) mandated that all states convert to EBT to deliver benefits by 2002.[6] Klerman and Danielson (2011) find that the transition to EBT cards, which occurred up through 2005 (ERS, 2013), increased the caseload, suggesting that stigma is an important factor reducing participation.

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[4] The FSP became a permanent program in 1964, but a pilot program operated during 1961-64 and an earlier form of the program operated during 1939-43 (FNS, 2013b).

[5] Originally, participants had to purchase the food stamps, for less than their face value, but the Food Stamp Act of 1977 eliminated this requirement, noting the requirement limited participation (FNS, 2013b).

[6] Despite this requirement, it wasn't until 2005 when all 50 States and the District of Columbia delivered 100% of program benefits through EBT cards (SNAP policy database).

Currently, eligibility in the SNAP program is determined by a gross income test (monthly less than 130% of the poverty line), a net income test (monthly income after deductions less than 100% of the poverty line), and an asset test (less than $2000, $3250 if someone in the household age 60 or older). These eligibility criteria have also changed over time, with some changes aiming to restrict access to the program by reducing the number of eligible households and other changes aiming to increase access. The 1977 Food Stamp Bill raised the asset limit, which increased the number of eligible households, but legislation in 1981 and 1982 made retirement accounts countable assets, which reduced eligibility. In the late 1980s Earned Income Tax Credits were excluded from countable income, the asset limit was increased further, and benefit levels were increased. The 2008 Farm Bill expanded eligibility further by indexing asset limits to inflation and excluding many forms of income and assets from countable resources (such as combat pay and retirement and education savings accounts).

The restrictions on eligibility through the gross income and asset tests were further reduced as some states began to use broad-based categorical eligibility starting in 2000. An individual is categorically eligible for SNAP if they have already been determined to be eligible for and/or received other means-tested assistance programs, such as Supplemental Security Income (SSI), Temporary Assistance for Needy Families (TANF), or other state-run General Assistance programs (Falk and Aussenberg, 2012). Thus, if the other program did not have an asset test, the applicant does not need to pass an asset test for SNAP, but still must meet income limits to be eligible for the program. The provision takes a very broad definition of benefits, which can include receiving very small or low-cost benefits through the TANF program, including a program information brochure. Prior to 2009, 16 states (covering 35 percent of the

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U.S. population) eliminated the asset test for eligibility this way.[7] By 2010, nearly 40 states were using categorical eligibility to eliminate the asset test for determining a household's eligibility for SNAP, reinforcing the 2008 Farm Bill exclusion of retirement accounts from the asset test. Thus, between 2007 and 2010, national program rules, and State-level policies broadened the pool of potential SNAP recipients nearly universally to include individuals with low current income, but that have retirement accounts or other savings above the standard limits. Klerman and Danielson (2011) found that between 1996 and 2009, the use of broad-based categorical eligibility increased the SNAP caseload by about 6 percent on average, and specifically among all types of SNAP recipients, except those that also receive cash assistance through the Temporary Assistance for Needy Families.

The widespread elimination of the asset test through expanded categorical eligibility and removing most retirement and education savings accounts from countable assets that occurred after 2008 may have allowed many households that suffered job loss or reduced income during the recession of 2007-2009 to receive SNAP benefits before having to deplete all or most of their savings (if they had any to begin with). Paired with the increased benefit level that began in April 2009 through the 2009 American Recovery and Reinvestment Act, one would expect SNAP participants observed in 2009-10 to be different, on average from the SNAP participants observed in 2007-08. Specifically, they would have higher average household income and might have a higher average level of savings. If greater savings is an indicator of being less present-biased, then SNAP recipients in 2009-10 may also be more likely to have other characteristics indicating that they are forward thinking, such as having completed high school or more education.

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[7] The states that eliminated the asset test through the use of categorical eligibility prior to 2009 were: Arizona, Delaware, Georgia, Maine, Maryland, Massachusetts, Michigan, New York, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, Washington, West Virginia, and Wisconsin (SNAP policy database CITE).

