

# Supplemental Nutrition Assistance Program Participation Is Associated with an Increase in Household Food Security in a National Evaluation<sup>1,2</sup>

James Mabli\* and Jim Ohls

Mathematica Policy Research, Cambridge, MA

## Abstract

**Background:** The Supplemental Nutrition Assistance Program (SNAP) provides nutrition assistance benefits to low-income families in an effort to reduce hunger and improve health and well-being. Because 1 in 7 Americans participate in the program each month, policymakers need to know whether the program is meeting these objectives effectively.

**Objective:** The objective of this study was to estimate the association between SNAP participation and household food security using recent data from the largest national survey of the food security of SNAP participants to date.

**Methods:** The analysis used a survey of nearly 6500 households and a quasi-experimental research design that consisted of 2 sets of comparisons. Using a cross-sectional sample, we compared information collected from SNAP households within days of program entry with information collected from a contemporaneous sample of SNAP households that had participated for ~6 mo. Next, using a longitudinal sample, we compared baseline information collected from new-entrant SNAP households with information from those same households 6 mo later. Multivariate logistic regression analysis was used to estimate associations between SNAP and household food security.

**Results:** SNAP participation decreased the percentage of SNAP households that were food insecure in both samples by 6–17%. SNAP participation also decreased the percentage of households experiencing severe food insecurity—designated very low food security—by 12–19%. Findings were qualitatively robust to different empirical specifications.

**Conclusion:** SNAP serves a vital role in improving the health and well-being of households by increasing food security. Given recent legislation to reduce program size and limit program eligibility, this study underscores SNAP's continued importance in affecting households' well-being. Future research is needed to determine whether specific groups of households experience differential improvements in food security. *J Nutr* 2015;145:344–51.

**Keywords:** SNAP, household food security, nutrition assistance, program participation, food stamps

## Introduction

The Supplemental Nutrition Assistance Program (SNAP) provides nutrition assistance benefits to low-income individuals and families in an effort to reduce hunger and improve the health and well-being of low-income people nationwide. Although SNAP has long been one of the largest and most important nutrition assistance programs administered by the USDA for low-income households, its significance has grown even larger in recent years as it experienced record-high levels of participation. In fiscal year 2013, the program provided benefits to ~48 million Americans each month (1).

Policymakers, advocates, and those administering SNAP have long hypothesized that SNAP reduces food insecurity, which is a measure of whether a household experiences food access limitations because of lack of money or other resources. In 2012, 1 in 7 households was food insecure (2). Estimating the effect of SNAP on food insecurity using household survey data has been challenging, however, because of selection bias (3–6). Most research studies attempted to isolate SNAP's effect on food insecurity from the compositional differences between participants and nonparticipants using a variety of data and empirical methods, but the evidence of the program's effect has been mixed. Some studies found positive or no associations between SNAP and food insecurity (7–11), whereas others, including some with the strongest designs, found that SNAP was associated with a decrease in food insecurity (3, 12–19).

In this article, we estimated the effect of SNAP on household food security using recently collected, nationally representative

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\* To whom correspondence should be addressed: jmabli@mathematica-mpr.com.

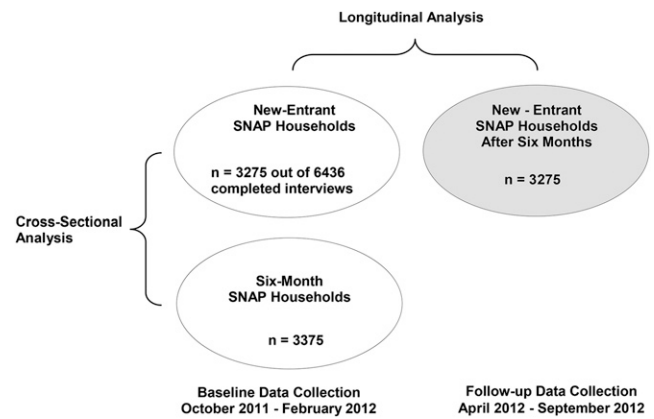
data from the SNAP food security survey conducted by Mathematica Policy Research for the USDA Food and Nutrition Service. This article contributes to the literature of the effects of SNAP on food insecurity in several ways. First, we used recent data, collected from 2011 to 2012, and a large sample size of ~6550 SNAP households. Second, we minimized selection bias by comparing extant SNAP participant households to new households that had just entered SNAP. Thus, a major source of selection bias in previous studies borne from comparing program participants to nonparticipants—many of which do not eventually even enter SNAP—was avoided in this study through interviewing new-entrant households and obtaining information from the month before entering SNAP. Third, SNAP households were identified from state caseload files obtained from SNAP administrative agencies. Therefore, compared with many studies that rely on national survey data, such as the Current Population Survey, the Survey of Income and Program Participation, or the Panel Study of Income Dynamics, our study avoids the extensive misreporting of self-reported SNAP participation status, which can bias estimates of policy effects (19–21).

