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Using Natural Experiments to Identify the Effects of SNAP on Child and Adult Health

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Using Natural Experiments to Identify the Effects of SNAP on Child and Adult Health

Final Report

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1. Acknowledgments

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2. Abstract

The Supplemental Nutrition Assistance Program (SNAP; formerly known as food stamps) can have important impacts that extend beyond its intended aims to improve food security and nutrition, particularly for health and health care use. This project examined the impact of SNAP receipt and benefit level on the health of adults and children using two natural experiments to address selection bias: 1) state policy variation in SNAP in an instrumental variables (IV) analysis; and, 2) the temporary expansion of SNAP benefits and eligibility provided through the American Recovery and Reinvestment Act (ARRA) in a difference-in-difference (DD) approach. We used restricted data from the National Health Interview Survey (NHIS) from 2008 to 2014, restricting our sample to persons in SNAP-eligible and low-income SNAP-ineligible households. The IV analysis suggests that SNAP receipt is associated with improved health and reductions in foregone medical care due to affordability among adults and children. However, we find little evidence that ARRA's temporary benefit increase led to any changes in health or health care use. Whereas SNAP receipt may improve health and health care use for populations close to the eligibility threshold (and thus induced to participate by some policies), the relatively small increase and reduction in SNAP benefits may not have been substantial enough to change health outcomes.

3. Executive Summary

As a sizeable near-cash benefit, the Supplemental Nutrition Assistance Program (SNAP; formerly known as Food Stamps) can have important impacts on household well-being that extend beyond its intended aims to improve food security and nutrition. In particular, SNAP may promote health via impacts on nutritional well-being, and – because it can offset food costs – may free up resources that can be spent on health-promoting activities or directly on health care. However, only a handful of studies have examined the effects of SNAP on health while accounting for concerns about selection that might bias estimates. Results of these studies have been inconsistent¹, with some finding SNAP receipt to be related to better self-reported health, fewer sick days, and better birth outcomes², but others findings poorer self-reported mental and general health^{3, 4}.

This project examined the impact of SNAP receipt and benefit level on the physical and mental health of adults and children using two natural experiments to address selection bias: 1) state variation in SNAP policies; and 2) the temporary expansion of SNAP benefits and eligibility related to the American Recovery and Reinvestment Act (ARRA). For both approaches, we used restricted data from the National Health Interview Survey (NHIS) from 2008 to 2014, restricting our samples to persons in SNAP-eligible and low-income SNAP-ineligible households. Our key dependent variables included measures of adult and child physical and mental health and health care utilization. These variables expanded upon those used in previous research, are important indicators for short- and long-term health, and might be particularly amenable to changes in household resources prompted by changes in SNAP participation or benefits. Control variables included a range of individual and household characteristics likely to be associated with both SNAP receipt and health.

In the instrumental variables (IV) analysis, we used an index of state SNAP policies that included the use of fingerprinting, broad-based categorical eligibility thresholds, and asset tests among others. Based on state rules, we restricted our sample to SNAP eligible households. SNAP eligibility was defined using household composition, income, employment, and elderly status, and state variation in broad-based categorical eligibility and other eligibility rules. Results indicate that for both children and adults, SNAP participation was associated with significant increases in the probability of very good or excellent health, and reductions in the probability of needing dental care or eyeglasses that they could not afford and needing one or more types of care they could not afford. For adults, participation was associated with reductions in the probability of having a stomach problem in the past two weeks. However, participation was also associated with significant increases in the probability of needing but not being able to afford prescription medicines for adults and behavior problems for children. There was no association between SNAP participation and mental health outcomes for adults.

Second, we exploited ARRA's temporary increase in SNAP benefits and eligibility. Beginning in April 2009, states were able to waive the traditional three-month limit on SNAP receipt among jobless, childless adults, effectively expanding eligibility. Because of persistently high unemployment, most states were able to continue to waive this limit until 2015 or 2016. In addition, benefits increased an average 16% starting in April 2009 and were then reduced to previous levels in November 2013. This amounted to an average reduction in benefits of 7% because of food price inflation. Following Nord and Prell (2011)⁵, we use differences-in-differences (DD) models comparing changes in child and adult health outcomes between SNAP-

eligible households and low-income but SNAP-ineligible households (termed “near-eligibles”) across the ARRA expansion and clawback periods. We limited our sample to eligible and near-eligible households. Near-eligibles were defined as those with incomes just above their states’ thresholds (e.g., 130%– 200% FPL). Controlling for a range of individual and household characteristics, year, month, and state fixed effects, preliminary results find little evidence that the temporary increase in benefits resulted in changes in child or adult health or health care use. There were few exceptions. Following the benefit expiration, there were several counter-intuitive results suggesting expiration was associated with increase health care use that may have resulted from co-occurring changes to the health system (e.g., health insurance expansion under the Affordable Care Act). The lack of findings may also have been due to the nature of data collection in the NHIS with respect to the reporting of household income, SNAP receipt, and health and health care use.

Findings shed light on the causal implications for SNAP participation on adults’ and children’s health. Whereas SNAP receipt may improve health and health care use for populations close to the eligibility threshold (who might be induced to participate by some policies), the relatively small increase and reduction in SNAP benefits was not substantial enough to change health outcomes.

4. Introduction

In the 20 years since Welfare Reform, the Supplemental Nutrition Assistance Program (SNAP; formerly food stamps) has come to occupy a particularly important place in the U.S. social safety net⁶. Research indicates that SNAP plays a countercyclical role⁷, a fact that was immediately clear during the Great Recession (2007-2009), which witnessed massive increases in program participation. Though down from peak levels, SNAP participation still remains at historically high levels. In 2015, nearly 46 million Americans received SNAP benefits (up from 26 million in 2007) at a total annual cost of almost 75 billion dollars⁸. Outside of Medicaid, SNAP is the largest program for low-income Americans⁹ and lifts more people out of poverty than any other means-tested program¹⁰. The program is particularly important to households with children; in 2012, 45% of SNAP-receiving households had children¹¹. Nearly one-half of all children receive SNAP at some point in their lives¹².

