UKCPR
University of Kentucky
Center for
Poverty Research

Discussion Paper Series
DP 2018-02

ISSN: 1936-9379

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Bradley Herring
Johns Hopkins University
Bloomberg School of Public Health

Robert Moffitt
Johns Hopkins University
Department of Economics

March 2018

Preferred citation
Herring, B., & Moffitt, R. (2018, March). Food security, health, and and healthcare utilization: The role of SNAP for families in extreme poverty. *University of Kentucky Center for Poverty Research Discussion Paper Series, DP2018-02*. Retrieved [Date] from http://www.cpr.uky.edu/research.

Author correspondence
Bradley Herring, herring@jhu.edu; Robert Moffitt, moffitt@jhu.edu

Food Security, Health, and Healthcare Utilization: The Role of SNAP for Families in Extreme Poverty

Bradley Herring
Johns Hopkins University

Robert Moffitt
Johns Hopkins University

March 26, 2018

Abstract: We study whether SNAP mediates the effect of food insecurity on future health and healthcare utilization more for the extreme poor (i.e., those with income below 50% of the poverty line) than it mediates the effect for other low-income families (i.e., with incomes between 50% and 200% of the poverty line). We use data for about 23,000 people in the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS surveys with the measures of food insecurity coming from the NHIS and the measures of SNAP benefits and various health outcomes from the MEPS. We find that SNAP significantly reduces the negative effects of food insecurity on several measures of health and healthcare-related outcomes for nonelderly adults, and that this reduction is often significantly greater for those in extreme poverty. However, we find no significant effects of this type for children. In addition, attempts to control for possible endogeneity of the SNAP effect of interest are unsuccessful because of a lack of strong instruments. Nevertheless, endogeneity of the effect of interest maybe biased downward, strengthening the support of the OLS estimates as valid.

Acknowledgments: The authors would like to thank participants at an ERS conference in October, 2017 for comments and to thank Hanchen Jiang for excellent research assistance. This project was supported with a grant from the University of Kentucky Center for Poverty Research through funding by the U.S. Department of Agriculture, Economic Research Service and the Food and Nutrition Service, Agreement Numbers 58-5000-1-0050 and 58-5000-3-0066. The opinions and conclusions expressed herein are solely those of the author(s) and should not be construed as representing the opinions or policies of the sponsoring agencies.

Executive Summary

Food insecurity is a major social and economic issue in the United States. Using the measure of food insecurity developed by the U.S. Department of Agriculture, 12.7 percent of all households and 16.6 percent of households with children were food-insecure in 2015. The SNAP program can alleviate food insecurity and can reduce the negative impact of food insecurity on future health and healthcare utilization. However, that beneficial effect of SNAP could vary across different types of individuals in families. This analysis asks whether the favorable effects of SNAP receipt on moderating the effect of food insecurity on health and healthcare utilization varies by level of income and, in particular, whether the favorable effects are greater for families in extreme poverty, defined as having income considerably below the poverty line, than for families with higher income levels but still low income.

We investigate this question by linking the information from two relevant household survey data sets, the National Health Income Survey (NHIS) and the Medical Expenditure Panel Survey (MEPS). The NHIS is an annual nationally representative survey of the non-institutional population in the U.S. which collects extensive data on health status, but began asking food insecurity questions in 2011. The MEPS is a two-year panel survey of the U.S. population which collects data on health status as well but it also collects detailed data on healthcare utilization, income, and social transfer program participation. The MEPS is drawn from a subset of the NHIS sample and is conducted in the years following the NHIS. The detailed information in the MEPS on family income allows us to determine a relatively precise measure of extreme poverty and the detailed information on transfer programs allows to measure the receipt of SNAP benefits. The lagged values of food insecurity from the NHIS allow us to therefore estimate the effect of food insecurity on subsequent health and healthcare outcomes and how those effects vary by level of income and SNAP receipt. Using the data available to us for two-year periods generates a sample of roughly 23,000 low-income people from the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS data.

Our analysis shows that SNAP results in a significant reduction in the negative effect of food insecurity on several measures of health status and healthcare utilization for nonelderly adults, and that the size of that reduction is often significantly greater for families in extreme poverty than for families with higher levels of income. Some specific findings are as follows:

- SNAP reduces the effect of food insecurity on the probability of being in only fair or poor health in the future by over 7 percentage points more for extremely poor families than for families of higher income.

- The program reduces that same effect on the probability of having limitations with daily activities by about 5 percentage points more for families in extreme poverty than for families with higher income

- SNAP significantly reduces the effect of food insecurity on future hospital inpatient stays and inpatient nights for families for families in extreme poverty relative to families with higher income

- There are no differential effects of SNAP in reducing the impact of food insecurity on asthma, diabetes, hypertension, and heart disease for families in extreme poverty and for families with higher income levels.

However, we find no significant effects of this type for children, and our sample sizes are not sufficient to estimate effects for the elderly.

The studies' limitations primarily concern the possibility that SNAP participation is endogenous and that self-selection by health status and healthcare utilization is present. We attempt to test for possible endogeneity by using a set of state-level SNAP policies as instruments, but these policies do not provide sufficiently strong instruments. However, a priori reasoning suggests that the effects we estimate are likely to be conservative, if the bias works in the way found in other studies of the effects of the SNAP program.