## Methods

**Study design.** This study used 2 overlapping research designs: a cross-sectional comparison group design and a longitudinal design. The cross-sectional design compared the food security of new-entrant households that were certified for SNAP in the 5 d prior to the sample date with the food security of households that had participated in SNAP for the previous 6–7 mo (6-mo households). The longitudinal design compared the food security of the new-entrant households at program entry with those same households 6 or 7 mo later. (Nearly all, or 99.7%, of households referred to as “6-mo households” confirmed in the screening section of the survey that they had been in SNAP for “~6 mo” and were not asked to report exactly how long. The remaining 0.3% of households reported having participated for 4 or 8 mo.) There are tradeoffs to using each design. The longitudinal design minimizes self-selection bias relative to the cross-sectional design in which different households are compared at a single point in time. Program effects in the longitudinal design may be confounded by changes over time in external factors. Using both experimental designs addresses each design’s weakness and demonstrates the robustness of our findings to study design properties in order to obtain definitive estimates of the effect of SNAP on household food security. This study was approved for ethical treatment of participants by the Office of Management and Budget. Additional details of the study design can be found in the survey report (22).

**Data collection.** Data were collected using computer-assisted telephone interviewing. The cross-sectional analysis compares 3275 new-entrant households to 3375 6-mo households interviewed from October 2011 through February 2012. The longitudinal analysis compares the 3275 new-entrant households at baseline with those same households 6 mo later, from April to September 2012 (Figure 1). We attempted to increase comparability between new-entrant and 6-mo households by restricting the sample of new-entrants in the cross-sectional analysis to those that continued to participate 6 mo later (the original sample size was 6436 new-entrant households at baseline). The reduction in the sample size of the new-entrant households was largely due to households leaving SNAP, identified from state caseload files, rather than survey attrition. In the Results section, we show that the article’s main findings were nearly identical when the unrestricted sample of all new entrants was used in place of the restricted sample.

An important analytic goal in implementing the study design was to interview new-entrant households as quickly as possible after they were certified for SNAP so that the recall period for the interview captured the households’ circumstances and experiences prior to receiving benefits. Interviews were conducted within a 2-wk period for new-entrant households, within a 4-wk period for 6-mo households, and within an 8-wk period for follow-up interviews with new-entrant households.



**FIGURE 1** Study design and sample sizes of numbers of households that completed the SNAP food security survey. SNAP, Supplemental Nutrition Assistance Program.

**Weighting.** The study had a 2-stage sample design. Using probability-proportional-to-size sampling and SNAP household counts in each state as a measure of size, we selected a sample of 30 states. In each of the 30 states, we then sampled households from state-level administrative caseload files. Sampling weights were used in all analyses to account for the sample design and to adjust for differences in nonresponse propensities across respondent groups. The sampling weights make the estimates of the policy effects presented in this article nationally representative of new-entrant SNAP households and 6-mo households at the time of the baseline interviews.

**Measuring household food security.** As in the core food security module used in the Current Population Survey Food Security Supplement (2, 23), we administered the 18 core items of the food security module for assessing the food security of households with children and 10 items for households without children. The questionnaire was based on a 30-d recall period.