SNAP was originally designed as an anti-hunger program. Evidence from high-quality studies suggest that it is effective in this regard, reducing food insecurity among low-income households^{13,14}. However, the size and reach of the SNAP program has prompted interest among policy makers and researchers about other unintended benefits of the program. In particular, recent attention has turned to understanding whether SNAP participation is associated with health, though research on whether and how SNAP participation affects health remains relatively scant. Further, research on SNAP participation is complicated by recognized problems with endogeneity; SNAP participants are different than even eligible non-participants in ways that confound simple methods of studying the effects of participation. Only in recent years have researchers been able to convincingly address concerns about selection into the program.

The SNAP Program in Brief

SNAP is a near-cash program that provides flexible vouchers with which recipients can purchase food (with relatively few exceptions). Benefit levels are tied to the USDA's Thrifty Food Plan, which approximates a nutritious diet at minimal cost and do not vary by geographic location. As a household's income increases, SNAP benefits decrease. In 2014, SNAP's average monthly benefit was \$247 per household, or \$125 per person¹¹. Though it is a federal program, and the majority of rules regarding SNAP eligibility and benefit levels are federally determined, states have some discretion over eligibility rules such as asset tests and recertification periods. An entitlement program, the program serves both the poor and working poor. Households must meet eligibility guidelines to participate: gross monthly income under 130% of the federal poverty line (FPL), net income under 100% FPL, and "countable" assets under \$2,250 (\$3,250 for elderly or disabled recipients). Households where all members receive SSI or cash benefits from Temporary Assistance for Needy Families (TANF) are categorically eligible for SNAP¹⁵. In addition, and consistent with rules established by the USDA, most states (42 as of 2016¹⁶) use receipt of non-cash TANF benefits or services (often in the form of a brochure) to confer broad-based categorical eligibility to families. Under broad-based categorical eligibility, states are able to set a more permissive gross eligibility limit between 130% and 200% of the FPL¹⁵.

SNAP and Health

Previous research suggests a number of different ways that SNAP participation might plausibly be related to health. Although the body of research examining SNAP's impacts on food insecurity has grown, the program's effects on health have received less attention. SNAP participation may improve health through several mechanisms. First, recent research finds that SNAP receipt reduces food insecurity^{13, 14, 17}, and food insecurity is associated with poorer health as well as poorer sleep¹⁸, which itself is associated with poor health¹⁹. Second, given that more nutritious foods like fresh fruits and vegetables tend to be more expensive than less nutritious options^{20, 21}, provided with a larger budget constraint for food, families may make more healthful choices, and in turn, experience better health. Previous research finds that both poverty and food insecurity are associated with poorer nutrition among adults²², and that SNAP participation and higher benefit levels leads to increases in household food expenditures^{5, 23-25} and modest increases in diet quality²⁶. In fact, a classical model would predict increases in both food and non-food expenditures related to SNAP participation²⁷. Thus, a final means by which participation might affect health is by freeing up household resources to purchase other goods and services. This may include opportunities for physical activity such as gym memberships or sports for children or health care. While greater health care utilization typically signifies worse health, SNAP may allow for household resources to purchase preventive health care including medical or dental check-ups, or may allow households to purchase other types of health care (like dental or eye care) that might otherwise be too expensive. Indeed, research points to increases in spending on housing, transportation, and education linked to recent SNAP benefit expansions²⁸ and higher expenditures on health care in participating households²⁹.

Despite this evidence, research examining the effects of SNAP receipt on adult health is somewhat mixed. Several studies have examined the effects of SNAP on body weight, finding mixed results^{1, 11}. Exploiting state policy variation in SNAP, Gregory and Deb³⁰ find that SNAP participation is linked to better self-reported health, fewer days in bed with illness and fewer doctor visits, but more medical check-ups³⁰. Similarly, research indicates that the experience of food insecurity is associated with poorer mental health including depression and anxiety among adults, particularly those who are the parents of young children³¹⁻³³. Likewise, SNAP participants have been found to have poorer self-reported mental health, but this finding appears to result from emotional stress from food insufficiency among new SNAP enrollees⁴. However, many of these studies do not adequately address selection into SNAP, and thus questions remain about causal impacts.

With the exception of research on body weight (which largely find some beneficial or no effects of SNAP on child overweight^{1, 11, 34, 35}), few studies have examined child health specifically. Examining the initial implementation of the program in the 1960s, Almond et al.² find that receipt of food stamps was associated with improved health infant, specifically reduced incidence of low birth weight. Using a similar approach, Hoynes et al. find that access to food stamps in utero and early childhood contributed to substantial reductions in metabolic health problems (e.g., obesity, diabetes, high blood pressure) and increased self-reported good health²⁷. Some research finds links between food insecurity and poorer nutritional intake among children

³⁶, while other research does not²². Adults tend to shelter children from reduced food intake when resources are scarce ³⁷, but even when children do not experience hunger themselves, research suggests that their physical, behavioral, and social-emotional development is affected by their parents' food insecurity via parental depression and stress^{31, 32, 38}. Likewise, recent research links food insecurity with poorer school readiness at kindergarten entry ³⁹. SNAP receipt, or increased SNAP benefits, may alleviate adult hunger, depression, and stress, and thus improve adults' physical and mental health; in turn, SNAP receipt or greater benefits may both directly and indirectly improve children's physical and mental health. Given the importance of nutrition in early life to long-term health and economic outcomes ¹¹, examining the effects of SNAP on children's health has important policy implications.