I. Introduction

Food insecurity is a major social and economic issue in the United States. Using the measure of food insecurity developed by the U.S. Department of Agriculture, 12.7 percent of all households and 16.6 percent of households with children were food-insecure in 2015, where food insecurity is defined as a condition where a household is "unable to acquire adequate food for one or more household members because they had insufficient money or other resources for food." (Coleman-Jensen et al., 2016). There have been many studies of the determinants of food insecurity and many correlates have been found, including poverty, low income more generally, not owning a home, low levels of education, living in a family with an unmarried household head and unmarried status in general, minority race-ethnicity status, living in a household with adults with physical or mental disabilities, the presence of substance abuse in the family, poor child care arrangements, and disadvantageous parenting styles, among other conditions (Gundersen et al., 2011; Gundersen and Ziliak, 2014). Triggering events for food insecurity include shocks to income, job loss, disruption to housing arrangements, and the occurrence of other crises.

This paper is concerned with the effect of food insecurity on health and how that effect varies by both the level of family income and by receipt of benefits from the Supplemental Nutrition Assistance Program (SNAP). In a comprehensive review, Gundersen and Ziliak (2015) find many studies indicating negative effects of food insecurity on health. These include increased levels of asthma and anemia, poor nutrient intake, and increased levels of cognitive problems for children. For nonelderly adults, food insecurity is associated with lower nutrient intakes, higher levels of mental health problems, and increased incidence of diabetes and hypertension. For elderly adults, similar findings are indicated as well as lower levels of self-

reported health. However, the research has also shown that receipt of SNAP benefits lowers food insecurity and thereby lessens these negative effects on health status (Gregory et al., 2016; Kreider et al., 2012). SNAP has, more generally, positive effects on health as well (Gregory and Deb, 2015; Bitler, 2016; Hoynes and Schanzenbach, 2016).

The focus of our analysis is whether the favorable effects of SNAP receipt on moderating the effect of food insecurity on health varies by level of income. The motivation for addressing this question comes from recent work on what is often called "extreme poverty," which is not precisely defined but is considered to occur when a family's income is considerably below the poverty line, perhaps half or even one-fourth of that level. This recent work has shown that there has been an increase in the fraction of all poor who are in deep poverty, defined as having income less than 50 percent of the poverty line (e.g., Fox et al., 2015); an increase in the number of "disconnected" families who have neither earnings nor welfare (Blank and Kovak, 2009); an increase in the percent of families living on less than $2 per day per person (Shaefer and Edin, 2013; Edin and Schaefer, 2015); and a decline in real per-family government transfer benefits going to families in deep pre-transfer poverty (Ben-Shalom et al., 2012; Moffitt, 2015).

Ethnographic accounts of families living in extreme poverty (Edin and Schaefer, 2015) make clear that families with very low income struggle on a weekly or even daily basis to obtain basic necessities of life for all family members, including food and nutrition. This suggests that the effect of SNAP receipt may be particularly important for such families in extreme poverty, perhaps more than for families who are also poor but who have slightly higher incomes which allow them more breathing room to organize their consumption expenditures. In the context of the research noted above on the moderating effects of SNAP receipt in reducing the negative impact of food insecurity on health outcomes, we ask whether those moderating effects are

particularly strong for families in extreme poverty. Thus the question we ask is whether the impact of food insecurity on health for families in extreme poverty is reduced by SNAP receipt *relative to* whatever impact SNAP receipt has in reducing the impact of food insecurity on the health of families with slightly higher incomes.

We investigate this question by linking the information from two relevant household survey data sets, the National Health Income Survey (NHIS) and the Medical Expenditure Panel Survey (MEPS). The NHIS is an annual nationally representative survey of the non-institutional population in the U.S. which collects extensive data on health status but began asking food insecurity questions in 2011. The MEPS is a two-year panel survey of the U.S. population which collects data on health status as well but it also collects detailed data on healthcare utilization, income, and social transfer programs. The MEPS is drawn from a subset of the NHIS sample and is conducted in the two years following the NHIS. The linked NHIS-MEPS data set therefore contains three years of data on the same families, comprised by the first year from the NHIS and the next two years from the MEPS. The detailed information in the MEPS on family income allows us to determine a relatively precise measure of extreme poverty and the detailed information on transfer programs allows to measure the receipt of SNAP benefits (and other correlated transfer programs as control measures in the analyses). The lagged values of food insecurity from the NHIS allow us to therefore estimate the effect of food insecurity on subsequent health and healthcare outcomes and how those effects vary by level of income and SNAP receipt. In order to maximize the number of people at low levels of income included in our analyses, we only use data from the first year of the two-year MEPS panel, as incorporating measures from the second year of the two-year MEPS would mean having to drop a large number of people with data only currently released from the NHIS and the first year of the

MEPS. Using the data available to us for two-year periods generates a sample of roughly 23,000 low-income people from the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS data.