The 2 outcomes used in the analysis were household food insecurity and household very low food security. We defined household food insecurity to be a binary variable indicating whether a household was food insecure. Similarly, we defined household very low food security to be a binary variable indicating whether a household experienced very low food security. Although household food security status can be measured using the 10 adult-referenced items for households without children and the full 18 items (the 10 adult-referenced items plus the 8 child-referenced items) for households with children, we measured food security using the 10 adult-referenced items for all households to minimize any measurement effects associated with the presence and ages of children (3, 24). Households that affirmed  $\geq 3$  items were classified as food insecure and households that affirmed  $\geq 6$  items were classified as having very low food security. Thus, a food-insecure household can be one that had very low food security, or one that affirmed 3–5 items and had low food security.

**Statistical analysis.** For the cross-sectional analysis, we estimated a logistic regression model to estimate the effect of SNAP on food security:

$$Y_i^* = \beta \text{SNAP}_i + \gamma X_i + \varepsilon_i \quad (1)$$

where  $Y_i = 1$  if  $Y_i^* > 0$  and  $Y_i = 0$  otherwise. In the model,  $Y_i$  is an indicator variable measuring whether household  $i$  is food insecure.  $\text{SNAP}_i$  is an indicator variable for whether household  $i$  had participated in SNAP for ~6 mo, vs. having just entered the program. The remaining explanatory variables, described below, are captured in the vector  $X_i$ . Finally,  $\varepsilon_i$  is an error term assumed to follow a logistic distribution.

In the longitudinal analysis, we used data collected from households at 2 points in time to estimate the following model:

$$Y_{it}^* = \beta \text{SNAP}_{it} + \gamma X_{it} + \delta_i + \varepsilon_{it} \quad (2)$$

where  $Y_{it} = 1$  if  $Y_{it}^* > 0$  and  $Y_{it} = 0$  otherwise. In the model,  $Y_{it}$  is an indicator variable measuring whether household  $i$  is food insecure at

time  $t$ .  $SNAP_{it}$  is an indicator variable for whether household  $i$  at time  $t$  had participated in SNAP for  $\sim 6$  mo, vs. having just entered the program.  $X_{it}$  is a vector of other explanatory variables, described below, for household  $i$  at time  $t$ .  $\delta_i$  is a household-level fixed effect and  $\varepsilon_{it}$  is an error term. Our main specification for the longitudinal model included household fixed effects, although the findings were statistically the same when they were excluded. As an approximation, when fixed effects were included, we estimated a linear probability model rather than a logistic regression model.

The regression models included the following explanatory variables: demographic characteristics of the household head (gender, highest grade completed, race and ethnicity, depression status, and employment status); household economic characteristics (household income-to-poverty ratio, household size, household composition, prior SNAP participation status, region of residence based on the 7 Food and Nutrition Service regions, and changes in housing status, household size, and employment, pay, or hours worked); state economic characteristics and SNAP policies [state 25th percentile wage, state nonseasonally adjusted unemployment rate, a binary variable for whether the state offered broad-based categorical eligibility to SNAP participants (25), and the average SNAP certification period (26)].

Several variables from the cross-sectional regression that were constant over time were dropped from the longitudinal fixed-effects regression. This included gender and race and ethnicity of the household head, prior SNAP participation status, and region of residence and state economic and SNAP policy variables (which are based on a household's state of residence).

Regression-adjusted percentages of new-entrant and 6-mo households that were food insecure (or had very low food security) that are presented in tables were calculated as means of household-level predicted probabilities of food insecurity (or very low food security). All analyses were weighted.

We performed sensitivity analyses to test whether the findings were robust to decisions regarding functional form, variable inclusion, and sample restrictions. Specifically, for the cross-sectional sample, we estimated an ordinary least-squares regression model in place of a logistic regression model to assess whether our findings were sensitive to the model's functional form. In the longitudinal sample, we estimated our basic logistic regression model without including household fixed effects. As another specification check, we used a smaller set of explanatory variables. Our original model used a large set of variables, reflecting the comprehensiveness of the survey and the fact that many variables can explain differences in food security between new-entrant and 6-mo households. The auxiliary model included a more parsimonious set of variables limited to household income, composition, and size; region of residence; prior SNAP participation; and whether the interview was conducted in English. In addition, we re-estimated the cross-sectional and longitudinal analyses using the sample of new-entrants that was not restricted to households that were still participating at the time of the follow-up interview.