The Endogeneity of Participation in SNAP

The endogeneity of SNAP participation presents a well-known methodological challenge to examining its impacts ^{3, 11, 27⁴⁰}. For example, several studies find that SNAP participants are more likely to be food insecure and in poorer health than non-participants ⁴¹⁻⁴³; likely, there are unobserved characteristics associated with SNAP receipt, food hardship, and other outcomes. Thus, naïve comparisons between SNAP participants and even eligible non-participants will likely be biased. Accordingly, recent research has employed a number of quasi-experimental designs (e.g., using state policy variation as instruments or comparing outcomes after exogenous expansions or loss of benefits) to address selection suggests. Results from these studies have been instrumental in demonstrating that participation in SNAP reduces food insecurity among adults and children ^{5, 14, 44-47}.

5. Research Methods

In light of the relatively sparse body of research on SNAP participation and health outcomes and given the need to pay careful attention to issues of selection, we exploit two different natural experiments, both of which create exogenous variation in SNAP participation or benefit levels that can be used to identify the causal impacts of SNAP receipt on child and adult health: 1) variation in state SNAP policies; and 2) the expansion and expiration of SNAP benefit levels and eligibility created by the American Recovery and Reinvestment Act (ARRA) of 2009.

State SNAP Policy Variation

As noted above, though SNAP is a federal program, states have substantial leeway in its administration. In addition to the use of TANF funds to establish broad-based categorical eligibility as described above, there is (among others) variation across and within states over time in their policies with respect to the frequency with which households must recertify, spending on outreach for the SNAP program, the use of fingerprinting program applicants to reduce fraud, and the implementation of simplified application procedures.

Because such policies are widely understood to be exogenous (that is, determined outside of the systems linking household participation decisions and health outcomes), they can be used as a natural experiment to develop causal estimates of participation in the SNAP program. In particular, the policies can be used as part of an instrumental variables (IV) analysis, which

estimates the effect of participation that occurred in response to state variation in SNAP policies, removing concern about individual- or household-level selection factors and the bias they would likely create. IV analyses are premised on three primary assumptions, that the state policy instruments are (1) strongly associated with an endogenous "treatment" of interest (SNAP participation), (2) only correlated with dependent variables (adult and child health) via their relationship with the treatment, and (3) as good as randomly assigned.^{48, 49}

Previous studies have used this approach to estimate how SNAP affects various health^{29, 30} and other outcomes^{14, 17, 26}. For instance, using data from the Medical Expenditure Panel Survey from 1999-2008, Gregory and Deb³⁰ find that SNAP participants have better self-reported health, fewer sick days, and fewer doctor visits per year when compared to non-participants.

Building on this body of earlier work, our study capitalizes on the large and comprehensive information on health in the National Health Interview Survey (NHIS), which we describe in greater detail below. Our analyses were based on two specific research questions:

- (1) Is the receipt of SNAP associated with adult health and health care utilization?
- (2) Is the receipt of SNAP associated with child health and health care utilization?

Given previous research summarized above and comparable analyses using state SNAP policies as instruments, we hypothesized that SNAP participation would be associated with increases in child and adult health and better health care utilization.

Restricting our sample to SNAP eligible households, we estimated two-stage least squares (2SLS) IV models of the general form⁴⁸:

$$\widehat{D}_{ist} = \alpha_1 + \tau Z_{st} + \beta_1 C_{ist} + \gamma_1 S_{st} + Time_t + u_{ist}^D \quad (1)$$

$$Y_{ist} = \alpha_2 + \varphi \widehat{D}_{ist} + \beta_2 C_{ist} + \gamma_2 S_{st} + Time_t + u_{ist}^Y \quad (2)$$

where \widehat{D}_{ist} is the predicted value of SNAP participation for an individual, a function of state- and time-varying SNAP policies, Z_{st} , vectors of individual (C_{ist}), state (time-varying) controls (S_{st}), and year and month fixed effects ($Time_t$), Y_i is any of the child or adult health outcomes described below¹, and u_{ist} is an idiosyncratic error term.

Rather than selecting a single state SNAP policy variable as an instrument (Z_{st}), we identified ten variables that had been used in previous research summarized above; they are listed in Table 1. Instead of testing these instruments separately, we generated a standardized index (mean=0, SD=1) representing an overall measure of state SNAP policies. This index had very good (alpha = 0.80) internal reliability.

Expansion and Expiration of SNAP Benefits and Eligibility under ARRA

¹ Unlike in previous studies, we do not include a term for state fixed effects. Though such controls would provide extra reassurance that the IV assumptions were being met, by the time period of our study (2008 and later), much of the variation in state SNAP policies occurred within states. As a consequence, nearly all the variability in our state policy index instrument (discussed in the next paragraph) would be accounted for by the state effects.

The American Recovery and Reinvestment Act (ARRA), signed into law in February 2009, temporarily expanded SNAP benefits and eligibility. Prior to ARRA, most jobless, working-age, non-disabled adults without children were limited to three months of SNAP benefits within any three-year period. From April 2009 to November 2010, ARRA permitted states to suspend this three-month limit on SNAP receipt among jobless, childless adults, effectively expanding eligibility. Although the ARRA provision expired in November 2010, most states were still eligible for USDA waivers due to high unemployment rates, and thus most states did not enforce the three-month limit until 2015 or 2016. Also beginning in April 2009, household SNAP benefits were increased by a dollar amount equal to 13.6% of the maximum benefit for that household size. This meant that the increase was 13.6% for households receiving the maximum benefit, and slightly higher for those with some income receiving less than the maximum benefit. For example, for a family of four receiving the maximum monthly SNAP benefit saw their benefits increase by \$80 from \$588 to \$668 (a 13.6% increase). A family of four receiving half the maximum monthly SNAP benefit also saw their benefits increase by \$80, from \$294 to \$374 (a 27.2% increase)⁵. The average increase in benefits was 16%. Like the eligibility expansion, the benefit increase went into effect April 2009. SNAP benefits eventually reverted to pre-ARRA levels in November 2013; however, due to food price inflation, the expiration of the benefit increase represented a 7% decrease in benefits⁵⁰.

