



SNAP benefits and childhood asthma

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ABSTRACT

Anecdotal and descriptive evidence has led to the claim that some low-income households may face a “eat or breathe” tradeoff, but quantitative evidence is scarce. We link Medicaid claims data to monthly Supplemental Nutritional Assistance Program (SNAP) participation data from the state of Missouri from 2010 to 2013 to explore monthly patterns in children's emergency room (ER) claims for asthma and to examine whether these patterns are sensitive to the timing and amount of SNAP benefits. This allows us to empirically test whether SNAP households with Medicaid insurance face trade-offs between food and medicine that increases the likelihood that a child in a SNAP and Medicaid household will go to the ER for asthma at the end of the month. While we do not find overwhelming evidence that the timing of SNAP benefits receipt are associated with the timing of asthma-related ER visits, we do find clear evidence that increased SNAP benefits are associated with a reduction in the overall probability of an asthma-related ER visit.

1. Introduction

Childhood asthma is the most common chronic childhood health conditions in the United States (Mangini et al., 2015), affecting nearly one in 10 children under the age of 18 (CDC, 2018), and is negatively associated with child behavioral skills and emotional wellbeing (Chen, 2014). The annual health care costs for asthma in the United States exceeded \$56 billion in 2017 (Gracy, 2018; Pearson et al., 2014), which makes effective disease management a significant concern to a wide audience. It is well understood that poverty is a risk factor for asthma (Largent et al., 2012; Mangini et al., 2015) and that the disease prevalence is more common among African-American youth, males, and those that live in an urban environment (Gracy, 2018; Mangini et al., 2015; Perrin et al., 2007). There is increasing evidence that nutrition is a factor for asthma (Perrin et al., 2007) and that food insecurity—a lack of consistent access to sufficient food—is associated with an increased risk of asthma (Kirkpatrick et al., 2010; Mangini et al., 2015). This is particularly interesting given that childhood asthma and food insecurity have many shared risk factors such as poverty, minority status, and urban location, but also given the persistence of the association between food insecurity and asthma after accounting for these factors (Mangini et al., 2015).

Childhood asthma is among the leading causes of emergency room visits for children under the age of 15 (accounting for more than 3 of

every 100 visits in 2015) (Rui and Kang, 2015). Prior studies have found that children who are covered by Medicaid are more likely to visit the emergency room and more likely to be hospitalized for asthma compared to children not covered by Medicaid (Finkelstein et al., 2000). In 2010, Medicaid costs for emergency room visits for pediatric asthma exceeded more than \$272 million (Pearson et al., 2014).

Disease management protocols for asthma center around the use of preventative asthma medications such as inhaled corticosteroids that suppress airway inflammation (Busse and Lemanske, 2007). However, these medications can be quite costly. Using data from the Medical Expenditures Panel Survey, Nurmagambetov et al. (2018) estimated the costs of prescription asthma medication to be \$1830 per person annually. Among Medicaid recipients, asthma medications have the highest annual per person costs (\$59.47 per member per year) (Express Scripts, 2013).

Qualitative studies (Knowles et al., 2016) and case-control studies (Lieu et al., 1997) suggest that emergency room (ER) visits for asthma can be reduced by beginning medications at home at the first sign of a cold or flu but that low-income households and those on Medicaid may be less likely to adhere to disease management protocols. For example, Capo-Ramos et al. (2014) found that close to two-thirds of children enrolled in fee-for-service Medicaid/CHIP discontinued use of preventive asthma medications within 90 days of having them prescribed. This may occur because low-income households face resource

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constraints that make it difficult to meet basic needs, such as purchasing food and medication required for daily health maintenance. Although qualitative studies, such as Knowles et al. (2016), provide evidence that parents make decisions between providing medications for their asthmatic children and purchasing food, we know of no quantitative study that directly tests what has been termed the “eat or breathe” trade-off.

This paper investigates patterns in emergency care for childhood asthma among children covered by Medicaid whose households participated in the Supplemental Nutrition Assistance Program (SNAP), a federal program that provides food assistance in the form of a voucher for food. A major goal of SNAP is reducing household food insecurity, and the program reaches approximately 9.2 million households with children, nearly one fourth (24%) of all US households with children under age 18 (Lauffer, 2017; U.S. Census Bureau, 2016). Because SNAP benefits provide households with the means to purchase food, SNAP might help families to manage child asthma and avoid the “eat or breathe” tradeoff by freeing up other sources of household income for non-food purchases, such as medication. However, if SNAP benefits are not enough to last households throughout the month, then asthmatic children in household's receiving SNAP benefits may face an increased risk of acute asthma attacks when food stores run out.

We link Medicaid claims data to monthly SNAP participation data from the state of Missouri to explore monthly patterns in children's emergency room (ER) claims for asthma and to examine whether these patterns are sensitive to the timing and amount of SNAP benefits. This allows us to empirically examine whether SNAP households with Medicaid insurance present patterns of ER claims for asthma that suggest trade-offs are made between food and asthma-related medication such that the likelihood that a child in a SNAP and Medicaid household will go to the ER for asthma increases at the end of the month.