Our analysis shows that SNAP results in a significant reduction in the negative effect of food insecurity on several measures of health status and healthcare utilization for nonelderly adults, and the size of that reduction is significantly greater for families in extreme poverty than for families with higher levels of income. However, we find no significant effects of this type for children, and our sample sizes are not sufficient to estimate effects for the elderly. We also attempt to test for possible endogeneity of the interaction coefficient of interest (i.e., SNAP, food insecurity, and extreme poverty) by using a set of state-level SNAP policies as instruments, but these policies do not provide sufficiently strong instruments. However, a priori reasoning suggests that the effects we estimate are likely to be conservative, if the bias works in the way found in other studies of the effects of the SNAP program.

The next section of the paper describes our data and variables in more detail, as well as the empirical modeling strategy. The following two sections presents the results of the analyses, and a final section summarizes our results and draws lessons for policy and future research.

II. Data and Modeling Approach

The NHIS began collecting information on food insecurity in 2011. We use the 2011, 2012, and 2013 releases of the NHIS, coupled with data from the 2012, 2013, and 2014 MEPS linked with the NHIS. As noted above, while we have two years of MEPS data for those who were in the 2011 and 2012 NHIS, we only have one year of data MEPS data for those in the 2013 NHIS because the (now currently available) 2015 MEPS was unavailable at the time of submitting our analytical files to the AHRQ restricted-use data center. We considered pooling the two MEPS waves (to generate two observations per person in the analyses), but were

concerned about the inconsistency of having one observation based on one year after the measurement of food insecurity and the other observation based on two years after the measurement of food insecurity. We therefore utilize, for the results presented in this paper, person-level models using only the first year of the MEPS surveys, i.e., those conducted in 2012, 2013, and 2014.

We separate the data into subsamples of children, nonelderly adults, and elderly adults, who have been shown to have different relationships between health outcomes and food insecurity (Gundersen and Ziliak, 2015). For each subsample, we construct variables for health status and healthcare utilization, SNAP receipt, and income as of each MEPS release, combined with the lagged measure of food insecurity from the NHIS for each MEPS family. The regressions we estimate for each subsample are of the general form

$$y_{it} = \alpha + \beta FI_{i,t-1} + \gamma EP_{it} + \delta SNAP_{it} + \theta FI_{t-1}EP_{it} + \psi FI_{i,t-1}SNAP_{it} + \pi EP_{it}SNAP_{it} + \varphi FI_{i,t-1}EP_{it}SNAP_{it} + X_{it}\omega + \varepsilon_{it}$$

where y_{it} is a measure of health status or healthcare utilization for individual *i* at year *t*, $FI_{i,t-1}$ is food insecurity at year *t-1*, EP_{it} is an indicator of extreme poverty for the family in which individual *i* resides at time *t*, $SNAP_{it}$ is an indicator participation in the SNAP program, and X_{it} is a vector of other socioeconomic variables (including both person-level and county-level characteristics described below). Year *t* is the MEPS year and year *t-1* is the NHIS year. The parameter of interest is φ, which measures whether SNAP participation generates a different effect of food insecurity on future health or healthcare outcome for those in extreme poverty compared to those not in extreme poverty. We also describe our various y variables to measure

poor health or high levels of healthcare utilization below. In this case, we hypothesize that the sign on the φ parameter is negative (i.e., if food insecurity raises the level of future poor health or healthcare utilization, and if SNAP moderates that effect by making it smaller, our hypothesis is that the moderating effect is greater for those with lower income levels).

The food insecurity variable in the NHIS is a 30-day recall measure asked about adults in the family and consists of 10 adult questions identical to those in the CPS Food Security Supplement except for asking about the most recent 30 days rather than the last 12 months. Each question has multiple answers to gauge the frequency of the insecurity problem ("often," "sometimes," etc.) and are coded to represent an occurrence if the problem occurred to any significant degree. The conventional approach is that a sum of three or more affirmative answers to the 10 questions is coded as representing the presence of food insecurity, $FI_{i,t-1}$.

The SNAP participation variable in the MEPS is based on a question asking about family receipt of SNAP benefits over the previous 12 calendar months. We code the $SNAP_{it}$ measure as 1 if any receipt occurred over that period.

Detailed data for income for each person in the household is included in the MEPS. For the creation of a variable for extreme poverty, we use the official government policy line to classify each family's total income as a percentage of the poverty line. For sample size reasons, we code extreme poverty, EP_{it}, as having income below 50 percent of the poverty line, which is equivalent to what is usually called deep poverty. Any lower cutoff point results in insufficient sample sizes. For our comparison group, we select families with income between 50 and 200 percent of the poverty line. Families with income above 200 percent of the poverty line are excluded from the analysis.

Table 1 shows the sample sizes of the cells defined by SNAP receipt, food insecurity, and

extreme poverty, pooled over all three NHIS-MEPS panels. The most important cell sizes are those for families who are both food insecure and receiving SNAP, separately for the two income groups, because these must be sufficiently large to test for the effects of the interaction of food insecurity, SNAP receipt, and income level. There are 587 children in extreme poverty in that group and 814 children in the 50-to-200 percent of the poverty line comparison group. The comparable numbers are 639 and 1,193 for nonelderly adults, but are only 29 and 134 for elderly adults. The samples for the elderly group are therefore too small for analysis, so we drop that group from further consideration.