Research examining food security in the pre- and post-ARRA period suggests that these ARRA expansions in eligibility and benefits stabilized or improved the food security of households during the Great Recession. Despite sharp increases in unemployment, the prevalence of very low food security during the prior 30 days was stable or declined from 2008 through the end of 2009⁵¹. More robust analyses also suggest a causal effect between benefit and eligibility expansions and decreased food insecurity. Using a difference-in-difference (DD) strategy to exploit benefit and eligibility expansion from ARRA, Nord and Prell⁵ found that SNAP expansions resulted in a 5.4 percent increase in food expenditures among low-income households (those with incomes below 130% of the federal poverty line [FPL]), and a decrease in food insecurity from 2008 to 2009 of 2.2 percentage points. Specifically, they used annual data from the Current Population Survey-Food Security Supplement (CPS-FSS) to compare SNAP benefits, food spending, and food security in December 2008 (prior to ARRA) and December 2009 (8 months after ARRA benefit and eligibility expansions were enacted). Notably, although food expenditures increased slightly for households with incomes just above the SNAP eligibility range, food security did not improve for these households, suggesting that SNAP participation, rather than other co-occurring economic or policy conditions, contributed to these changes. However, Nord and Prell were only able to examine the effects of SNAP expansions in eligibility and benefits in concert, as they were both expanded simultaneously and used broad income cutoffs as proxies for SNAP eligibility.

Consistent with the expansion findings, decreases in the value of SNAP benefits are associated with increased food insecurity. Again using a DD analysis, Nord (2013) used CPS-FSS data to compare food spending and food security from 2009 to 2011 among households receiving and not receiving SNAP, finding that decreases in the real value of SNAP benefits (due to inflation and rising food prices) led to a 16.5% increase in the number of SNAP-receiving

households with very low food security and a decline of 4.4% in median food spending among SNAP-receiving households⁵². Notably, this study did not examine the sharp decrease in SNAP benefits associated with the expiration of ARRA provisions, which might have larger effects.

Several research questions remain. First, despite the theoretical links and research suggesting SNAP's positive effects on adults' health and preventive health care use³⁰, to date, research has not applied the natural experiment of ARRA expansion or retraction to estimate the causal effects of SNAP eligibility and benefit levels on participants' health and health care use. Second, while this limited research has examined SNAP's effects on adults' health, there is a dearth of research on the effects of household SNAP receipt on children's health. Parents often shield children from food insecurity, but the mental health and stress associated with household or adult food insecurity may indirectly affect children's physical and mental health, as well³⁸. Finally, whereas eligibility and benefit level expansions occurred simultaneously, the staggered "clawback" of these two program changes allow for the examination of the independent effects of reduced SNAP benefit levels on health.

This study addresses these gaps in the literature by examining the impact of SNAP receipt and benefit level on the physical and mental health of adults and children. Specifically, we used data from the NHIS to address two research questions:

- (1) Do expansions in SNAP eligibility and benefit levels affect adult health?
- (2) Do reductions in SNAP benefit levels affect child and adult health?

We separately estimated the impacts of expansions in SNAP benefit levels and eligibility, and retractions in SNAP benefit levels, using two related regression-based DD identification strategies. Specifically, we identified the intent to treat (ITT) effect, comparing SNAP eligibles to near-eligibles and thus avoiding issues of selection into SNAP.

First, to estimate the effects of expansions in SNAP benefit levels and eligibility on health, we used a DD strategy that compares the health of the SNAP eligibles and SNAP near-eligibles before and after the policy was implemented. Formally, this DD design is operationalized by estimating linear time use regressions in equation 1:

$$Y_{it} = \beta_0 + \beta_1 \text{Expansion}_i + \beta_2 \text{Eligible}_i + \delta \text{Expansion}_i \times \text{Eligible}_i + \beta_3 X_{it} + u_{it}, \quad (1)$$

where i and t represent the household, child, or adult, and month-years, respectively; Y represents a measure of health (e.g., self- or parent-reported health or health care use); Expansion is a binary indicator equal to one for data collected in April 2009 to December 2010, the first year during which ARRA temporarily expanded benefit levels and eligibility, and zero for data collected from January 2008 to March 2009, prior to expansions; Eligible is a binary indicator equal to one if the household is eligible for SNAP, and zero if near-eligible; X is a vector of household and individual characteristics (e.g., household size, poverty ratio); and u is an idiosyncratic error. The parameter of interest is δ , which represents the intent to treat (ITT) effect of SNAP expansions under ARRA on health. The control group consists of households that are low-income but near-eligible for SNAP.

Second, to estimate the effects of reductions in SNAP benefit levels on health, we used a DD strategy that compares the health of the SNAP eligibles and SNAP near-eligibles during and after the policy expired, represented in equation 2:

$$Y_{it} = \beta_0 + \beta_1 Post_t + \beta_2 Eligible_i + \delta Post_t \times Eligible_i + \beta_3 X_{it} + u_{it}, \quad (2)$$

where *Post* is a binary indicator equal to zero for data collected in January to October 2013, during ARRA's expanded benefit levels, and one for data collected from January to October 2014, the year following the expiration of expanded benefits. We controlled for a range of background characteristics (see description of control variables below).