We also tested the sensitivity of the results to the timing of the receipt of SNAP benefits relative to the interview date. Sixteen percent of new-entrant households were interviewed before receiving SNAP benefits. Thirteen percent were interviewed within 5 d of receiving their benefit, 23% within 6–10 d, 24% within 11–15 d, 13% within 16–20 d, and 11% within at least 21 d. To examine the sensitivity of the findings to the amount of time since new-entrant households received SNAP benefits, we categorized new-entrant households into 3 groups based on the days since benefit receipt: 0 d, 1–11 d, or  $\geq 12$  d. (Among new-entrant households that had received their benefit on or before the interview date, the median number of days since receipt was 11.) We re-estimated our main regression model for each of these sets of new-entrant households and the full set of 6-mo households.

We used a first-order Taylor series approximation to estimate SEs. We accounted for the complex survey design of the SNAP food security survey when estimating SEs using the “svy” commands in Stata 13.1 and performed 2-sided statistical  $t$  tests using significance levels of 0.10, 0.05, and 0.01.

## Results

**Sample statistics.** Descriptive statistics can be found in Table 1. In the cross-sectional sample the percentage of new-entrant

and 6-mo households that were food insecure were 65.5% and 58.7%—a difference of  $-6.8$  percentage points. In the longitudinal sample, there was a  $-12.7$  percentage point difference in the percentage of new-entrant households and those same households 6 mo later that were food insecure (65.5% and 52.8%, respectively). The analogous percentages of households with very low food security were 39.4% and 32.0%, respectively, in the cross-sectional sample (a  $-7.4$  percentage point difference) and 39.4% and 30.4%, respectively, in the longitudinal sample (a  $-9.0$  percentage point difference).

Comparing the summary statistics of new-entrant and 6-mo households in this article to the summary statistics for all SNAP households in a USDA report (26) that is based on fiscal year 2011 SNAP administrative data shows that the households in our samples of new-entrant and 6-mo households in fiscal year 2012 were generally similar to all SNAP households in fiscal year 2011 (administrative data from fiscal year 2012 are not yet available).

**Multivariate analysis of SNAP and food insecurity.** Participating in SNAP for 6 mo decreased the likelihood of household food insecurity in both the cross-sectional and longitudinal analyses, and these effects were statistically significant at the 0.01 level (Table 2). Interpreting the effects in terms of percentages, participating in SNAP for  $\sim 6$  mo decreased the percentage of food-insecure households by 4.2 percentage points in the cross-sectional sample and 11.1 percentage points in the longitudinal sample.

**Multivariate analysis of SNAP and very low food security.** Participating in SNAP for 6 mo also decreased the likelihood of a household having very low food security in the cross-sectional and longitudinal analyses (Table 2). SNAP decreased the percentage of households that experienced very low food security by 4.6 percentage points in the cross-sectional sample and 7.4 percentage points in the longitudinal sample.

**Sensitivity of results to alternative specifications.** Results of sensitivity analyses indicated that our main findings were qualitatively robust to various analysis specification decisions. The research design itself embodied an important specification test by using both cross-sectional and longitudinal samples. As discussed in the previous section, both approaches led to similar substantive conclusions.

In testing whether our findings were sensitive to the model's functional form, the estimated effect of SNAP on the percentage of food-insecure households was a decrease of 4.3 percentage points when using an ordinary least-squares model, compared with a decrease of 4.2 percentage points in the original logistic model (Table 3). The robustness was similar for very low food security.

In the longitudinal sample, we estimated our basic logistic regression model without including household fixed effects. This changed the estimated effects of SNAP compared with our basic equation (Table 4) from  $-11.1$  percentage points in the original specification with fixed effects to  $-9.7$  percentage points in the alternative model without fixed effects. The sensitivity was similar for very low food security.