We examine 16 measures of health and healthcare status available in the MEPS. The mean, maximum, and minimum values are shown in the upper section of Table 2 for children and nonelderly adults separately. For health measures, we have the traditional self-reported health measure, which we code as equal to 1 if in fair or poor health; a dichotomous indicator of whether limitations with daily activities were reported; three measures related to BMI, where one is the continuous measure of BMI and the other two are indicators for being obese and being underweight; an indicator of whether the individual has any chronic health condition and a count of the number of such conditions; and then specific indicators of asthma, diabetes, hypertension, heart disease, and mental health. Some of these health measures (in particular, limitations with daily activities, diabetes, hypertension, heart disease, and mental health) are rare for children, as expected, and are not considered in our empirical analysis below. For healthcare outcomes, the MEPS provides information on the number of office-based physician visits, emergency department visits, hospital inpatient stays, and hospital inpatient nights. Aside from the child measures just noted, most outcomes have reasonable incidence of the outcomes (for the dichotomous outcomes) or sufficient variation (for the continuous outcomes) to analyze for both

children and nonelderly adults.

The lower section of Table 2 shows the mean values of the three key independent variables: food insecurity, SNAP participation, an extreme poverty. About 27 percent of children are in families who previously experienced food insecurity while about 28 percent of nonelderly adults are. Almost 50 percent of children were families receiving SNAP over the past year, while about 35 percent of nonelderly adults were. About 29 percent of children were in families in extreme poverty while about 26 percent of adults were. The differences in means for children versus adults here are partly explained by the inclusion of both multiple children within families (i.e., the MEPS includes data for all children rather than just one sample child) and adults without children. A higher proportion of these low-income children falling into extreme poverty relative to adults likely contributes to the higher SNAP participation rates of children.

Other than BMI (which is a continuous measure), our dependent variables are either binary outcomes (e.g., fair/poor health status, obesity, and asthma) or discrete count outcomes (e.g., number of chronic conditions, number of physician visits) which are often modelled empirically as either logistic regressions or negative binomial regressions, respectively. We instead model these outcomes as linear regressions here for two main reasons. One is that we are particularly interested in the three-way interaction term, and interaction terms are difficult to interpret in nonlinear models (Ai and Norton, 2003). The second is that it is relatively straightforward to use a linear two-stage least squares model for our analyses treating SNAP as potentially endogenous, as described below.

III. OLS Results

Table 3 shows the results of the estimation of the equation specified in the previous section for nonelderly adults. Each column represents a regression for a particular outcome, and

only the coefficients on the main variables of interest are shown: the main and interaction effects for SNAP participation, Food Insecurity (FI), and Extreme Poverty (EP). Our primary interest is in the coefficient on the three-way interaction variable shown in the first row. Of the 16 outcome variables for adults, five have significant and negative coefficients in the hypothesized direction. Three of these are with measures of health status (fair or poor health, limitations with daily activities, and BMI) and two are for healthcare utilization (hospital inpatient stays and inpatient nights). The magnitudes of the coefficients are often large, such as a 7 percentage point reduction on the probability of fair or poor health status. Among the remaining outcome variables, most coefficients are negative in sign, sometimes with modest standard errors and sometimes with large standard errors. Only one significant positive and anomalous effect is found, for underweight BMI.

Table 4 shows the analogous set of results for children for the ten outcomes with sufficient prevalence in the data. For this population group, all the coefficients on the main variable of interest (the three-way interaction) are statistically insignificant. Almost all are negative in sign, but the standard errors are usually large. While there could be a number of explanations for this result, the most obvious is that the food insecurity variable in the NHIS only measures it for adults, not for children. Moreover, it is well known by the so-called "child protection hypothesis" that adults tend to sacrifice their own food consumption before that of their children, and hence the presence of food insecurity among adults does not necessarily imply food insecurity for children.

IV. Instrumental Variables Estimation

While both income and food insecurity could be considered endogenous, we consider only the potential endogeneity of the SNAP participation variable in our additional analyses

presented in this section. Selection bias has been suggested in many prior analyses of the effect of SNAP participation, for example, as an explanation for why participation is often positively correlated with negative outcomes such as those for poor health or high healthcare utilization. As families in poor health are more likely to participate in the program, it would not be surprising if those families receiving SNAP has poorer health outcomes than those not receiving SNAP.

Although this intuition is clear, it less obvious how selection on poor health would affect the coefficient on the three-way interaction variable of interest here. Any selection bias that occurs would have to be differential for those participants experiencing food insecurity versus those not experiencing food insecurity, and be differential for those in extreme poverty versus those not in extreme poverty among those experiencing food insecurity. Taking the selection bias argument to this higher level, for example, it might be that those SNAP participants experiencing food insecurity would have even lower levels of health than those participants not experiencing food insecurity, even in the absence of the SNAP program. Going to the third level, one might suspect that those in extreme poverty have lower levels of health than those not in extreme poverty and, further, that those in extreme poverty who experience food insecurity would have lower levels of health even in the absence of SNAP participation than those not in extreme poverty who experience food insecurity. However, this logic would imply that the OLS estimates we obtained in the previous section are biased in a positive direction, which means that the negative coefficients we found in OLS might be even larger. A selection bias hypothesis explaining our OLS results would have to go in the opposite direction, and those SNAP participants in extreme poverty who experience food insecurity have higher levels of health in the absence of the program than those not in extreme poverty who experience food insecurity. While anything is possible, it is not clear what selection bias would generate this result.