Because of co-occurring expansions and changes in health insurance resulting from the Affordable Care Act, we also estimated equations (1)-(2) separately: for states that had and had not expanded Medicaid in 2014; for elderly and non-elderly populations, as those over 65 would be continuously eligible for Medicare whereas health insurance for those under 65 changed more dramatically; for non-elderly, non-employed adults with no dependents (i.e., a proxy for able-bodied adults without dependents [ABAWDs]); and by household size, as larger households experienced greater benefit increases under ARRA.

We hypothesized that expansions in both SNAP eligibility and SNAP benefits would be associated with improved measures of health among adults and children, and conversely, reductions in SNAP benefit levels would be associated with poorer measures of health among adults and children. Further, given the wealth of information on health care use in the NHIS, we can test whether changes in SNAP eligibility or benefits are associated with decreases in health care use as a potential mechanism for the expected negative effects.

6. Data

Both sets of analyses used data from the NHIS. The NHIS is the primary national public health surveillance study, administered to tens of thousands of households annually. In each surveyed family, an adult provides information on a core set of topics (like health general health and health insurance coverage) for every family member. In addition, for each family, a sample adult and sample child (under age 18, when present) are selected for additional survey. Knowledgeable adults provide information on sample children.⁵³ Because both studies rely on state-specific information on eligibility and additional state-level controls, analyses required the use of state identifiers and detailed information on family income-to-poverty ratio. Accordingly, analyses were based on restricted NHIS data at the National Center for Health Statistics (NCHS) in Hyattsville, MD, and then at the Census Research Data Centers in Boston, MA, and Suitland, MD.

For our first set of (IV) analyses, we used data from January 2008 to September 2013, when corresponding information was available from the USD ERS SNAP Policy Database. We merged data from the ERS database to the NHIS data using state and time identifiers. Using state rules for income and categorical eligibility⁵⁴, we restricted our sample to eligible participating and non-participating households. Though the NHIS includes multiply imputed data on family

income when it is missing, IV analyses are not possible with multiply imputed data, and thus we further restrict our analyses to NHIS respondents for whom income was available.

For our second set of (DD) analyses, we used restricted NHIS data from 2008 to 2014. We restricted our sample to persons in SNAP-eligible and low-income SNAP-ineligible households. We used state rules for income and categorical eligibility⁵⁴ to classify households as either SNAP eligible or low-income but SNAP-ineligible (i.e., with gross household incomes close to but above the state eligibility limit).

Our key dependent variables, which included measures of adult and child physical and mental health and health care utilization, expand upon those used in previous research, are important indicators for short- and long-term health, and might be particularly amenable to changes in household resources prompted by changes in SNAP benefits and eligibility. For example, these include self- or parent-reported health (coded into two indicators: very good/excellent and fair/poor), the number of days of work or school missed due to health in the last year, the number of days spent in bed due to health in the last year, whether the individual had experienced a stomach or cold within the last two weeks, whether an individual delayed health care, did not get medical care because he/she could not afford it, or had other specific unmet health care needs (prescription, dental, glasses, or mental health) because he/she could not afford it. In addition, we created an indicator for whether an individual had any unmet health care need that he/she could not afford based on responses to the previous four questions. The full set of dependent variables is listed in Table 2

Control variables, listed in Table 3, include a range of individual and household characteristics likely to be associated with both SNAP receipt and health. These include: age, sex, race/ethnicity (Black, Hispanic, Asian, and other), educational attainment (for children, the highest level in the household), employment status (for children, whether any adult in the household was employed), family structure (currently married, cohabitating, never married, or other), household income-to-needs ratio, citizenship, disability status, homeownership, household size, and whether any elderly or disabled individuals lived in the household. We also controlled for state-level average per capita income, average unemployment rate, average lagged unemployment rate, and average food insecurity rate². DD analyses, unless otherwise noted, included state, month, and year fixed effects. IV analyses controlled for month and year effects.

7. Results

IV Analyses

Table 4 presents results for IV analyses examining the effects of SNAP participation on adult health and health care utilization. Each row in the table presents results for a different dependent variable. Sample sizes are larger (n=85,574) for variables that were included in the core survey and smaller (43,609) for variables that were asked only of sample adults. The further reductions in sample size for analyses of the number of days of work missed in the last year are due to the fact that this question was only asked of sample adults who reported some paid

² Data from the Bureau of Labor Statistics, the Census Bureau, and USDA.

employment. Results from the 2SLS IV analyses indicate that SNAP participation was associated with significant increases in the probability of very good or excellent health (0.208), and reductions in the probability of having a stomach problem in the past two weeks (-0.067), needing but not being able to afford dental care (-0.394), or eyeglasses (-0.263), and needing one or more type of care that they could not afford (-0.598). However, participation was also associated with significant increases (0.103) in the probability of needing but not being able to afford prescription medicines. There was no association between SNAP participation and mental health outcomes. For all outcomes, the first stage F statistic was far greater than the traditional cutoff of 10, indicating that the state policy index was significantly associated with SNAP participation in the first stage regression.

Table 5 presents results for child health and health care utilization. The results closely mirror those for adults. SNAP participation was associated with significant increases in very good or excellent health (0.379), decreases in needing but going without dental care (-0.431) or eyeglasses (-0.207), and needing one or more type of care but not being able to afford it (-0.757). As for adults, SNAP participation was linked with one negative health outcome: significant increases in SDQ score, a measure of child behavior problems. With the exception of MHI score, the F statistic for all child health regressions was again substantially above the traditional cutoff of 10 for a strong instrument. Interestingly, the F statistics were many times larger for most adult health outcomes, implying a stronger relationship between state SNAP policies and program participation for adults than for children.