2. Background

The United States Department of Agriculture (USDA) funds SNAP to supplement household food security for those who qualify by providing a near-cash supplement to purchase food products. In 2017, SNAP provided nutrition support to 42.2 million Americans, with a total value of \$63.7 billion (USDA, 2018b). The basic rules for SNAP eligibility and payment amounts are set at the federal level but states administer the program at the state or county level (e.g., application process, recertification period, payment schedule) and, as a consequence, there is a substantial amount of observed variation in SNAP policies across states. According to federal eligibility criteria, households must have a gross income below 130% of the federal poverty line (FPL), or be categorically eligible through participation in a specified program, such as Temporary Assistance for Needy Families (TANF), in order to qualify for SNAP. In 2015, the USDA estimated that 83% of all eligible individuals participated in the program (Cunningham, 2018).

Generally once eligibility for SNAP is established, SNAP benefits are made available to households one time each month through an electronic benefit transfer (EBT) (Hoynes et al., 2015). However, benefit disbursement schedules (the day of the month that a household receives their monthly benefit) vary across states, with some states distributing SNAP benefits to all households on the first day of the month, some within the first ten days of the month, and others over twenty or more days of the month (USDA, 2018a). Missouri, the site of this study, falls into the latter category, distributing benefits to households over the first 22 days of the calendar month, depending on the birth month and the first letter of the last of name of the head of the SNAP household (USDA, 2018a).

The federal formula used to determine SNAP benefit amount takes into account a household's net income and size and the cost of food (under the USDA's Thrifty Food Plan), and it is designed so that households with the fewest resources receive more benefits (CBPP, 2018). The formula assumes that households spend 30% of net income

on food. SNAP benefits make up the difference between 30% of a household's net income and the cost of food according to the Thrifty Food Plan at that household's size. Families with no net income receive the maximum benefit amount (the total cost of the Thrifty Food Plan at that household size).

Of particular relevance for this study, an estimated 16 million children (one in five children) received food assistance through the SNAP program in 2014 (U.S. Census Bureau, 2015). Over two-thirds of children in households receiving SNAP are school aged (age 5 to 17) and 82.5 percent have gross household incomes below 100 percent of the poverty line. Furthermore, Rank and Hirschl (2009) estimate that nearly half of all children will reside in a household that receives food stamps at some point over their childhood.

Because households with children tend to be larger than average (3.2 people versus 1.1 people for households without children) they tend to have larger SNAP benefits (about \$388 per month on average) (Lauffer, 2017). In Missouri, the state for which we have administrative data on SNAP participation and Medicaid claims, the average benefit for all households was \$258 in 2016 and the average benefit for households with children was \$413 in 2016 (Nchako and Lexin, 2018). Furthermore, children in Missouri are eligible for Medicaid if their household incomes are below 148% of the FPL (Missouri Department of Social Services, 2018), meaning that all children in households who are income-eligible for SNAP benefits are also income eligible for Medicaid.

Prior literature has established a strong negative link between food insecurity and children's health outcomes (Gundersen and Ziliak, 2015). Because SNAP benefits have a direct effect on household income but are earmarked for food purchases, the general expectation is that SNAP should reduce food insecurity and improve child health outcomes. Although several studies do find that SNAP benefits mediate the negative link between food insecurity and child health outcomes, the effects are generally smaller than one might expect. For example, Cook et al. (2004) found that participation in the food stamp program (SNAP) reduced the effects of household food insecurity on the odds that caregivers report that children are in fair/poor health by 24% but did not eliminate the positive association between food insecurity and reports of fair/poor child health. Kreider et al. (2012) found that food insecurity among children was more prevalent for SNAP recipients than SNAP-eligible non-recipients (45% compared to 36% respectively), but after adjusting for adverse selection into SNAP participation, they found that SNAP participation reduces child food insecurity by 8.1 percentage points. However, they found that the magnitude of SNAPs reduction in health outcomes was smaller (3.1 percentage points for poor health, the 5.3 percentage points for obesity, and 1.5 percentage points for anemia).

SNAP participation may not fully attenuate the negative relationship between food insecurity and children's health if SNAP benefits and SNAP-related food purchases do not last throughout the entire month. Previous research has found that food spending and food consumption decreases over the month following the receipt of SNAP benefits, as households deplete their resources (Castellari et al., 2016; Castner and Henke, 2011; Goldin et al., 2016; Shapiro, 2005; Todd, 2015). National estimates suggest that 60% of SNAP households use all of their benefits in the week following benefit disbursement and 91% of households use all of their benefits in the first three weeks following benefit disbursement. Although no prior studies of which we are aware have examined the link between SNAP benefit exhaustion and monthly patterns in children's health outcomes, two studies have examined monthly patterns in children's educational and behavioral outcomes. Gassman-Pines and Bellows (2015) found that children's reading test scores peaked in the second and third weeks following SNAP benefit receipt and then declined in the fourth week. Gennetian et al. (2016) found a greater increase in disciplinary infractions at the end of the month among children receiving SNAP benefits compared to those in households not receiving SNAP. The results of these studies suggest that the timing of SNAP benefit receipt during the month is of importance to children's

well-being.

At least two factors related to SNAP benefit disbursement are expected to affect whether household food budgets and food purchases last the month. First, the amount or size of the SNAP benefits might increase funds available for food throughout the month and might also improve the quality of food consumed by households over the month. A recent random assignment study found that increasing household food budgets by \$60 per month decreased household food insecurity and increased school-aged children's dietary qualities (Collins and Klerman, 2017). Unfortunately, few studies have examined whether children's health outcomes for chronic conditions are sensitive to SNAP benefit amounts and particularly whether higher SNAP benefit amounts are more protective in terms of reducing acute health care crises that require emergency room visits. However, Heflin et al. (2016) found that higher levels of SNAP benefits were associated with reduced ER visits for hypoglycemia among adult SNAP participants. Second, the timing of SNAP benefit disbursement during the month likely affects whether household food budgets and food purchases last the month. Damon et al. (2013) find that food spending decreases toward the end of the month among SNAP households that receive benefits early in the month but not among SNAP households that receive benefits later in the month.