These a priori considerations notwithstanding, we test for the endogeneity of our three-way interaction variable with conventional two-stage least estimation using instrumental variables. For instruments, we use cross-state variation in SNAP policy rules, first allowed in the late 1990s and 2000s after the 1996 welfare reform act, which allowed and encouraged states to seek waivers to their SNAP administrative procedures. These state SNAP policies have been used many times in past research to instrument for SNAP participation, although never for the particular interaction model we specify here. However, an important difference between our data and that used in much prior work is that we only have people in three different time periods following 2011, when most states had essentially already settled on their SNAP policies; in contrast, much of the prior work has used data from multiple years during an earlier period when states were implementing their SNAP policies, so that, in those cases, differential changes in SNAP policies across states can be used to difference out state fixed effects. That is not possible here, and we must instead rely purely on cross-sectional variation in the instruments to correct for endogeneity.

Table 5 shows the state policy variables we use, taken from the SNAP Policy Database available online at the website of the USDA's Economic Research Service. We test nine different policy variables. While the variables were infrequently used in the initial years of their development, many have spread to almost all states by 2012-2014. However, some have means considerably less than one, and outreach spending has a high variance across states and years.

Tables 6 and 7 show the results of first stage equations using the three-way interaction variable as the dependent variable (i.e., the interaction of SNAP, food insecurity, and extreme poverty) and the state policies as the independent variables (including the other exogenous

person-level and county-level control variables used in the OLS analysis).[1] Table 6 tests each of the policies individually, and Table 7 tests several combinations of policies. Table 6 shows that many of the instruments have statistically significant effects on the three-way interaction variable. These include broad-based categorical eligibility, fingerprinting, online applications, outreach spending per capita, and simplified reporting. The other instruments do not significantly affect the interaction variable. However, none of the instruments have F-statistics of significant levels, and only one (fingerprinting) passes the conventional strong instrument test statistic of 10. Table 7 shows our attempt to use various combinations of multiple instruments instead, including a specification when all instruments are used. While several of the instruments have significant effects, the F-statistics remain low and below the levels needed for strong instruments. Other specifications not reported here yield similarly poor results for the instruments.[2]

As noted previously, the cross-sectional nature of the analyses due to the lack of variation in the state policies over our time period is the most likely reason for this result. Other data sets over different time periods or with data on alternative instruments would be needed to further explore these issues.

V. Summary and Conclusions

This paper has tested the hypothesis that SNAP participation reduces the negative effects of food insecurity on health status and healthcare utilization outcomes more for families in extreme poverty than for families with somewhat higher incomes. Our analysis shows that SNAP has a significant effect reducing the effects of food insecurity on several measures of

[1] There are four endogenous variables in the model. We show the first-stage equations only for the endogenous variable of interest, the three-way interaction of SNAP, food insecurity, and extreme poverty.
[2] We do not show second-stage estimates of the model for health and healthcare utilization outcomes using these instruments because, as expected, all coefficients on the SNAP endogenous variables are statistically insignificant.

health status and healthcare utilization for nonelderly adults, and the size of that reduction is significantly greater for families in extreme poverty than for families with higher levels of income. However, we find no significant effects of this type for children. In addition, applying an initial set of SNAP policy instruments to address the issue of endogeneity of SNAP participation renders the effects for nonelderly adults statistically insignificant. Nevertheless, our OLS estimates are likely to be biased downward, suggesting that the effects we find have credibility for detecting a true causal effect. Further work with other data sets could provide additional evidence on these issues.

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Table 1

Sample Counts for Extreme Poverty by Food Insecurity and SNAP participation

	Children	Nonelderly Adults	Elderly Adults
Income <50% FPL:	2,587	3,851	455
Food Insecure	826	1,204	69
SNAP Participant	1,728	1,743	89
Food Insecure and SNAP Participant	587	639	29
Income >50% FPL and <200% FPL:	6,270	10,788	2,304
Food Insecure	1,581	2,819	342
SNAP Participant	2,632	3,288	474
Food Insecure and SNAP Participant	814	1,193	134

Notes:
Samples are from the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS.
FPL=Federal Poverty Line

Table 2

Statistics for the Outcome Variables and the Main Independent Variables

	Children			Nonelderly Adults		
	Mean	**Min.**	**Max.**	**Mean**	**Min.**	**Max.**
Outcome Variables:						
Fair or Poor Health	0.043	0	1	0. 219	0	1
Limitations With Daily Activities	0.006	0	1	0.121	0	1
BMI (Body Mass Index)	22.20	6.5	386	28.60	9.3	187
Obese BMI	0.291	0	1	0.352	0	1
Underweight BMI	0.060	0	1	0.056	0	1
Any Chronic Health Condition	0.114	0	1	0.384	0	1
Asthma	0.085	0	1	0.062	0	1
Diabetes	0.003	0	1	0.095	0	1
Hypertension	0.003	0	1	0.189	0	1
Heart Disease	0.002	0	1	0.038	0	1
Mental Health	0.016	0	1	0.095	0	1
Num. Chronic Health Conditions	0.124	0	3	0.827	0	10
Office-Based Physician Visits	1.487	0	63	2.532	0	175
Emergency Department Visit	0.170	0	7	0.282	0	24
Hospital Inpatient Stays	0.022	0	6	0.103	0	17
Hospital Inpatient Nights	0.092	0	4	0.504	0	122
Main Independent Variables:						
Food Insecure	0.274	0	1	0.277	0	1
SNAP Participant	0.498	0	1	0.348	0	1
Extreme Poverty: <50% FPL	0.292	0	1	0.263	0	1