DD Analyses

DD Results are summarized in Tables 6 through 9, which present selected results from our analyses. In general, results identify few statistically significant associations between the expansion of SNAP benefits and eligibility under ARRA in 2009, or with the expiration of the increased benefits in 2013. There were few exceptions. After the benefit and eligibility expansion in 2009, SNAP eligible respondents were less likely to report that children delayed care due to cost, or needed but could not afford at least one type of care (Table 7), but these associations were only marginally ($p < .10$) significant.

Following the ARRA expiration, there were a few counter-intuitive results: compared to those in near-eligible homes, SNAP eligible adults missed fewer days of work ($p < .05$; not shown), averaged lower (better) Kessler scores ($p < .10$; Table 8), and were less likely to report needing but not being able to afford eyeglasses ($p < .05$; not shown). These results are unexpected, as we hypothesized that benefit reductions would lead to worse health outcomes on average. A series of sensitivity analyses identified no consistent pattern of variation in results by household size, for ABAWDs, or for households living in Medicaid expansion and non-expansion states. Surprisingly, the subsample of elderly adults showed the same decrease in the likelihood of needing glasses following the SNAP benefit expiration as observed with the broader adult population.

8. Discussion

This project took advantage of two natural experiments (variation across states and over time in state SNAP policies, and a SNAP benefit and eligibility expansion and benefit clawback related to the ARRA) to understand the relationship between the SNAP program and child and adult health. Our results are a tale of disparate findings. On the one hand, our analyses using state SNAP policies as exogenous instruments to predict SNAP participation found that SNAP was mostly associated with better health among those eligible for the program. On the other, analyses comparing changes in health before and after a SNAP benefit and eligibility expansion and after a benefit clawback for eligible adult and children to similar changes in near-eligible households indicated few positive effects of the program and indeed a handful of unexpected outcomes.

Our IV findings are mostly consistent with previous research, and indicate fairly large predicted benefits to participation, for example a 0.379 increase in the probability of very good or excellent health for adults. However, it is important to note the 2SLS IV model produces a particular causal estimate: the effect of the program for those whose decision to participate was a consequence of changes in the instrument (our index of state SNAP policies). Thus, while valid, our results do not necessarily imply similar predicted effects for all SNAP participants. Despite an overall positive pattern of results and a fair degree of consistency between results for adults and children, the IV analyses also indicate significant increases in needing but not being able to afford prescription medicines for adults and in behavior problems for children. Though our analyses do not test for this possibility, the result for prescription medicines may be a product of increased use of doctors' visits among participants. SNAP benefits may free up resources to be spent on medical care, but might not afford participants sufficient resources to cover all related expenses. For children, SNAP participation may come with attached stigma, which might prompt observable changes in negative behaviors. Alternatively, if participating children are better fed, they may have more energy and may appear more rambunctious to adult survey respondents.

With respect to our DD analyses, in general, there was little evidence that ARRA's expanded SNAP benefits or eligibility, or the decrease in SNAP benefits following ARRA's expiration, significantly affected the child or adult health or health care outcomes examined in this study. The few exceptions tended to suggest *positive* impacts on adult health and health care use after the expiration of ARRA's SNAP benefit increase, whereas we hypothesized the decrease in funds would lead to poorer health and less health care utilization. For adults, the marginally significant improvements in mental health, and the significantly fewer missed days of work and lower likelihood of needing eyeglasses but not being able to afford them may be due to changes in health insurance that began in January 2014, just two months following the SNAP benefit decrease. These included expanded access to private health insurance and Medicaid and improvements to existing health insurance plans provided under the Affordable Care Act. The elderly population may have also benefited from this change in health insurance, too, as Medicare does not cover eyeglasses whereas most state Medicaid programs do.

We consider two additional possibilities underlying our apparently divergent findings. The first is the potential for measurement error in our DD analyses. To be specific, this analytic framework relied on comparisons in health between eligible and near-eligible households for the

periods spanning the implementation of ARRA-related benefit and eligibility expansions and the benefit clawback. However, because the NHIS asked respondents to identify their household income in the *previous calendar year*, our treatment group (SNAP eligible households) may have included some whose previous year incomes made them eligible but whose current (unobserved) income placed them outside of program eligibility. This contamination of our treatment group would serve to reduce the predicted program effect, as would the potential for some eligible households to be included in the comparison group. Likewise, a number of health outcomes (e.g., delayed getting medical care) were based on the previous 12 months. Thus, respondents may have been reporting on outcomes based on circumstances that predated a policy change. The sum total of these various measurement problems may have been substantial enough to confound our ability to estimate the effects of SNAP with these data based on ARRA-related policy changes.

The second possibility is that our two set of analyses, though both broadly focused on understanding the relationships between SNAP and health, do not in fact attempt to measure the same thing. The major aim of our IV analyses is to study how participation in the program is related to health, whereas our DD analyses investigate the effect of changes in benefits and eligibility. Though the ARRA-driven eligibility expansions would have the putative effect of increasing (or extending) participation, that change occurred contemporaneous to benefit expansions, which affected a far larger number of people. Our clawback analyses, which examine the effect of the expiration of benefit expansion, indicate few significant results. Taken together, the DD and IV analyses might imply that the effects of SNAP on health operate on the extensive margin (moving from non-participation to participation) rather than the intensive one (changing benefit levels), at least with respect to the benefit changes implemented by ARRA. Future analyses might continue to explore this distinction.