Data and identification

The National Health and Nutrition Examination Survey (NHANES) is a continuous survey that collects detailed information about individual dietary intake, as well as many other individual and household characteristics. The data are collected through a number of different instruments: a household survey, a physical exam and questionnaires in a Mobile Examination Center (MEC), and various follow-up questionnaires. Generally, the household interview is conducted first, followed by the MEC exam and questionnaires, and the follow-up surveys are conducted after that. The time between each of these components varies. I use data from the 2007-08 and 2009-10 rounds because they provide the information about when SNAP was last received, which is critical for this research.

One day of dietary intake is collected via a recall survey at the time of the physical exam in the MEC. A second day of dietary intake is collected through a follow-up phone survey, usually within 10 days of the MEC exam. Individuals report the type and amount of food consumed, at what time it was consumed, and from where each food was obtained, for the previous day. The public release data include the total quantity (in grams), caloric value, as well as the quantity of fat, protein, carbohydrates and other nutrients in each food consumed, as well as totals for the day. In the 2007-10 data, the time between the household interview and each dietary intake day is provided in the public use dietary intake data.

SNAP participation is collected at the time of the household interview. Before 2007, the information included whether or not a household receives SNAP, both currently and in the previous 12 months. Beginning in 2007, the Flexible Consumer Behavior Survey, funded by the

Economic Research Service, also asked households how many days had passed since they last received SNAP benefits.[8]

Sample

I restrict the sample to current SNAP recipients—defined as those that report having received SNAP within 31 days of the household interview—who report the first day of dietary intake. Furthermore, I exclude children under age two and women that are pregnant or lactating, as well as those with incomplete data on household income, body size or activity level. The final sample consists of 3,063 individuals (1,486 adults age 20 and up, and 1,577 children under age 20).

Weighted sample means of individual and household-level characteristics are reported in table 1, for adults and children separately, as well as for each of the two NHANES rounds for each group. About half of the children are male, while only about 41 percent of adults are men. A larger share of the adults than children are non-Hispanic White (47 versus 37 percent among children) and a smaller share are Hispanic (23 versus 30 percent). Not surprisingly, adults are more likely to report being on a special diet than are children (14 percent versus 4) and have greater body weight and height. Adults report about 91 minutes more per day of moderate-intensity activity than do children. Since total activity level include both recreational and work-related activity, some of the difference between adults and children is likely due to additional activity at work for adults. Adults also live in smaller households on average than do children (3.75 members versus 4.69), and have higher average household income relative to the poverty line (104% of the poverty line versus 86%). The sources of household income in the previous calendar year are also different between adults and children. Children are more likely to live in

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[8] These data were released with the food security module data.

households that earned some wage income and/or received cash assistance and benefits from WIC in the past year, while a larger share of adults live in households that had some income from Social Security, the Supplemental Security Income (SSI) program, or from pensions. There are also differences in grocery shopping frequency between children and adults. About 47 percent of the children live in households that conduct major grocery shopping weekly or more often, while only 42 percent of adults do. Correspondingly, only 23 percent of children live in households that conduct major grocery shopping once per month or less often, while 31 percent of adults live in such households. For both groups, this share is well below the 42 percent of monthly shoppers reported by Wilde and Ranney (2000). While I don't have enough information to attribute the difference in shopping frequency to the transition to EBT, it is clear that current SNAP recipients are more likely to shop for food more than once per month than recipients in 1989-91.