In this paper, we examine how SNAP participation affects patterns in ER visits for child asthma. Prior studies have demonstrated a negative association between food security and child asthma (Kirkpatrick et al., 2010). We hypothesize that among households that receive SNAP, depletion of benefits over the month might decrease the ability to effectively manage asthma flare-ups near the end of the month. Several theoretical arguments support this hypothesis. First, SNAP payments are paid out as a lump sum which presents an income shock at the point of benefit distribution that should boost the quantity and quality of healthy food available to household members (Hastings and Washington, 2010; Tarasuk et al., 2007; Todd, 2015). In addition, resources for food may free up other resources to cover other essential expenses, such as asthma medication. As a consequence, children may be more likely to receive asthma medication when food resources are abundant, and with their asthma being managed at home properly, less likely to end up in the ER for asthma-related conditions (Lieu et al., 1997). Second, given the evidence that SNAP benefits are exhausted by the third week of the month (Castner and Henke, 2011; Hastings and Washington, 2010), and that households reduce food intake at the end of the month because of financial hardship (Wilde and Ranney, 2000), ER visits are likely to increase towards the end of the month for acute health conditions that are sensitive to food consumption (Seligman et al., 2014) or for households that are forced to make trade-offs between eating or following disease management protocols for asthma (Haltermann et al., 2000; Knowles et al., 2016; Lieu et al., 1997).

We examine the empirical evidence in support of a “eat or breathe” trade-off that leads to increases in ER claims at the end of the month using Medicaid claims data and monthly SNAP participation data from the state of Missouri. In 2010, 10% of children covered by Medicaid in Missouri had a diagnosis of asthma and two of every 10 of those children had an ER visit for asthma (Pearson et al., 2014; Reidhead, 2015). The Medicaid costs associated with those visits totaled more than 6 million, making Missouri fifteenth in the nation for Medicaid costs related to ER visits for child asthma (Pearson et al., 2014; Reidhead, 2015). By using administrative data this study makes an important contribution to our understanding of the social and environmental predictors of flare-ups of childhood asthma while also exploring the consequences of specific implementation choices related to food and nutrition policies, such as the date of SNAP benefit disbursement.

3. Data and methods

3.1. Administrative data

Our primary analysis uses an innovative dataset: SNAP data from the Missouri Department of Social Services (Family Support Division) for the period January 2010 to December 2013 are linked to Medicaid claims data for emergency room visits during that same time-period. Our analyses focus on children in households that have received SNAP on the most recent date specified by the rule for payment and made an ER visit during the month. Unfortunately, we are not able to identify children with asthma who do not submit ER claims: our sample includes all children who visited the ER, a group that defines the population at risk for visiting the ER due to an asthma-related issue. Our time-frame, 2010 to 2013, is the result of a 2-year window in which health care providers can submit claims for past medical treatment. At the time of our data linkage, the last year that complete Medicaid claims data were available was 2013.

We use data from a single state, Missouri, because it was the only state in the country at the time of the study to have a 22-day SNAP benefit issuance schedule (Economic Research Service (ERS), 2018). Additionally, during the study period, asthma was the most commonly diagnosed chronic condition for children in Missouri (Reidhead et al., 2015). Furthermore, certain cities in Missouri, such as St. Louis, received national attention for incidence of childhood asthma, particularly among low-income African American children (Green, 2012). Although the results of this study cannot be generalized beyond the state of Missouri, Missouri is a typical state in population size (ranked 18 out of 50) and is also in the middle for educational attainment (ranked 27 out of 50 for percentage of adults with a high school diploma), though perhaps a little lower on median income (ranked 37 out of 50) (U.S. Census Bureau, 2018). Additionally, from 2012, Missouri was in the top 10 states for levels of household food insecurity (Coleman-Jensen et al., 2013).

Of the 772,690 children ages 17 and younger living in a household that received SNAP at some point in the time-period from January 2010 to December 2013, 86% had a Medicaid claim filed during the same period. For the 667,383 children jointly receiving SNAP and Medicaid, a total of 2,563,640 Medicaid claims were submitted for emergency care. Of these Medicaid records for emergency care, 2,477,560 claims were submitted for children who lived in households that had received a regularly scheduled SNAP benefit payment within the prior 30 days of their ER claim.

Households that apply for SNAP benefits and are determined to be eligible may receive a one-time emergency or expedited SNAP benefit to cover the period between when they are determined eligible and when they are scheduled to receive a regular SNAP benefit disbursement (based on their birth month and first letter of their last name). Because a household may receive a regular benefit less than a month after receiving an emergency benefit, the timing between an emergency benefit payment and a regular SNAP benefit payment does not correspond to a regular SNAP benefit month. Thus, 86,080 (or 3%) claims for emergency room visits that occurred after a household has received an expedited or emergency SNAP benefit disbursement and before a family has received a regularly scheduled SNAP benefit disbursement were excluded from the analysis. Descriptive statistics for the sample are presented in Appendix Table 1.