9. Conclusion

As a sizeable part of the social safety net that plays a critical counter-cyclical role, understanding the potential benefits of SNAP program to outcomes other than food insecurity is essential to the program's continued viability. This grant-funded project used two natural experiments to understand the relationships between the SNAP program and child and adult health. Findings shed light on the causal implications for SNAP participation on adults' and children's health. Whereas SNAP receipt may improve health and health care use for populations close to the eligibility threshold (and thus induced to participate by some policies), the relatively small increase and reduction in SNAP benefits as provided under ARRA may not have been substantial enough to change the health outcomes included in our analyses.

Table 1. State SNAP Policy Instruments

<i>Variable</i>	<i>Coding</i>
State uses broad-based categorical eligibility	Dichotomous
State exempts one vehicle from SNAP asset tests	Dichotomous
State requires fingerprint information to enroll in SNAP	Dichotomous
State has implemented simplified systems for reporting changes in earnings	Dichotomous
>=50% of participants required to recertify eligibility within 3 months	Dichotomous
State requires eligibility recertification every 6 months or less	Dichotomous
Proportion of SNAP benefits issued by Electronic Bank Transfer	Continuous (0-1)
Outreach spending to increase participation	Continuous
State makes all legal immigrants eligible	Dichotomous
State makes some legal immigrants eligible	Dichotomous

Source: United States Department of Agriculture, Economic Research Service State SNAP Policy Database (Tiehen, 2016)

Table 2. Adult and Child Health and Health Care Utilization Dependent Variables.

<i>Adult Health</i>	<i>Source</i>
Self-reported health status (very good/excellent; fair/poor)	Core Survey
Bed disability days, past 12 months	Sample Adult
Had stomach illness, past 2 weeks	Sample Adult
Had cold, past 2 weeks	Sample Adult
Work loss days, past 12 months ^a	Sample Adult
Kessler short form mental health index (K6)	Sample Adult
How often did negative feelings interfere with daily life?	Sample Adult
<i>Adult Health Care Utilization</i>	
Medical care delayed b/c of cost, past 12 months	Core Survey
Needed but couldn't afford medical care	Core Survey
Needed but couldn't afford dental care	Sample Adult
Needed but couldn't afford eyeglasses	Sample Adult
Needed but couldn't afford prescription meds	Sample Adult
Needed but couldn't afford mental health care	Sample Adult
Had any unmet health need, because could not afford care (based on 4 previous questions)	Sample Adult
<i>Child Health</i>	
Adult-reported health status (very good/excellent; fair/poor)	Core Survey
School loss days, past 12 months ^b	Sample Child
Had stomach illness in past 2 weeks	Sample Child
Had cold in past 2 weeks	Sample Child
Difficulty with emotion, concentration, or behavior, past 6 months ^c	Sample Child
Mental Health Indicator (MHI) ^d	Sample Child
The Short Strengths and Difficulties Questionnaire (SDQ)	Sample Child
<i>Child Health Care Utilization</i>	
Medical care delayed b/c of cost, past 12 months	Core Survey
Needed but couldn't afford medical care	Core Survey
Needed but couldn't afford dental care	Sample Child
Needed but couldn't afford eyeglasses	Sample Child

Needed but couldn't afford prescription meds	Sample Child
Needed but couldn't afford mental health care	Sample Child
Had any unmet health need, because could not afford care (based on 4 previous questions)	Sample Child

^a among adults who were employed

^b among school-aged children only

^c children aged 4-17 only

^d children aged 2-3 only

Table 3. Control Variables

Adult Health Model Controls	Child Health Model Controls
Health insurance coverage	Health insurance coverage
Poverty ratio	Poverty ratio
Age	Age
Race/ethnicity	Race/ethnicity
Educational attainment	Highest level of education of HH members
Labor force status	Any HH member employed
Citizenship status	Any HH member is not a citizen
HH WIC receipt	HH WIC receipt
Marital status	Any elderly HH members
Any elderly HH members	Any disabled HH members
Any disabled HH members	HH size
HH size	Home ownership
Home ownership	

Table 4. IV Estimates: SNAP Participation and Adult Health

Variable (range)	Adults			
	Sample size	Coefficient SNAP Participation	95% Confidence Interval	First Stage F-Statistic
Delayed Seeking Medical Care	85,574	-0.005	-.0843 - .073	278.521
Needed but Could not Afford Medical Care	85,574	0.036	-0.036 - 0.108	278.521
Fair or Poor Health	85,574	0.005	-0.080 - 0.089	278.521
Very Good or Excellent Health	85,574	0.208***	0.092 - 0.323	278.521
Stomach Problem Past 2 Weeks	43,609	-0.067*	-0.134 -- -0.001	307.854
Cold Past 2 Weeks	43,609	-0.038	-0.111 -- 0.064	307.854
Needed but Could Not Afford:				
Prescription Medicine	43,609	0.103*	0.009-- 0.197	307.854
Dental Care	43,609	-0.394***	-0.513 - -0.274	307.854
Eyeglasses	43,609	-0.263***	-0.361 - -0.166	307.854
Mental Health Care	43,609	-0.044	-0.100 - 0.013	307.854
Had any Unmet Need but Could Not Afford	43,609	-0.598***	-0.864 - -0.32	307.854
# Bed Days in the Past Year	43,609	-4.500	-13.725 - 4.726	307.854
Kessler K6 Score	43,609	0.799	-0.423 - 2.020	307.854
Feelings Interfered with Life	43,609	-0.152	-0.395-0.091	307.854
# Missed Work Days in Last Year	20,834	-12.569	-26.422 - 1.284	48.225