Notes:
Sample consists of all children and nonelderly adults in the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS with income less than 200% FPL.
N=8,857 for children and N=14,639 for adults.
FPL=Federal Poverty Line

Table 3

OLS Results for Nonelderly Adults' Health Outcomes

	Fair or Poor Health Status	Limitations With Daily Activities	BMI (Body Mass Index)	Obese BMI	Underweight BMI	Any Chronic Health Condition	Asthma	Diabetes
SNAP*FI*EP	-0.0770**	-0.0498*	-1.6655**	-0.0579	0.0446**	0.0004	-0.0139	-0.0360
	(0.0360)	(0.0278)	(0.6551)	(0.0420)	(0.0209)	(0.0367)	(0.0236)	(0.0250)
SNAP*FI	0.0343*	0.0502***	0.2894	-0.0160	-0.0127	-0.0045	0.0259**	0.0287*
	(0.0197)	(0.0155)	(0.3532)	(0.0233)	(0.0101)	(0.0201)	(0.0129)	(0.0148)
SNAP*EP	0.0011	0.0013	0.8197**	0.0520**	-0.0152	0.0083	0.0059	0.0089
	(0.0187)	(0.0142)	(0.3473)	(0.0233)	(0.0124)	(0.0206)	(0.0120)	(0.0127)
SNAP	0.0604***	0.0159**	0.7499***	0.0462***	0.0101	0.0733***	0.0171***	0.0121
	(0.0106)	(0.0076)	(0.2025)	(0.0135)	(0.0063)	(0.0117)	(0.0065)	(0.0076)
FI	0.0868***	0.0394***	0.4492**	0.0412***	0.0006	0.0711***	0.0142**	0.0137
	(0.0115)	(0.0083)	(0.1924)	(0.0141)	(0.0063)	(0.0124)	(0.0065)	(0.0085)
EP	0.0368***	0.0320***	-0.6858***	-0.0209	0.0250***	0.0259**	0.0080	0.0044
	(0.0107)	(0.0081)	(0.1974)	(0.0138)	(0.0083)	(0.0125)	(0.0064)	(0.0071)
FI*EP	0.0280	-0.0101	1.0386**	0.0211	-0.0244*	-0.0149	0.0084	0.0174
	(0.0240)	(0.0177)	(0.4219)	(0.0282)	(0.0141)	(0.0248)	(0.0140)	(0.0161)

Notes:
Sample consists of all nonelderly adults in the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS with income less than 200% FPL.
N=13,272.
FI=Food Insecurity. EP=Extreme Poverty (i.e., Under 50% of the Federal Poverty Level)
Each regression model uses person-level characteristics (including age, gender, race/ethnicity, number of people in the health insurance unit, education, marital status, insurance status, and other welfare program benefits from WIC, government-assisted housing, SSI, and TANF), county-level characteristics (including real per capita income, percent in poverty, general community hospital total beds per 1000 capita, physicians per 1000 capita, has at least one federally qualified health center, and rural status), and both year and region indicators.
Standard errors in parentheses; p-values: * p<0.1 ** p<0.05 *** p<0.01

Table 3 (continued)

OLS Results for Nonelderly Adults' Health Outcomes

	Hypertension	Heart Disease	Mental Health	Num. of Chronic Health Conditions	Office-Based Physician Visits	Emergency Department Visits	Hospital Inpatient Stays	Hospital Inpatient Nights
SNAP*FI*EP	-0.0210	0.0113	-0.0098	-0.0880	-0.0881	-0.1202	-0.0761**	-0.8942***
	(0.0302)	(0.0171)	(0.0271)	(0.1043)	(0.4863)	(0.0924)	(0.0368)	(0.3113)
SNAP*FI	0.0123	0.0052	0.0144	0.1662***	0.0670	-0.0314	0.0508**	0.6014***
	(0.0176)	(0.0106)	(0.0153)	(0.0621)	(0.3302)	(0.0426)	(0.0225)	(0.1865)
SNAP*EP	0.0091	-0.0141*	0.0018	-0.0015	-0.4113	0.1366***	0.0241	0.1467
	(0.0161)	(0.0085)	(0.0141)	(0.0538)	(0.2767)	(0.0412)	(0.0176)	(0.1388)
SNAP	0.0193**	0.0087*	0.0398***	0.1942***	0.5445***	0.1215***	0.0089	-0.0917
	(0.0095)	(0.0051)	(0.0079)	(0.0314)	(0.1917)	(0.0211)	(0.0108)	(0.0853)
FI	0.0219**	0.0136**	0.0348***	0.1792***	0.3068	0.1058***	0.0110	-0.0269
	(0.0104)	(0.0058)	(0.0082)	(0.0338)	(0.1869)	(0.0217)	(0.0113)	(0.0736)
EP	-0.0002	0.0138***	0.0092	0.0786**	0.1692	-0.0152	0.0063	0.0050
	(0.0093)	(0.0052)	(0.0076)	(0.0305)	(0.1654)	(0.0156)	(0.0087)	(0.0795)
FI*EP	0.0077	-0.0148	-0.0114	-0.0743	-0.2874	0.0673	0.0225	0.3614*
	(0.0195)	(0.0107)	(0.0163)	(0.0633)	(0.3234)	(0.0500)	(0.0224)	(0.2180)