3.2. Variables

We used International Classification of Disease, Ninth Revisions (ICD-9) diagnosis codes to indicate ER care for an asthma related condition (ICD-9 codes) (O'malley et al., 2005). 138,237 claims had a diagnosis of an asthma-related condition; 5,580 out of every 100,000 childhood ER claims submitted to Medicaid involved an asthma-related condition.

Unlike many states that disburse SNAP benefits within the first 9 days of the calendar month, Missouri pays SNAP benefits between the 1st and 22nd day of the month, based on the birth month and the first letter of the last name of the head of the SNAP case. Since the SNAP benefit payment date varies widely across households according to rules that are exogenous to individual decisions or outcomes, these data are ideal for examining the causal impact of benefit payment timing.

In order to conduct our analysis of the timing of ER claims over the calendar month, since months vary in their length, we create a standard month that is 28 days long. We do this by taking the first seven days of the month and defining them as *week 1* and the last seven days of the month as *week 4*. Remaining days are added to the end of *week 2* and the beginning of *week 3* following the approach used by Seligman and co-authors (2014). We also construct a SNAP benefit month defined as the number of days between the date of the SNAP benefit receipt prior to the ER visit and the same date in the following month. To conduct analysis by the SNAP benefit month, we standardized the SNAP benefit month to a 28-day month using the same method as described for calendar month.

In addition to the timing of ER visits over the calendar month and the SNAP benefit month, we use a measure of the SNAP benefit amount received in the prior month to examine how SNAP benefit levels are related to the probability of a child going to the ER for asthma.

We also include shared covariates between SNAP participation and healthcare utilization for asthma including: race (White, Black/African American, American Indian/Alaskan Native, Asian, Native Hawaiian/Pacific Islander, multi-racial, and unknown), Hispanic ethnicity (dummy variable), age (0–5, 6–9, 10–11, 12–17), and household size (one, two, three, and four or more) as suggested by the literature (Nath and Hsia, 2015; Reidhead et al., 2015). These demographic control variables are included because they may be correlated with SNAP benefit amount—SNAP benefits depend on household size and households with children are larger than SNAP households without children (Lauffer, 2017)—and ER claims for asthma (Nath and Hsia, 2015; Reidhead, 2015; Reidhead et al., 2015). In order to control for policy and economic changes over the time-period, we also include dummy variables for the calendar year.

It is important to note that the administrative data analysis relies upon asthma-related ER claims identified from administrative claims data for households that received SNAP between 2010 and 2013. Our state administrative data contain a direct measure of SNAP benefit levels, timing of issuance, and medical records of ER visits, and therefore avoids several sources of measurement error inherent in analyses using surveys that rely on self-reports. However, Medicaid claims data and ICD-9 codes both likely contain measurement error that may result in both false negatives and false positives in the identification of ER visits due to asthma. Additionally, asthma-related health complications that result in medical treatment provided in other settings are not captured by this analysis. These errors will act to attenuate the findings presented.

3.3. Methods

Although we expect that SNAP benefits on aggregate may reduce the probability of an ER visit for asthma, we are concerned that children in households receiving SNAP benefits may still be susceptible to flare-ups in asthma. For example, if SNAP supports food consumption mainly (and not expenditures on other household needs), we might see evidence of the SNAP benefit cycle as an important determinant of asthma-related ER claims. If SNAP not only supports food consumption but also frees up household resources for other expenditures and allows households to avoid the “eat or breathe” trade-off, then we might observe that SNAP benefits received later in the calendar month are more helpful at smoothing household income and supporting health than SNAP benefits received earlier in the calendar month. We test for evidence of both effects separately.

To investigate whether ER visits for asthma increase at the end of the month, we define a binary response equation:

$$\text{Prob}(ER_{cit}^{\text{asthma}} = 1|X) = F(\beta_0 + \beta_1 CWeek2 + \beta_2 CWeek3 + \beta_3 CWeek4 + \beta_4 SNAP\$_i + \gamma_1 W_i + D_t) \quad (1)$$

where we estimate the response probability of an ER claim with a diagnosis of asthma $\text{Prob}(ER_{cit}^{\text{asthma}} = 1|X)$ out of the universe of all Medicaid ER claims for children in Missouri jointly participating in the Medicaid and SNAP programs. In our model the probability of an ER claim for asthma depends on the week of the calendar month represented by the binary indicators *CWeek2*, *CWeek3*, and *CWeek4*. The covariates (*X*) include the monthly SNAP benefit amount ($SNAP\$_i$), a vector of demographic control variables for the individual associated with the claim (W_i) including sex (female = 1), race (binary indicators of White, Black/African American, American Indian/Alaskan Native, Asian, Native Hawaiian/Pacific Islander, Multi-racial, and unknown), Hispanic ethnicity (yes = 1), age (binary indicators of age 0 to 5, 6 to 9, 10 to 11, 12 to 17), and household size (binary indicators of one, two, three, and four or more individuals), and a vector of year fixed effects (D_t), which accounts for time trends as well as policy and economic conditions. The major assumption underlying our model is that the patterns in ER claims for individuals receiving SNAP should vary over the calendar month only for conditions that are sensitive to fluctuations in household income and food availability.