[table 1 here]

Given the changes in SNAP rules affecting eligibility and the prolonged high unemployment in existence during 2009-10, I also compare the means among children and adults across the two survey rounds. There are fewer significant differences between 2007-08 and 2009-10 for both adults and children than there are between adults and children overall. Recall that for both periods, the sample only includes individuals in households that currently receive SNAP at the time of the household interview. Among adults, 48 percent report being married in 2009-10, while only 40 percent were married in 2007-08. The share of adults that have less than a high school degree (or GED) was lower in 2009-10 as compared to 2007-08 (42 percent versus 50 percent). Although not statistically significant, average household income relative to the poverty line was higher in 2009-10 as compared to 2007-08 (110% versus 97% among adults)

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and a larger share of adults in 2009-10 live in households that received wage income in the previous calendar year, and a smaller share in households that received SS, SSI, or cash assistance. These changes are consistent with the expanded eligibility to SNAP that occurred in recent years due to the removal of retirement and education savings accounts from countable assets, the increase in the benefit level that would make households with income near the eligibility cut off eligible for a larger benefit, and the general economic decline affecting working households. One other significant difference across the two survey rounds is that for both adults and children, a smaller share report being on a special diet in 2009-10 as compared to 2007-08.

Dependent variables

In addition to total daily caloric intake, I also look at the probability that the individual reports consuming less than usual and more than usual on the intake day. Aspects of diet quality examined are the share of calories from sugar-sweetened beverages (SSBs), fat and saturated fat, and total milligrams of sodium consumed and grams of fiber. Besides changes in total calories and the overall quality of daily intake, the source of an individual's daily intake may evolve over the month. SNAP households tend to redeem the majority of their benefits in the first half of the month. Thus, later in the month they are more likely to be using cash, which can be spent without restriction. Unconstrained by SNAP rules, individuals may choose to consume more of their food from restaurants or other away-from-home sources. Alternatively, if both cash and food are more limited in the household later in the month, individuals may rely more heavily on other sources, such as food banks, other assistance programs, friends, and other free sources of food. Thus, I include the percent of calories from food away from home (FAFH, restaurants and

similar outlets), from grocery stores and similar outlets, from school cafeterias and daycare facilities, and other sources (such as food pantries, other assistance programs, gifts from friends and family, or food obtained from hunting and fishing or grown in a home garden) as dependent variables.

Table 2 summarizes these variables for the first day of intake for adults and children separately. Children report consuming about 1,900 calories on the intake day, while adults consume about 100 calories more. Underreporting of intake is known to occur in the dietary recall data in NHANES (Briefel et al., 1997), so it is not surprising to see average intake below 2,000 calories among adults. An equal share of children and adults—about 7 to 8 percent—report consuming more than usual on the intake day. About twice as many children (17 percent) report consuming less than usual, while more than three times as many adults (27 percent) report consuming less than usual. The measures of diet quality appear quite similar for adults and children, except for total sodium intake. About 13 percent of calories come from SSBs and one third from total fat (11 percent from saturated fat). Children consume about 13 grams of fiber per day, while adults consume slightly more (14 grams). Adults report consuming 420 more milligrams of sodium than children, but both groups consume more than the recommended 2,300 milligrams per day.

[table 2 here]

Not surprisingly, at 15 percent among children and 19 percent among adults, the share of calories from FAFH is much lower than the national average of 32 percent. SNAP benefits must be redeemed in grocery stores and similar food outlets for food that will be prepared at home. On average, food from grocery stores makes up about 70 percent of children's daily calories and 76

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percent of adult's daily calories. Around 4 to 5 percent of calories come from other sources, and among children, about 11 percent come from schools and day care centers.

Identification

Identifying the effect of time since SNAP benefits were received on dietary intake depends on having exogenous variation in the explanatory variable. In this section, I explain how variation in SNAP distribution schedules both across and within states, paired with variation in interview dates in NHANES allows for identification. Shapiro (2005) and Mastrobouni and Weinberg (2009) employ a similar identification method to study the effect of time since receipt of income or pay on consumption.

SNAP distribution schedules

All SNAP recipients receive their monthly SNAP benefit on one day each month. SNAP program rules allow States to set their own distribution schedule, and some states even permit counties or localities to set their own schedule. Although some states deliver benefits to all program participants on the same day each month, many states have elected to stagger the distribution of benefits to their beneficiary rosters. This entails dividing the roster into groups and distributing benefits to only one group of beneficiaries each day. Common methods to divide the beneficiary roster include the first letter of the household head's last name, the last digit of the head's social security number, or the last digit of the SNAP case number. The result is that distribution schedules vary across states and in many cases, across SNAP recipients within some states. Moreover, distribution schedules have changed over time within states, most notably in recent year.