We also tested whether our findings were sensitive to the specific explanatory variables that were included in the model. The reductions in food insecurity and very low food security associated with SNAP were larger in a model with a more parsimonious set of explanatory variables than in the original specification (Table 4). However, the differences were not

**TABLE 1** Summary statistics of households that recently entered SNAP and households that had been participating in SNAP for ~6 mo<sup>1</sup>

	Cross-sectional estimates			Longitudinal estimates		
	New-entrant households (baseline)	6-mo households	Difference	New-entrant households (baseline)	New-entrant households (6-mo follow-up)	Difference
Female household head	64	66	2	64	64	0
Race and ethnicity of household head						
Non-Hispanic white	47	50	3	47	46	-1
Non-Hispanic black	26	25	-1	26	26	0
Non-Hispanic other	7	8	1	7	7	0
Hispanic	23	22	-1	23	24	1
Age of household head						
18-24 y	20	20	0	20	20	0
25-49 y	52	54	2	52	54	2
50-64 y	21	20	-1	21	20	-1
≥65 y	7	6	-1	7	6	-1
Educational level of household head						
Less than high school	23	23	0	23	23	0
High school graduate (diploma or general equivalency diploma)	33	31	-2	33	33	0
Some college, but no degree	36	39	3	36	36	0
College graduate and beyond	9	7	-2	9	8	-1
Average household size, <i>n</i>	2.3	2.5	0.2	2.3	2.3	0
Households with children	41	46	5	41	42	1
Households with elderly	12	12	0	12	11	-1
Households with a disabled member	32	34	2	32	27	-5
Employment status of household head						
Employed full-time	12	18	6	12	18	6
Employed part-time	9	9	0	9	10	1
Not employed	79	73	-6	79	73	-6
Mean monthly income as a percentage of the federal poverty level	61	72	11	61	71	10
Households with zero monthly income	25	20	-5	25	20	-5
Household head felt depressed in past 30 d	80	77	-3	80	72	-6
Interview conducted in English	90	91	1	90	90	0
Prior SNAP participation	49	48	-1	49	NA	NA
Region of residence						
Northeast	13	12	-1	13	13	0
Mid-Atlantic	7	14	7	7	7	0
Midwest	13	18	5	13	13	0
Southeast	25	17	-8	25	25	0
Southwest	12	11	-1	12	12	0
Mountain Plains	6	6	0	6	6	0
West	24	23	-1	24	24	0
In past 6 mo, experienced the following:						
Change in household size	21	14	-7	21	16	-5
Eviction from house or apartment	5	3	-2	5	3	-2
Change in employment, pay, or hours worked	39	26	-13	39	20	-19
Average state 25th percentile wage, US dollars	11	11	0	11	11	0
Average state unemployment rate	9	9	0	9	9	0
Households residing in states that offer broad-based categorical eligibility for SNAP	89	89	0	89	89	0
Average state SNAP certification period, mo	12	12	0	12	12	0
Food security						
Food secure	34.5	41.3	6.8	34.5	47.2	12.7
Food insecure	65.5	58.7	-6.8	65.5	52.8	-12.7
Food insecure with low food security	26.1	26.7	0.6	26.1	22.4	-3.7
Food insecure with very low food security	39.4	32.0	-7.4	39.4	30.4	-9.0

<sup>1</sup> Values are percentages unless otherwise indicated. Data were derived from the SNAP Food Security Survey 2012. The cross-sectional estimates compare new SNAP participants with a contemporaneous set of participants who had been participating in SNAP for ~6 mo. The longitudinal estimates compare new SNAP participants with the same participants ~6 mo later. NA, not applicable; SNAP, Supplemental Nutrition Assistance Program.

**TABLE 2** Regression-adjusted percentage of households that are food insecure and regression-adjusted percentage of households that have very low food security, for households that recently entered SNAP and households that had been participating in SNAP for ~6 mo<sup>1</sup>

	Cross-sectional estimates			Longitudinal estimates		
	New-entrant households		Difference <sup>2</sup>	New-entrant households		Difference <sup>2</sup>
	(baseline)	6-mo households		(baseline)	(6-mo follow-up)	
Food insecure	64.2	60.0	-4.2 ± 1.3*	65.0	53.9	-11.1 ± 0.9*
Food insecure with very low food security	38.0	33.4	-4.6 ± 0.8*	38.8	31.4	-7.4 ± 1.0*