For ease of interpreting results across models, we present marginal effects for ER claims in calendar weeks 2–4, using calendar week 1 as the reference period and holding all covariates at their means. In these models, marginal effects can be interpreted as the average change in the probability of submitting an ER claim for asthma associated with a discrete change in the independent variable. We estimate standard errors robust to heteroscedasticity and clustering at the individual level.

We estimate equation (1) for the full sample, as well as breaking the sample by week of SNAP benefit receipt. Since many states disperse SNAP benefits in the first week of the month, results for those receiving SNAP in the first week of the month can be viewed as predicting the relationship between SNAP receipt and asthma-related ER claims in many states and as providing the strongest test of whether households that receive benefits at the start of the month face a trade-off between food and treating childhood asthma at home at the end of the calendar month. The timing of asthma-related ER visits for those receiving SNAP in calendar weeks 2 and 3 provides an indication of how an alternative payment arrangement influences asthma-related healthcare utilization patterns.

As an additional test of whether the depletion of resources for food influences the home treatment for childhood asthma and affects ER visits for asthma, we define a SNAP benefit month that begins on the first day that a household receives SNAP benefits in month *m* and ends on the next day that the household receives benefits in month *m* + 1. Thus, the SNAP benefit month differs from the calendar month in that the date of issuance of SNAP benefits for a household is day 1 of the SNAP benefit month, regardless of the calendar day, and date before SNAP issuance in the next month is last day of the SNAP calendar month. Since SNAP benefit payment date does not depend on individual characteristics, decisions, or outcomes, the relationship between timing of SNAP benefits and asthma-related ER visits is exogenous. In Model 4, *BWeek2*, *BWeek3*, and *BWeek4* represent the weeks of the SNAP benefit month. If ER visits for asthma are more likely to occur when households have depleted their SNAP resources, then we would expect to see an increase in ER visits for asthma in Weeks 3 and Weeks 4 of the SNAP benefit month, relative to week 1.

$$\text{Prob}(ER_{cit}^{\text{asthma}} = 1|X) = F(\beta_0 + \beta_1 BWeek2 + \beta_2 BWeek3 + \beta_3 BWeek4 + \beta_4 SNAP\$_i + \gamma_1 W_i + D_t) \quad (2)$$

The importance of SNAP benefits to the household food supply over

the month could be a function not only of when SNAP benefits are received but also of the size of the SNAP benefit. In order to explore the possible relationship between the size of SNAP benefits and the probability of ER claims related to asthma, out of the universe of all Medicaid ER claims for children in Missouri jointly participating in the Medicaid and SNAP programs, we estimated probit models that include the size of the SNAP benefit, while controlling for the full set of covariates indicated in equation (2). Therefore, we estimate equation (3):

$$\text{Prob}(ER_{cit}^{asthma} = 1|X) = F(\beta_0 + \beta_1 \text{SNAP}\$_i + \gamma_1 W_i + D_i) \quad (3)$$

where the existing terms are defined as in equation (3) and $\text{SNAP}\$_i$ is the amount of the SNAP benefit received by the household of the individual associated with the ER claim.

The rationale behind this model is that more generous SNAP benefits are more likely to be effective at supporting food consumption than smaller benefits in a dosage-response framework, as shown by Nord and Prell (2011) for food insecurity. In these models, as before, we present estimated marginal effects of SNAP benefit size on the probability that an ER visit is asthma related, based on probit models including the same set of demographic and time controls as equations (1) and (2).

3.3.1. Sensitivity analysis

For the main results, we will estimate equation (1) and equation (2) for the entire SNAP caseload observed to have ER claims during our observation window. However, as a sensitivity analysis, we will also split the sample into those with zero earnings and those with positive earnings. Nationally, 55% of SNAP households with children had earned income (USDA, 2017). We do this to explore the possibility that the households that do not have earnings coming into the household throughout the month, our zero earning group, are more sensitive to the timing of SNAP benefits. Many of these households have access to other benefit programs such as TANF, the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), or Supplemental Security Income (SSI) that are distributed on a single date at the beginning of the month. As a consequence, SNAP benefits delivered later in the month have the potential to be particularly beneficial in reducing the “breathe or eat” tradeoff by boosting food consumption at a point when other resources may be exhausted.

In contrast, we expect that households with earned income may have resources flowing into the household throughout the month (rather than once per month) making it somewhat easier for them to smooth their food consumption and avoid critical trade-offs in essential needs. For instance, Missouri Statute 290.080 stipulates that, with the exception of professional occupations and some commission-based occupations, employers must pay employees at least twice per month (The Lunt Group LLC, 2018). Additionally, a recent study using financial data from JPMorgan Chase found that a 83% of jobs pay more than once a month (semi-monthly, every two weeks, or weekly), while only 17% pay monthly (Farrell and Greig, 2016).

As an additional sensitivity analysis, we will break our SNAP participants into those that are new to SNAP (first observed month or two) and those who have been on SNAP for three months or longer. We do this to test the hypothesis that SNAP participants learn over time to budget their resources over the month to smooth consumption and avoid periods of hardship. We expect that those who are new SNAP participants are most likely to be sensitive to the SNAP benefit month while those who have been on the program for several months will be less sensitive to the SNAP benefit month. In analysis not shown, we examined the sensitivity of our definition of being “new to SNAP” to one-month, two-months, three-months, four-months, five-months and six months. We found the largest difference to be between two and three months, which is what we present here.

Table 1

Average marginal effects of **calendar week** and **benefit week** on ER claims for childhood asthma.