Table 3 summarizes the SNAP distribution schedules between 1998 and 2012. During 2007-10, only 9 or 10 states (depending on the year) delivered benefits to their entire roster on a single day each month. This is generally on the first of the month, but New Hampshire distributes on the 5th of every month and South Dakota distributes on the 10th (see table A.1. for details on each State for 2007-10). Between seven and eight states stagger distribution over three to five days each month, generally between the 1st and the 5th, but Montana begins on the 2nd of each month and Maine begins on the 10th. Just over half of the states spread distribution over a 7 to 14 day period, and between eight and nine states delivered benefits over 15 days or more each month.[9] Thus, it is clear that even if everyone reported dietary intake for the exact same day each month, the across and within-state variation in benefit delivery would provide some variation in time since benefits were received to identify the effect. Fortunately, there is also variation in interview dates, which is (plausibly) exogenous to SNAP benefit receipt, strengthening my identification approach.

[table 3 here]

NHANES measure of time since SNAP was received

Selection into the NHANES sample is not related to the date on which a household receives SNAP, nor is the day on which the household interview is conducted or the date of the physical exam in the MEC, when the first day dietary intake is collected. The exact date of each of these interviews is not provided in the public data, nor is each individual's SNAP distribution day available. Through the National Center for Health Statistics (NCHS), I obtained the NHANES interview dates and merged the SNAP distribution schedule to each individual's

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[9] Although the intake data do not include 2012, it is interesting to note that the number of states employing a longer stagger increased by nearly 50 percent between 2011 and 2012 (from 9 to 13).

record. Using the date of the household interview and the number of days since SNAP was last received reported in the household interview, I determine each individual's SNAP benefit receipt day. I also verify that the time since SNAP was received appears accurate by cross checking the SNAP receipt day with the known distribution schedule. (MORE ON THIS QUALITY CHECK WHEN CLEARED BY NCHS).

To calculate the time between the dietary intake day and when SNAP was last received for my sample of current SNAP recipients, I calculate the number of days between the SNAP receipt day and the intake day. If this distance is greater than 30 days, I assume that SNAP was received on the same day each month and recalculate the time since SNAP was received. For example, if SNAP was received on March 1st, the household interview was on March 20th, and the dietary intake day was April 6th, the raw time between last SNAP and the dietary intake day would be 35 days. However, if I recalculate, assuming SNAP was also received on April 1st, then the time since SNAP was received would be 5 days.[10] Given that the SNAP delivery date is fixed over time for each household, this is a fairly safe assumption, as long the household continued to be a SNAP recipient in the month when dietary intake was reported. The vast majority of individuals in NHANES that report having received SNAP within the past year also report having received SNAP within 30 days. Furthermore, the time between the household interview and the first day of intake is never more than 76 days (and for 90 percent of the sample is 30 days or less). Thus, the estimate of the time between last SNAP receipt and the first day of dietary intake is not likely to calculated with much error, especially given the accuracy of the SNAP date as noted above (TO BE ADDED WHEN CLEARED BY NCHS).

To confirm the exogeneity of this final measure of time since SNAP was received, I regress it on the set of observable characteristics in table 1 along with indicators for whether the

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[10] NOTE HOW MANY OBSERVATOINS ARE RECALCULATED THIS WAY ONCE CLEARED BY NCHS.

intake day was a Friday, or a weekend day (Saturday or Sunday). RESULTS TO BE SHOWN ONCE CLEARED BY NCHS.

Empirical approach

Given that identification is achieved by the exogenous variation in survey interview dates and variation in SNAP distribution dates, my empirical approach is straightforward. I regress the dependent variable on the number of days since SNAP was received, and add controls for demographic characteristics and indicators for holidays and weekend days, all of which also explain dietary intake, to improve precision. I use OLS for the total daily calories, sodium, and fiber consumed, a probit model for the indicators that the individual ate more and less than usual on the dietary intake day, and fractional response models for the percent of calories from SSBs, fat, saturated fat, and for each food source (grocery stores, FAFH, school/daycare, and other sources).