*p<.05, **p<.01; ***p<.0001
Note: models include all controls

Table 5. IV Estimates: SNAP Participation and Child Health

Variable (range)	Adults			
	Sample size	Coefficient SNAP Participation	95% Confidence Interval	First Stage F-Statistic
Delayed Seeking Medical Care	42,319	-0.067	-0.206-- 0.071	28.588
Needed but Could not Afford Medical Care	42,319	-0.088	-0.204 -- 0.028	28.588
Fair or Poor Health	42,319	-0.091	-0.214 -- 0.032	28.588
Very Good or Excellent Health	42,319	0.379*	0.011 -- 0.746	28.588
Stomach Problem Past 2 Weeks	16,370	-0.115	-0.320 -- 0.090	27.907
Cold Past 2 Weeks	16,370	-0.226	-0.539 -- 0.087	27.907
Needed but Could Not Afford:				
Prescription Medicine	16,370	-0.065	-0.242 -- 0.111	27.907
Dental Care	16,370	-0.431**	-0.710 -- -0.151	27.907
Eyeglasses	16,370	-0.207*	-0.380 -- -0.03	27.907
Mental Health Care	16,370	-0.055	-0.155 -- 0.046	27.907
Had any Unmet Need but Could Not Afford	16,370	-0.757**	-1.278 -- -0.237	27.907
# Missed School Days in Last Year	12,616	-2.938	-9.761 -- 3.885	27.608
MHI Score	2,378	-1.608	-10.168 -- 6.951	0.752
SDQ Score	10,704	2.092*	0.124 -- 4.060	19.111
Difficulty with Emotions, Concentration, Other People	13,881	0.211	-0.308 -- 0.730	28.736

*p<.05, **p<.01; ***p<.0001
Note: models include all controls

Table 6. Difference-in-Difference Results: SNAP Eligibility and Benefit Expansion Effects on Adult Health and Health Care Use.

	In very good/excellent health	Delayed care due to cost	Needed but Could not Afford Medical Care	Stomach problem in last 2 weeks	Cold in last 2 weeks	Kessler K6 mental health scale
Near-eligible (ref)						
SNAP eligible	-.035*** (.009)	.015* (.006)	.022*** (.005)	.009+ (.005)	.004 (.008)	.425*** (.104)
Pre-ARRA (Jan 08-Mar 09, ref)						
ARRA (Apr 09-Dec 10)	-.004 (.015)	-.014 (.010)	-.003 (.009)	-.002 (.009)	.001 (.013)	.073 (.147)
Eligible x ARRA	-.009 (.010)	.006 (.007)	.002 (.006)	-.001 (.006)	.007 (.008)	.025 (.100)
# of observations	82,927	82,949	82,917	37,562	37,551	37,064

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Notes: Each column represents a separate regression. The table includes a subset of the dependent variables examined.

Table 7. Difference-in-Difference Results: SNAP Eligibility and Benefit Expansion Effects on Child Health and Health Care Use.

	In very good/excellent health	Delayed care due to cost	Needed but could not afford medical care	Stomach problem in last 2 weeks	Cold in last 2 weeks	Difficulty with concentration (4-17 yrs)
Near-eligible (ref)						
SNAP eligible	-.027+ (.014)	.015* (.007)	.010+ (.006)	.009 (.008)	.025+ (.013)	.041+ (.023)
Pre-ARRA (Jan 08-Mar 09, ref)						
ARRA (Apr 09-Dec 10)	-.014 (.023)	.008 (.012)	.005 (.009)	-.006 (.014)	.011 (.023)	.034 (.036)
Eligible x ARRA	.019 (.015)	-.015+ (.008)	-.011+ (.006)	-.005 (.009)	.004 (.014)	.038 (.024)
# of observations	38,897	38,877	38,870	16,904	16,893	12,610

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Notes: Each column represents a separate regression. The table includes a subset of the dependent variables examined.

Table 8. Difference-in-Difference Results: Expiration of SNAP Benefit Expansion Effects on Adult Health and Health Care Use.

	In very good/excellent health	Delayed care due to cost	Needed but Could not Afford Medical Care	Stomach problem in last 2 weeks	Cold in last 2 weeks	Kessler mental health scale
Near-eligible (ref)						
SNAP eligible	-.048*** (.009)	.032*** (.005)	.027*** (.005)	.015** (.005)	.019** (.007)	.712*** (.089)
ARRA (Jan-Oct 2013, ref)						
Post-ARRA (Jan-Oct 2014)	.004 (.009)	-.002 (.005)	-.003 (.004)	-.001 (.004)	-.004 (.006)	-.220** (.077)
Eligible x Post-ARRA	-.001 (.011)	-.001 (.006)	.002 (.006)	-.004 (.006)	-.006 (.008)	-.169+ (.102)
# of observations	64,337	64,356	64,352	30,593	30,585	29,434

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Notes: Each column represents a separate regression. The table includes a subset of the dependent variables examined.

Table 9. Difference-in-Difference Results: Expiration of SNAP Benefit Expansion Effects on Child Health and Health Care Use.

	In very good/excellent health	Delayed care due to cost	Needed but Could not Afford Medical Care	Stomach problem in last 2 weeks	Cold in last 2 weeks	Difficulty with concentration (4-17 yrs)
Near-eligible (ref)						
SNAP eligible	-.010 (.013)	.0002 (.006)	.002 (.004)	.008 (.008)	.007 (.012)	.029 (.022)
ARRA (Jan-Oct 2013, ref)						
Post-ARRA (Jan-Oct 2014)	.025* (.012)	.002 (.006)	.001 (.004)	.002 (.008)	.011 (.012)	-.009 (.022)
Eligible x Post-ARRA	-.026 (.016)	-.004 (.007)	-.007 (.005)	-.009 (.009)	-.009 (.014)	.031 (.027)
# of observations	27,664	27,659	27,654	12,490	12,488	9,513

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Notes: Each column represents a separate regression. The table includes a subset of the dependent variables examined.

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