Variable		(1)	(2)
		Calendar Week	Benefit Week
Week 1		— ^c	— ^c
Week 2	dy/dx^b	−0.0015**	0.0007
	SE	(0.0006)	(0.0006)
Week 3	dy/dx	−0.0007	0.0003
	SE	(0.0006)	(0.0006)
Week 4	dy/dx	0.0001	0.0000
	SE	(0.0007)	(0.0007)
Observations		2,477,560	2,477,560

***p < 0.01, **p < 0.05, *p < 0.1.

Source: Authors' analysis of data from Missouri Department of Social Services. Notes: Results are from Probit regression models controlling for SNAP benefit amount, race/ethnicity, sex, age, household size, and year of ER visit. ^c indicates reference category.

4. Results

4.1. Timing of SNAP benefits results

The first column of Table 1 presents findings for estimates of the probability that a SNAP recipient has an asthma-related ER claim as a function of the week of the calendar month, controlling for SNAP benefit amount and basic demographic characteristics (sex, race, Hispanic ethnicity, age, household size, and calendar year). In the overall sample that combines SNAP recipients over the three weeks of benefit receipt, we find evidence of a calendar month pattern in asthma-related ER visits in that ER claims for asthma are lower in week 2 relative to week 1.

In the second column of Table 1, results are shown for SNAP benefit month using equation (2). Recall that benefit month begins on the day of receipt of SNAP benefits and runs until the next date benefits are issued. Thus, if benefits are received on the 7th of the calendar month this becomes the first dates of the SNAP benefit month. The second column of Table 1 demonstrates that there is no observed relationship between the SNAP benefit month and date of ER claim for asthma as there is with the calendar month.

The right-hand columns in Table 2 provides a comparison of the timing of asthma-related ER claims for those who receive SNAP benefits in calendar weeks 1, 2 and 3. For those who receive SNAP benefits in

Table 2

Average marginal effects of **calendar week** on ER claims for childhood asthma, by week of SNAP benefit disbursement.

Variable		SNAP Benefit Disbursement		
		Week 1	Week 2	Week 3
Calendar week				
Week 1		— ^c	— ^c	— ^c
Week 2	dy/dx^b	−0.0023**	−0.0013	−0.0009
	SE	(0.0011)	(0.0012)	(0.0011)
Week 3	dy/dx	−0.0018*	0.0003	−0.0008
	SE	(0.0011)	(0.0011)	(0.0011)
Week 4	dy/dx	−0.0009	0.0009	0.0001
	SE	(0.0012)	(0.0011)	(0.0011)
Observations		807,301	837,368	832,891

***p < 0.01, **p < 0.05, *p < 0.1.

Source: Authors' analysis of data from Missouri Department of Social Services. Notes: Each column represents a different regression. Results are from Probit regression models controlling for SNAP benefit amount, race/ethnicity, sex, age, household size, and year of ER visit. ^c indicates reference category.

calendar week 1, there is a decrease in ER visits for asthma in the second or third calendar week that is not observed for those who receive SNAP in week 2 or week 3. Given that children who receive SNAP benefits in the first week of the calendar month should be similar in both observed and unobserved characteristics with children who receive SNAP in weeks 2 or 3, the reduction in ER visits due to asthma after receiving SNAP benefits is consistent with the expectation that receipt of SNAP benefits reduces ER visits for childhood asthma. However, there is no observed effect for receiving SNAP in weeks 2 or 3, suggesting that those who receive their SNAP benefits later in the month are better able to smooth consumption over the calendar month.

4.1.1. Earned income status analysis of calendar month

Based on the results in Table 1 and Table 2, it appears that there is some consequence to the timing of SNAP issuance with regard to ER visits for asthma that is nuanced and is not the same for all households in a manner that is predictable across all households. To explore this finding further, we split the sample by those with earnings (any earnings > 0) and those without earnings based on the logic that households with earnings likely receive an inflow of resources throughout the month while households without earnings are forced to stretch their cash resources from TANF or SSI, which are disbursed at the beginning of the month, until the end of the month. We expect to find that households without earnings are more sensitive to the timing of SNAP disbursement with regard to the timing of ER visits for asthma, and, if this is true, we expect to see differences in the marginal effects for asthma visits for the calendar week.

Table 3 presents results of our base model in the first columns split by earned income status. As expected, we observe that there is no variation in the timing of asthma ER visits over the calendar month for households with earned income. However, those with no earned income have a reduction in the probability of an ER claim for asthma in the second calendar week. We explore this further by breaking the sample into the week of SNAP issuance in results not shown. When we do this, we find that there is no statistical difference between the probability of a claim in the second calendar week across the three issuance weeks (and the standard errors increase as a result of the loss

Table 3
Average Marginal effects of **calendar week** by earned income status.