<sup>1</sup> Data were derived from SNAP Food Security Survey 2012. The cross-sectional estimates compare 3275 new SNAP households with a contemporaneous set of 3375 households that had been participating in SNAP for ~6 mo. The longitudinal estimates compare 3275 new SNAP households with the same participant households ~6 mo later. The percentage estimates are adjusted for gender, race, ethnicity, highest grade completed, employment status, and depression status of the household head; household income-to-poverty ratio, size, and composition; prior SNAP participation status; current participation in federal or state programs; changes in household size, housing status, employment, pay, or hours worked; region of residence; state 25th percentile wage and state (nonseasonally-adjusted) unemployment rate; and variables indicating whether the state offers broad-based categorical eligibility to SNAP participants and the average SNAP certification period. \*Significantly different from zero at the 0.01 level, 2-sided *t* test. SNAP, Supplemental Nutrition Assistance Program.

<sup>2</sup> Values are mean percentage point differences ± SEs.

substantial and, based on an *F* test, we rejected using this specification in favor of using the original model for both the cross-sectional and longitudinal samples.

Finally, the effects on food insecurity were similar using either the unrestricted sample of new-entrant households or the restricted sample (Table 4). The same was true for very low food security. This likely reflects the fact that there were few differences between new-entrant households with a follow-up interview and new-entrant households without a follow-up interview. As shown in the survey report (22), respondents who completed a follow-up interview were more likely to be female, younger, and nonemployed (relative to being employed full-time), and to have an elderly or disabled member in the household. They were less likely to have experienced a change in employment, pay, or hours worked in the 6 mo preceding the baseline interview.

**Sensitivity of results to the timing of the receipt of SNAP benefits relative to the interview date.** The findings from the main specification were also robust to the timing of when new-

entrant households received program benefits relative to their interview date. Compared with the full sample of SNAP households in the main analysis, the reductions in food insecurity and very low food security were larger for households that were interviewed before receiving benefits or within several days of receiving benefits. The decrease in food insecurity for households interviewed before they received benefits was 12.0 percentage points in the cross-sectional sample and 16.9 percentage points in the longitudinal sample (Table 4). Among households that were interviewed after receiving benefits, the reductions in food insecurity (or very low food security) were generally similar for households that had received their benefit at least 12 d prior to the interview and households that had received them more recently (Table 4). An exception was for very low food security in the cross-sectional sample; very low food security decreased by a greater amount for households that had received benefits more recently.

This analysis showed that the study's main finding—that participating in SNAP improved food security—was not

**TABLE 3** Effects of participating in SNAP for ~6 mo on the percentage of households that are food insecure or that have very low food security, by alternative model specifications<sup>1</sup>

	Cross-sectional estimates	Longitudinal estimates
Food insecure		
OLS for cross-sectional sample	-4.3 ± 1.3*	NA
Logistic without fixed effects for longitudinal sample	NA	-9.7 ± 0.8*
Smaller set of explanatory variables	-6.5 ± 1.5*	-11.8 ± 0.7*
Unrestricted sample that includes all new-entrant households	-4.7 ± 1.2*	-10.9 ± 1.2*
Food insecure with very low food security		
OLS for cross-sectional sample	-4.5 ± 0.8*	NA
Logistic without fixed effects for longitudinal sample	NA	-5.8 ± 1.0*
Smaller set of explanatory variables	-6.9 ± 0.8*	-8.4 ± 1.1*
Unrestricted sample that includes all new-entrant households	-5.8 ± 1.1*	-7.1 ± 1.0*

<sup>1</sup> Values are mean percentage point differences ± SEs. Data were derived from the SNAP Food Security Survey 2012. The cross-sectional estimates compare 3275 new SNAP households with a contemporaneous set of 3375 households that had been participating in SNAP for ~6 mo. The longitudinal estimates compare 3275 new SNAP households with the same participant households ~6 mo later. Percentage estimates are adjusted for gender, race, ethnicity, highest grade completed, employment status, and depression status of the household head; household income-to-poverty ratio, size, and composition; prior SNAP participation status; current participation in federal or state programs; changes in household size, housing status, employment, pay, or hours worked; region of residence; state 25th percentile wage and state (nonseasonally-adjusted) unemployment rate; and variables indicating whether the state offers broad-based categorical eligibility to SNAP participants and the average SNAP certification period. \*Significantly different from zero at the 0.01 level, 2-sided *t* test. NA, not applicable; OLS, ordinary least squares; SNAP, Supplemental Nutrition Assistance Program.