I also estimate models with a nonlinear specification of time since SNAP was received, replacing the continuous days measure with indicators of weeks since SNAP was received. Consumption may not change gradually over the month, but may instead drop off in the final week of the benefit month.

Models are estimated separately for adults and children, as children have access to different food sources, such as school meals, especially during the school year. I also estimate separate models for men and women who live with children as compared to those who do not. Given that previous research found inconsistent relationships between food shopping frequency and consumption cycles, I also estimate separate models for three shopping regimes: major

grocery shopping once per week or more often; every two weeks (bimonthly); and monthly

major food shopping.

Results

TO BE POSTED ONCE CLEARED BY NCHS

Discussion

TO BE INCLUDED ONCE CLEARED BY NCHS

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Table 1. Demographic characteristics of children and adults, current SNAP recipients, 2007-10 and by survey round.

	Children	Adults	Children		Adults	
Individual-level variables	2007-10	2007-10	2007-08	2009-10	2007-08	2009-10
Age	9.57	41.51***	9.54	9.59	40.92	41.97
	(0.18)	(0.57)	(0.33)	(0.19)	(1.01)	(0.58)
Male	0.49	0.41***	0.50	0.47	0.39	0.43
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(0.01)
White	0.37	0.47***	0.41	0.32	0.48	0.47
	(0.06)	(0.06)	(0.10)	(0.06)	(0.10)	(0.06)
Black	0.28	0.25	0.27	0.29	0.26	0.25
	(0.04)	(0.03)	(0.07)	(0.03)	(0.06)	(0.03)
Hispanic	0.30	0.23***	0.27	0.32	0.22	0.23
	(0.05)	(0.04)	(0.07)	(0.06)	(0.06)	(0.05)
Other race	0.06	0.05	0.05	0.06	0.04	0.06
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)
Married†	0.47	0.44	0.43	0.51	0.40	0.48*
	(0.04)	(0.02)	(0.07)	(0.03)	(0.04)	(0.03)
Less than High School /GED †	0.40	0.46	0.39	0.42	0.50	0.42*
	(0.03)	(0.02)	(0.05)	(0.04)	(0.03)	(0.03)
High School diploma or GED †	0.30	0.28	0.32	0.27	0.28	0.28
	(0.03)	(0.02)	(0.05)	(0.03)	(0.04)	(0.02)
Some college or more †	0.28	0.26	0.25	0.30	0.23	0.29
	(0.02)	(0.02)	(0.04)	(0.03)	(0.03)	(0.03)
On special diet	0.04	0.14***	0.06	0.03*	0.16	0.13*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Weight (kg)	42.46	84.84***	42.26	42.64	85.42	84.40
	(1.13)	(1.06)	(2.05)	(1.11)	(1.49)	(1.47)
Height (cm)	135.70	166.75***	136.03	135.41	166.58	166.89
	(1.02)	(0.39)	(1.83)	(0.98)	(0.76)	(0.39)
Usual minutes of moderate exercise per day‡	49.31	140.26***	55.44	43.78	145.38	136.32
	(5.67)	(7.91)	(10.02)	(6.14)	(13.14)	(9.98)