Variable	(1)
	Overall
Panel A. No Earnings	
Week 1	— ^c
Week 2	dy/dx ^b − 0.0018**
	SE (0.0008)
Week 3	dy/dx − 0.0012
	SE (0.0008)
Week 4	dy/dx − 0.0004
	SE (0.0009)
Observations	1,490,495
Panel B. Some Earnings	
Week 1	— ^c
Week 2	dy/dx ^b − 0.0010
	SE (0.0010)
Week 3	dy/dx 0.0000
	SE (0.0010)
Week 4	dy/dx 0.0007
	SE (0.0010)
Observations	987,065

***p < 0.01, **p < 0.05, *p < 0.1.

Source: Authors' analysis of data from Missouri Department of Social Services. Notes: Results are from Probit regression models controlling for SNAP benefit amount, race/ethnicity, sex, age, household size, and year of ER visit. ^c indicates reference category.

of sample size). However, we do observe the marginally significant finding that households with no earned income that receive their SNAP benefits in the third calendar week have a drop in ER claims for asthma in the third week as predicted. This suggests that the distribution of SNAP in the third calendar week may reduce ER claims for asthma in that week for households without earnings. However, there is no observed effect for the distribution of SNAP in the second calendar week, perhaps signaling that the third week of distribution is especially helpful, but the reduction is very short lived and does not extend into the fourth calendar week. When we replicate the analysis (not shown) for those with positive earnings, we observe that receiving SNAP benefits in the first week is associated with a reduction in ER visits for childhood asthma.

4.1.2. New to SNAP analysis of SNAP benefit month

One hypothesis that is often proposed for why some households may be able to stretch their benefits through the month and others are not able to do this is that smoothing food consumption may be a learned skill that is acquired over time on SNAP. In order to examine this possibility, we split the sample into those households who are new to SNAP, having only received SNAP for 1 or 2 months (excluding the first four months of our time series), and those who have received SNAP for three months or longer. We expect that if financial literacy were driving the relationship between SNAP issuance date and ER visits for asthma, we might observe an increasing probability of ER visits for asthma at the end of the SNAP benefit month and that no observed effect would be observed for those who had been on SNAP long enough to learn how to smooth their consumption.

Results are shown in Table 4 and are partially supportive of our expectations. We find that households who are new to SNAP are more likely to go to the ER for childhood asthma in the second SNAP benefit week but not in weeks 3 or 4, as expected. However, there is no observed relationship between the SNAP benefit month and childhood asthma among those who have been on SNAP for three or more months. Thus, we find that there is some evidence that SNAP recipients learn to smooth consumption over the SNAP benefit month once they are on

Table 4
Average marginal effect of **benefit week** on ER claims for childhood asthma-related conditions for New and Long-Term Recipients of SNAP.

Variable	(1)
	Overall
Panel A. New Users (1 or 2 Months)	
Week 1	— ^c
Week 2	dy/dx ^b 0.0021**
	SE (0.0008)
Week 3	dy/dx 0.0014
	SE (0.0008)
Week 4	dy/dx 0.0008
	SE (0.0008)
Observations	1,186,650
Panel B. Long-Term Users (3 or more Months)	
Week 1	— ^c
Week 2	dy/dx ^b 0.0003
	SE (0.0011)
Week 3	dy/dx − 0.0000
	SE (0.0012)
Week 4	dy/dx 0.0001
	SE (0.0012)
Observations	1,087,994

***p < 0.01, **p < 0.05, *p < 0.1.

Source: Authors' analysis of data from Missouri Department of Social Services. Notes: Results are from Probit regression models controlling for SNAP benefit amount, race/ethnicity, sex, age, household size, and year of ER visit. ^c indicates reference category.

Table 5
Average marginal effect of SNAP benefit amount on ER claims for childhood asthma.

Benefit Amounts	Average Marginal Effect	SE	95% CIs	
175	−0.000784***	0.000201	−0.001178	−0.000390
275	−0.000776***	0.000197	−0.001162	−0.000390
375	−0.000768***	0.000193	−0.001145	−0.000390
475	−0.000759***	0.000189	−0.001129	−0.000390
575	−0.000751***	0.000185	−0.001113	−0.000389
675	−0.000743***	0.000181	−0.001098	−0.000389
775	−0.000735***	0.000177	−0.001082	−0.000389

***p < 0.01, **p < 0.05, *p < 0.1.

Source: Authors' analysis of data from Missouri Department of Social Services. N = 2,477,560.

Notes: No timing controls included. Results are from Probit regression models controlling for race/ethnicity, sex, age, household size, and year of ER visit.

SNAP for a few months.

4.2. Generosity of SNAP benefits analysis results

In Table 5 we investigate the risk of an asthma-related ER claim as a function of the SNAP benefit size, no longer focusing on the timing of the benefit receipt. Since monthly SNAP benefit amount is a function of household size and is not randomly distributed across demographic groups, we estimate probit models of the relationship between SNAP benefit size and ER visits, controlling for sex, race, Hispanic ethnicity, age, household size, and calendar year. It is important to note that since those with per capita lower financial resources receive higher SNAP benefits and that income is associated with worse health outcomes, high SNAP benefit households are negatively selected with respect to health.

If households receiving higher amounts of SNAP benefits are negatively selected with respect to health and are therefore more likely to seek treatment at the ER for asthma-related conditions, then we would expect the probability of an ER claim to increase with the SNAP benefit amount. However, the coefficient for the size of SNAP benefits from this probit model is negative and statistically significant (see Table 5). Additionally, as the monthly SNAP benefit amount increases, the predicted probability of submitting an asthma-related ER claim decreases for a child with the same individual and household characteristics, suggesting that a dose-response relationship is present. That is, for a child who lives in a household that receives \$275 in benefits per month the predicted probability of going to the ER for asthma is 5.73% while a child with the same characteristics but in a household that receives \$675 in SNAP benefits monthly has a predicted probability of going to the ER for asthma of 5.43% and differences shown are statistically different from one another.