**TABLE 4** Effects of participating in SNAP for ~6 mo on the percentage of households that are food insecure or that have very low food security, by number of days since SNAP benefit receipt for new-entrant households<sup>1</sup>

	Cross-sectional estimates	Longitudinal estimates
Food insecure		
New-entrant households that had not received benefits before interview	-12.0 ± 2.5** <sup>2</sup>	-16.9 ± 2.3** <sup>2</sup>
New-entrant households that had received benefits before interview	-3.3 ± 1.5*	-10.7 ± 0.9**
New-entrant households that had received benefits 1–11 d before interview	-4.9 ± 1.4**	-10.8 ± 1.4**
New-entrant households that had received benefits ≥12 d before interview	-1.6 ± 2.2	-10.5 ± 1.5**
Food insecure with very low food security		
New-entrant households that had not received benefits before interview	-9.6 ± 2.2** <sup>3</sup>	-14.4 ± 2.8** <sup>3</sup>
New-entrant households that had received benefits before interview	-3.7 ± 1.0**	-6.9 ± 1.2**
New-entrant households that had received benefits 1–11 d before interview	-5.3 ± 1.3** <sup>3</sup>	-7.7 ± 1.5**
New-entrant households that had received benefits ≥12 d before interview	-2.0 ± 1.4	-6.1 ± 1.5**

<sup>1</sup> Values are mean percentage point differences ± SEs. Data were derived from the SNAP Food Security Survey 2012. The cross-sectional estimates compare 3275 new SNAP households with a contemporaneous set of 3375 households that had been participating in SNAP for ~6 mo. The longitudinal estimates compare 3275 new SNAP households with the same participant households ~6 mo later. The percentage estimates are adjusted for gender, race, ethnicity, highest grade completed, employment status, and depression status of the household head; household income-to-poverty ratio, size, and composition; prior SNAP participation status; current participation in federal or state programs; changes in household size, housing status, employment, pay, or hours worked; region of residence; state 25th percentile wage and state (nonseasonally-adjusted) unemployment rate; and variables indicating whether the state offers broad-based categorical eligibility to SNAP participants and the average SNAP certification period. All samples use the original set of 6-mo households. Only the sample of new-entrant households is restricted by days since benefit receipt. For each sample and food security measure, the hypothesis that the effects were equal across all "time since benefit receipt" groups was rejected at the 0.01 level. \*, \*\*Significantly different from zero at the 0.05 and 0.01 levels, respectively, 2-sided *t* test. SNAP, Supplemental Nutrition Assistance Program.

<sup>2</sup> Effect of SNAP on food insecurity for households that had not received benefits before the interview is statistically different from the effect for households that had received benefits at the 0.01 level (2-sided *t* test) in the cross-sectional and longitudinal samples.

<sup>3</sup> Effect of SNAP on very low food security for households that had not received benefits before the interview is statistically different from the effect for households that had received benefits at the 0.05 level (2-sided test) in the cross-sectional and longitudinal samples. Effect for 1- to 11-d households is statistically different from effect for ≥12-d households at the 0.10 level (2-sided test) in the cross-sectional sample.

sensitive to the time since receipt of benefits at baseline. The size of the effects of SNAP on food insecurity and very low food security did differ by time since benefit receipt, however, and suggests that the effects in the main analysis may be conservative in magnitude. Because the characteristics of households that were interviewed before receiving benefits may be different from the characteristics of households that were interviewed after receiving benefits, the larger effects found in these sensitivity analyses may not be due only to the length of time since benefit receipt.

## Discussion

SNAP has long been recognized as a critically important cornerstone in America's system for providing assistance to low-income households. The program has generally received broad political and public support, much of which is attributable to its close links with food purchasing and food consumption. In this context, it is very important to provide continuing surveillance of the program's effects on the outcomes of its participants. The current study provided important evidence in this regard. With its large sample size, carefully structured quasi-experimental research design, and robust and statistically significant findings, this study provided convincing evidence that SNAP improves household food security.