Notes:
Sample consists of all nonelderly adults in the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS with income less than 200% FPL. N=13,272.
FI=Food Insecurity. EP=Extreme Poverty (i.e., Under 50% of the Federal Poverty Level)
Each regression model uses person-level characteristics (including age, gender, race/ethnicity, number of people in the health insurance unit, education, marital status, insurance status, and other welfare program benefits from WIC, government-assisted housing, SSI, and TANF), county-level characteristics (including real per capita income, percent in poverty, general community hospital total beds per 1000 capita, physicians per 1000 capita, has at least one federally qualified health center, and rural status), and both year and region indicators.
Standard errors in parentheses; p-values: * p<0.1 ** p<0.05 *** p<0.01

Table 4

OLS Results for Children's Health Outcomes

	Fair or Poor Health Status	BMI (Body Mass Index)	Obese BMI	Underweight BMI	Any Chronic Health Condition	Asthma	Num. of Chronic Health Conditions
SNAP*FI*EP	-0.0000	-3.6193	0.0460	-0.0317	-0.0183	-0.0370	-0.0256
	(0.0268)	(4.3017)	(0.0702)	(0.0407)	(0.0356)	(0.0307)	(0.0444)
SNAP*FI	0.0023	-0.9271	-0.0263	0.0077	0.0247	0.0128	0.0253
	(0.0134)	(0.8718)	(0.0363)	(0.0175)	(0.0204)	(0.0182)	(0.0237)
SNAP*EP	-0.0111	-0.3006	-0.0592	-0.0069	0.0085	0.0226	0.0092
	(0.0115)	(0.5410)	(0.0392)	(0.0197)	(0.0183)	(0.0157)	(0.0203)
SNAP	0.0113*	0.8627***	0.0695***	-0.0048	0.0251**	0.0172*	0.0260**
	(0.0064)	(0.3025)	(0.0206)	(0.0106)	(0.0101)	(0.0089)	(0.0110)
FI	0.0175**	1.5552**	0.0615***	-0.0123	0.0318**	0.0279**	0.0404***
	(0.0084)	(0.7831)	(0.0238)	(0.0117)	(0.0129)	(0.0116)	(0.0152)
EP	0.0049	0.4311	0.0389	-0.0026	-0.0026	-0.0207*	-0.0006
	(0.0085)	(0.3955)	(0.0297)	(0.0152)	(0.0133)	(0.0107)	(0.0149)
FI*EP	0.0185	2.9680	-0.0752	0.0570*	-0.0208	-0.0066	-0.0098
	(0.0213)	(4.2020)	(0.0548)	(0.0340)	(0.0265)	(0.0226)	(0.0346)

Notes:
Sample consists of all children in the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS with income less than 200% FPL.
N= 4491 for BMI related outcomes; N=8,441 for all else.
FI=Food Insecurity. EP=Extreme Poverty (i.e., Under 50% of the Federal Poverty Level)
Each regression model uses person-level characteristics (including age, gender, race/ethnicity, number of people in the health insurance unit, education, marital status, insurance status, and other welfare program benefits from WIC, government-assisted housing, SSI, and TANF), county-level characteristics (including real per capita income, percent in poverty, general community hospital total beds per 1000 capita, physicians per 1000 capita, has at least one federally qualified health center, and rural status), and both year and region indicators.
Standard errors in parentheses; p-values: * p<0.1 ** p<0.05 *** p<0.01

Table 4 (continued)

OLS Results for Children's Health Outcomes

	Office-Based Physician Visits	Emergency Department Visits	Hospital Inpatient Stays	Hospital Inpatient Nights
SNAP*FI*EP	-0.4765	-0.0853	-0.0028	-0.1007
	(0.3071)	(0.0584)	(0.0160)	(0.1172)
SNAP*FI	0.2579	0.0142	0.0000	0.0578
	(0.1863)	(0.0316)	(0.0102)	(0.0676)
SNAP*EP	0.0526	0.0264	0.0001	0.0670
	(0.1704)	(0.0280)	(0.0094)	(0.0629)
SNAP	0.1438*	0.0540***	0.0060	0.0135
	(0.0741)	(0.0166)	(0.0057)	(0.0279)
FI	0.1385	0.0279	-0.0003	-0.0079
	(0.1124)	(0.0186)	(0.0057)	(0.0310)
EP	-0.0477	-0.0315*	-0.0022	-0.0171
	(0.1412)	(0.0186)	(0.0061)	(0.0231)
FI*EP	-0.0587	0.0613	-0.0032	0.0388
	(0.2352)	(0.0432)	(0.0111)	(0.0564)