Another way to view this same relationship is to observe that the magnitude of the marginal return to an additional dollar of SNAP benefits is larger at the bottom of the SNAP benefit spectrum when SNAP benefits total \$75 per month than at the top, near \$675 per month. A \$100 increase in SNAP benefits from \$175 to \$275 decreases the likelihood of asthma-related ER visits by about 784 per 100,000, a \$100 increase in benefits from \$575 to \$675 reduces the likelihood of asthma-related ER visits by about 751 per 100,000, which represents a 13.5–14.1% decrease in the base rate of ER claims for asthma.

5. Discussion

This study uses Missouri linked administrative data for SNAP and Medicaid from 2010 to 2013 to explore the association between SNAP timing and benefit size and asthma-related ER visits. We find that among the population of children receiving both SNAP and Medicaid in Missouri and who filed an ER claim, the probability of going to the ER for an asthma-related cause is lower in the second calendar week

(relative to the first calendar week) and this effect is concentrated among those who receive SNAP in the first calendar week or those who have zero earnings. Furthermore, the average marginal effect of going to the ER for an asthma-related cause is negatively associated with the size of the SNAP benefit. This result is not consistent with the hypothesis that low-income households exhaust their resources at the end of the calendar month. More consistent with the “breathe or eat” trade-off is the finding that higher SNAP benefits are associated with reductions in asthma-related ER visits.

Our study contributes to the literature on the health consequences of SNAP participation by investigating how random differences in the timing of benefit receipt are associated with differences in the timing of ER visits for asthma. While qualitative literature suggested that low-income households may face “eat or breathe” trade-offs (Knowles et al., 2016), our study provides the first empirical test of the generalizability of this finding. Our results provide lukewarm support for such trade-offs and suggest that although they may occur, they may not be widespread or systematically tied to the timing of SNAP benefit receipt or at least in the ways that have been formally hypothesized to date.

It is worth noting that we find no support for the hypothesis that asthma-related ER visits are associated with the SNAP benefit month while do we find an association with the calendar month. This suggests that the trade-offs low-income households face may be tied to the monthly calendar and not the SNAP benefit cycle. Additionally, this suggests that SNAP households treat SNAP benefits as fungible resources and that receipt may free up money that can be spent on other items, such as asthma medication. It is also notable that we find no evidence that the probability of asthma-related ER visits increase significantly at the end of the month as hypothesized but, instead, that the first calendar week is when asthma-related ER claims peak, most likely when rent and utilities fall due, but are relatively smooth throughout the rest of the month.

Our results regarding the SNAP benefit size provide clearer evidence that increased SNAP benefits are associated with a reduction in the overall probability of an asthma-related ER visit. When considering this result, it is important to note that high benefit SNAP households are likely to be negatively selected with respect to health since they are also likely to have lower income from all other sources and there is a clear income-health gradient. Thus, our results, which do not attempt to control for the negative selection process, are most likely an underestimate of the true relationship between SNAP benefit size and the probability of an asthma-related ER visit.

Our study is limited because the SNAP timing and generosity analysis is based on a sample of households from Missouri over the 2010 to 2013 time-period and is limited to those who receive both SNAP and Medicaid and have an ER claim. Thus, the results are not generalizable to the full US population of SNAP or Medicaid child caseload and those without an ER claim. Furthermore, while the timing of SNAP issuance date is based on the last name and birth month of the main recipient, it is not strictly random, which limits the ability to make causal inferences from these findings.

Further research using other state administrative linked data is encouraged to further explore the relationship between the timing of SNAP receipt and patterns of healthcare utilization. Prior research has demonstrated that there is a relationship between the timing of SNAP benefit issuance and pregnancy-related ER claims (Arteaga et al., 2018) but not hypoglycemia (Heflin et al., 2016). Clearly, the results differ depending on the specific health condition examined and the underlying biophysical processes at play. Future research should continue to examine a broad set of adult and child health conditions to more fully document the extent to which there are externalities in terms of health consequences for participation in SNAP and the importance of specific features of the program under state control, such as the timing of benefit issuance.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2018.11.001>.

Appendix

Appendix Table 1

Characteristics of medicaid recipients ages 17 and younger, who also received SNAP with emergency room visits between 2010 and 2013.

Characteristic	ER Visits			
	All (N = 2,477,560)		Asthma-related Claim (n = 138,237)	
Age (17 to 45)				
0 to 5	1,288,586	52.01%	63,088	45.64%
6 to 9	415,668	16.78%	32,493	23.51%
10 to 11	178,047	7.19%	12,560	9.09%
12 to 17	595,259	24.03%	30,096	21.77%
Race				
White	1,557,466	62.86%	56,930	41.18%
Black/African American	767,947	31.00%	74,448	53.86%
American Indian/Alaskan Native	4547	0.18%	274	0.20%
Asian	9440	0.38%	376	0.27%
Native Hawaiian/Pacific Islander	3488	0.14%	112	0.08%
Multi-racial	40,986	1.65%	2523	1.83%
Unknown	93,686	3.78%	3574	2.59%
Ethnicity				
Hispanic	144,549	5.83%	6128	4.43%
Household Size				
None	128,820	5.20%	7182	5.20%
One	27,260	1.10%	1178	0.85%
Two	437,852	17.67%	25,125	18.18%
Three	655,835	26.47%	38,153	27.60%
Four or more	1,227,793	49.56%	66,599	48.18%

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