Household-level variables

Household size	4.69	3.75***	4.61	4.75	3.71	3.78
	(0.07)	(0.10)	(0.10)	(0.09)	(0.14)	(0.14)
Household income relative to poverty line	0.86	1.04***	0.83	0.89	0.97	1.10
	(0.03)	(0.04)	(0.04)	(0.05)	(0.06)	(0.05)
Wage income last calendar year #	0.80	0.65***	0.78	0.81	0.62	0.68
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Social Security in last calendar year #	0.11	0.28***	0.12	0.10	0.31	0.25
	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
Supplemental Security Income in last calendar year #	0.17	0.26***	0.16	0.17	0.28	0.25
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)
Pension income in last calendar year #	0.09	0.14***	0.08	0.10	0.14	0.14
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
Cash Assistance in last calendar year #	0.20	0.17*	0.20	0.20	0.19	0.15
	(0.02)	(0.01)	(0.03)	(0.02)	(0.02)	(0.01)
Received WIC in past 12 months #	0.41	0.27***	0.38	0.43	0.29	0.26
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Major grocery shopping weekly or more frequently	0.47	0.42**	0.51	0.43	0.44	0.41
	(0.03)	(0.03)	(0.05)	(0.04)	(0.04)	(0.04)
Major grocery shopping bi-weekly	0.30	0.27	0.25	0.34*	0.22	0.30**
	(0.03)	(0.02)	(0.04)	(0.03)	(0.02)	(0.02)
Major grocery shopping monthly or less often	0.23	0.31***	0.23	0.23	0.34	0.28
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)
Observations	1,577	1,486	700	877	616	870

Notes: weighted means reported, standard errors (in parentheses) account for complex sampling design. Difference from children (for comparison of children to adults) and from 2007-08 (for within children/adult comparisons) is statistically significant with *** $p<0.01$, ** $p<0.05$, * $p<0.1$; † value is that of household reference person for children and difference between children and adults not tested; ‡ Individuals report both moderate and vigorous activities at work and for recreation. Minutes of vigorous-intensity activities are converted to effective minutes of moderate-intensity activity by multiplying by 2. # indicates whether anyone in the household received income/benefits from the source listed.

Table 2. Summary of dependent variables, day 1 intake.

	Children	Adults
Total Intake		
total calories	1,900.72	2,093.71
	(27.66)	(35.37)
Ate more than usual	0.08	0.07
	(0.01)	(0.01)
less than usual	0.17	0.27
	(0.01)	(0.02)
Diet quality		
% calories from SSBs	0.13	0.13
	(0.00)	(0.01)
% calories from fat	0.32	0.32
	(0.00)	(0.00)
% calories from saturated fat	0.11	0.11
	(0.00)	(0.00)
Total sodium (mg)	2,948.74	3,369.55
	(45.65)	(70.72)
Total fiber (g)	12.59	13.91
	(0.28)	(0.40)
Source of calories		
% calories from grocery stores	0.70	0.76
	(0.01)	(0.01)
% calories from FAFH	0.15	0.19
	(0.01)	(0.01)
% calories from school/daycare	0.11	0.00
	(0.01)	(0.00)
% calories from other sources	0.04	0.05
	(0.00)	(0.01)
Observations	1,577	1,486

Notes: weighted means reported, standard errors (in parentheses) account for complex sampling design. FAFH = food away from home and includes food obtained from restaurants (including non-school cafeterias), bars, vending machines, food trucks and street venders, and fund raisers. Other sources includes other food assistance (such as soup kitchens and food pantries) and food from family and friends, and food grown or caught by oneself or someone the individual knows.

Table 3. Summary of SNAP distribution schedules, 1998-2012.

Distribution Span (number of days)	Year or period					
	1998-2001	2002	2003-08	2009	2010-11	2012
	Number of States					
1	10	9	9	10	9	8
3-5	8	9	8	7	7	7
7-14	26	25	27	27	27	24
15+	8	9	8	8	9	13

* New York City, which has a different schedule than the rest of New York State and is counted separately, so the total is 52.