Notes:
Sample consists of all children in the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS with income less than 200% FPL.
N=8,441.
FI=Food Insecurity. EP=Extreme Poverty (i.e., Under 50% of the Federal Poverty Level)
Each regression model uses person-level characteristics (including age, gender, race/ethnicity, number of people in the health insurance unit, education, marital status, insurance status, and other welfare program benefits from WIC, government-assisted housing, SSI, and TANF), county-level characteristics (including real per capita income, percent in poverty, general community hospital total beds per 1000 capita, physicians per 1000 capita, has at least one federally qualified health center, and rural status), and both year and region indicators.
Standard errors in parentheses; p-values: * p<0.1 ** p<0.05 *** p<0.01

Table 5

Means of the SNAP Policy Instrumental Variables

State SNAP Policy	Mean
Any kind of broad-based categorical eligibility	0.891
Combined application for SSI	0.507
Fingerprinting of applicants required	0.115
Online application allowed	0.903
Outreach spending per capita (approximate)	3.468
Outreach spending per person in poverty (approximate)	21.985
Simplified reporting	0.879
All vehicles excluded from asset test	0.747
Any of three vehicle/auto rules is lenient	0.871

Notes:
Means are taken over all states in all years.

Table 6

First Stage Instrumental Variable Results for Three-Way SNAP*FI*EP Interaction Variable: Single Instruments

	Any kind of broad-based categorical eligibility	Combined application for SSI	Finger-printing of applicants required	Online application allowed	Outreach spending per capita	Outreach spending per person in poverty	Simplified reporting	All vehicles excluded from asset test	Any of three vehicle/auto rules is lenient
	0.0082*	-0.0011	-0.0162***	-0.0072*	0.0005	0.0002**	0.0159***	0.0026	-0.0013
	(0.0044)	(0.0032)	(0.0048)	(0.0042)	(0.0005)	(0.0001)	(0.0054)	(0.0031)	(0.0040)
Regular F Statistic	3.49	0.12	11.16	3.04	0.92	4.61	8.63	0.71	0.11
Uncentered R2	0.2462	-6.7666	0.2251	0.2815	-3.07E+00	-0.3514	0.3256	-1.4759	-12.184
Cragg-Donald Wald F statistic	3.475	0.123	11.715	2.896	0.795	3.961	8.525	0.672	0.109
Kleibergen-Paap rk Wald F statistic	3.494	0.115	11.16	3.04	0.916	4.606	8.631	0.707	0.113

Notes:
Sample consists of all nonelderly adults in the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS with income less than 200% FPL. N=13,272.
FI=Food Insecurity. EP=Extreme Poverty (i.e., Under 50% of the Federal Poverty Level)
Each regression model uses person-level characteristics (including age, gender, race/ethnicity, number of people in the health insurance unit, education, marital status, insurance status, and other welfare program benefits from WIC, government-assisted housing, SSI, and TANF), county-level characteristics (including real per capita income, percent in poverty, general community hospital total beds per 1000 capita, physicians per 1000 capita, has at least one federally qualified health center, and rural status), and both year and region indicators.
Standard errors in parentheses; p-values: * p<0.1 ** p<0.05 *** p<0.01

Table 7

First Stage Instrumental Variable Results for Three-Way SNAP*FI*EP Interaction Variable: Multiple Instruments

Any kind of broad-based categorical eligibility					0.0081*
					(0.0046)
Combined application for SSI	-0.0005	-0.0033		-0.0019	-0.0016
	(0.0032)	(0.0032)		(0.0032)	(0.0035)
Fingerprinting of applicants required	-0.0162***		-0.0125**	-0.0119**	-0.0092
	(0.0048)		(0.0058)	(0.0059)	(0.0062)
Online application allowed					-0.0025
					(0.0044)
Outreach spending per capita					-0.0063***
					(0.0022)
Outreach spending per person in poverty					0.0010***
					(0.0003)
Simplified reporting		0.0171***	0.0094	0.0104	0.0105
		(0.0054)	(0.0065)	(0.0066)	(0.0067)
All vehicles excluded from asset test					0.0029
					(0.0035)
Any of three vehicle/auto rules is lenient					-0.0039
					(0.0042)
Regular F Statistic	5.58	5.12	7.52	5.17	4.38
Uncentered R2	0.2338	0.3379	0.2727	0.2968	0.3292
Cragg-Donald Wald F statistic	5.868	4.79	7.038	4.813	3.777
Kleibergen-Paap rk Wald F statistic	5.581	5.122	7.518	5.168	4.377

Notes:
Sample consists of all nonelderly adults in the 2011-2012, 2012-2013, and 2013-2014 linked NHIS-MEPS with income less than 200% FPL. N=13,272.
FI=Food Insecurity. EP=Extreme Poverty (i.e., Under 50% of the Federal Poverty Level)
Each regression model uses person-level characteristics (including age, gender, race/ethnicity, number of people in the health insurance unit, education, marital status, insurance status, and other welfare program benefits from WIC, government-assisted housing, SSI, and TANF), county-level characteristics (including real per capita income, percent in poverty, general community hospital total beds per 1000 capita, physicians per 1000 capita, has at least one federally qualified health center, and rural status), and both year and region indicators.
Standard errors in parentheses; p-values: * p<0.1 ** p<0.05 *** p<0.01