The results of this study suggest that SNAP participation reduced food insecurity by 4.2–11.1 percentage points and reduced very low food security by 4.6–7.4 percentage points. Translating these into percentage changes using as a base the percentage of new-entrant households that were food insecure or that had very low food security (65.5% and 39.4%,

respectively), SNAP participation reduced food insecurity by 6% in the cross-sectional sample and 17% in the longitudinal sample. For very low food security, the reductions were 12% and 19%, respectively.

The sizes of these associations are larger than those in past studies that found no significant associations, and generally smaller than those that found significant associations. As discussed in the introduction, parts of the past literature failed to find any clear associations at all (7–10), or even positive associations between SNAP and food insecurity (11). These studies may not have been successful in correcting for selection bias caused by correlations between unobserved variables and both SNAP participation and food insecurity (4).

There are also a number of studies in the literature that suggest substantially larger effects than we found, ranging from ~20% to 30%. Many of these studies are based on multiyear panel data sets like the Survey of Income and Program Participation or Panel Study of Income Dynamics or matched Current Population Survey data (3, 12–18). Although most of these studies use econometric methods to address selection bias, the estimates of policy effects may be biased by the extensive misreporting of self-reported SNAP participation (19–21).

Relative to these studies, the estimates of policy effects in our main analysis suggest that SNAP improved food security by a smaller amount. It is possible that our estimates are conservative, because the effects were larger when we restricted the sample to new-entrant households that were interviewed before or with several days of receiving SNAP benefits. In those analyses, the reductions in food insecurity were 18–26% and the reductions in very low food security were 24–37%. However, it is unclear whether the larger reductions reflect a comparison group that better represents pre-SNAP

circumstances or simply reflect differences between households interviewed before receiving benefits and those interviewed after receiving benefits.

In comparing our study with others, it is important to consider that we estimated a program effect that is different from in other studies. Our effect measured the reduction in food insecurity from participating for ~6 mo in SNAP for those eligible households that choose to participate in the program. This differs from the effect in related studies, which typically measures what the reduction in food security would be if all eligible households participated in SNAP (14, 16, 17, 19). Given that \$76 billion is spent on program benefits each year out of a total of \$80 billion in SNAP expenditures (1), an important policy question is whether those benefits are improving the food security of program participants. Our study addressed this question. A related, but different, question is what the effect on food security would be if benefits were given to all eligible households, even those that do not eventually participate. It is this latter question that is addressed by most of the other studies in the field. This is important for understanding whether the food security of the SNAP-eligible population would respond the same way as the full set of participants to receiving SNAP benefits. It also helps to inform the decision of whether the cost of expanding outreach activities or program access to foster participation among eligible households outweighs the cost of that expansion.

When comparing estimates of policy effects across studies, one should also consider differences in the study populations and study periods. Our study compared the food security of SNAP households that had just entered the program with those that had participated for ~6 mo, whereas other studies typically compare all participants to nonparticipants (14, 16, 17). In addition, whereas our study provides the most recent evidence of the effect of SNAP on food security by using data from 2011–2012, other study periods used data from the 1990s (14, 17) or the early to mid-2000s (3, 16, 18).

There are 2 related lines of research that could provide additional insights into program effects. First, our study examined overall food security as estimated using standard government measures. Insights could also be gained in understanding which of the 18 components of the food security scales are most affected by the program; the data to do this are available in the current survey data set.

Second, although this study essentially focused on the entire household as a single food consumption unit, there is also potential value in more closely examining how low-income households make their food purchasing and consumption decisions, in order to determine details of the roles that SNAP benefits play in this process. A beginning of this line of research was implemented as a component of the current study based on standardized but open-ended in-depth interviews with 90 households selected from the survey sample frames. The results, presented in a recent qualitative study (27), provided interesting insights, and we believe that more research in this area would be useful as a supplement to the statistical analysis that we reported. This includes obtaining more information on fluctuations in household expenses and income to understand how SNAP households reallocate scarce resources to pay for transportation, utilities, rent, and other basic needs; exploring networks within the family as a food coping strategy; and understanding how household food purchase decisions relate to food security.

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JM and JO designed the research, conducted the research, analyzed the data, and wrote the paper. JM had primary responsibility for the final content. Both authors read and approved the final manuscript.

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