Table 4. Distribution of time since SNAP received

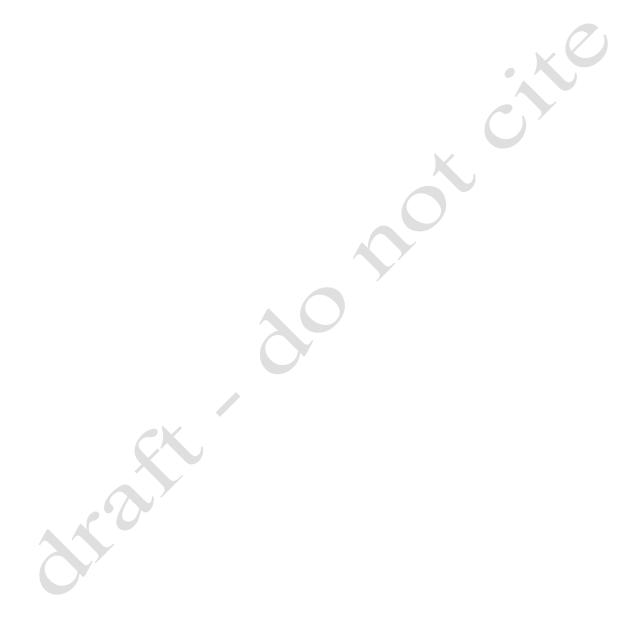**RESULTS NOT CLEARED**

Table 5. Results

RESULTS NOT CLEARED

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Table A.1. State-level SNAP distribution schedules, 2007-2010

State	2007 First day	2007 Last day	2008 First day	2008 Last day	2009 First day	2009 Last day	2010 First day	2010 Last day
Alabama	4	18	4	18	4	18	4	18
Alaska	1	1	1	1	1	1	1	1
Arizona	1	13	1	13	1	13	1	13
Arkansas	4	13	4	13	4	13	4	13
California	1	10	1	10	1	10	1	10
Colorado	1	10	1	10	1	10	1	10
Connecticut	1	3	1	3	1	3	1	3
Delaware	5	11	5	11	5	11	5	11
District of Columbia	1	10	1	10	1	10	1	10
Florida	1	15	1	15	1	15	1	15
Georgia	5	14	5	14	5	14	5	14
Hawaii	1	5	1	5	1	5	1	5
Idaho	1	5	1	5	1	1	1	1
Illinois	1	23	1	23	1	23	1	23
Indiana	1	10	1	10	1	10	1	10
Iowa	1	10	1	10	1	10	1	10
Kansas	1	10	1	10	1	10	1	10
Kentucky	1	10	1	10	1	10	1	10
Louisiana	5	14	5	14	5	14	5	14
Maine	10	14	10	14	10	14	10	14
Maryland	6	15	6	15	6	15	6	15
Massachusetts	1	14	1	14	1	14	1	14
Michigan	1	9	1	9	1	9	3	21
Minnesota	4	13	4	13	4	13	4	13
Mississippi	5	19	5	19	5	19	5	19
Missouri	1	22	1	22	1	22	1	22
Montana	2	6	2	6	2	6	2	6
Nebraska	1	5	1	5	1	5	1	5
Nevada	1	1	1	1	1	1	1	1
New Hampshire	5	5	5	5	5	5	5	5
New Jersey	1	5	1	5	1	5	1	5
New Mexico	1	20	1	20	1	20	1	20
New York Upstate	1	9	1	9	1	9	1	9
New York City	1	15	1	15	1	15	1	15
North Carolina	3	12	3	12	3	12	3	12
North Dakota	1	1	1	1	1	1	1	1
Ohio	1	10	1	10	1	10	1	10
Oklahoma	1	1	1	1	1	1	1	10
Oregon	1	9	1	9	1	9	1	9
Pennsylvania	4	17	2	12	2	14	1	14
Rhode Island	1	1	1	1	1	1	1	1
South Carolina	1	10	1	10	1	10	1	10
South Dakota	10	10	10	10	10	10	10	10
Tennessee	1	10	1	10	1	10	1	10
Texas	1	15	1	15	1	15	1	15
Utah	5	15	5	15	5	15	5	15
Vermont	1	1	1	1	1	1	1	1
Virginia	1	1	1	1	1	1	1	1
Washington	1	10	1	10	1	10	1	10
West Virginia	1	9	1	9	1	9	1	9
Wisconsin	2	15	2	15	2	15	2	15
Wyoming	1	4	1	4	1	4	1	4

Notes: highlighted rows indicate a change at some point between 2007 and 2010.