Social Science & Medicine 150 (2016) 8–14

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Low-income Children's participation in the National School Lunch Program and household food insufficiency

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ARTICLE INFO

Article history:
Received 5 June 2015
Received in revised form
7 December 2015
Accepted 13 December 2015
Available online 15 December 2015

Keywords:
School lunch
Food assistance
Food insufficiency
Food insecurity

ABSTRACT

Assessing the impact of the National School Lunch Program (NSLP) on household food insufficiency is critical to improve the implementation of public food assistance and to improve the nutrition intake of low-income children and their families. To examine the association of receiving free/reduced-price lunch from the NSLP with household food insufficiency among low-income children and their families in the United States, the study used data from four longitudinal panels of the Survey of Income and Program Participation (SIPP; 1996, 2001, 2004, and 2008), which collected information on household food insufficiency covering both summer and non-summer months. The sample included 15, 241 households with at least one child (aged 5–18) receiving free/reduced-price lunch from the NSLP. A dichotomous measure describes whether households have sufficient food to eat in the observed months. Fixed-effects regression analysis suggests that the food insufficiency rate is .7 (95%CI: .1, 1.2) percentage points higher in summer months among NSLP recipients. Since low-income families cannot participate in the NSLP in summer when the school is not in session, the result indicates the NSLP participation is associated with a reduction of food insufficiency risk by nearly 14%. The NSLP plays a significant role to protect low-income children and their families from food insufficiency. It is important to increase access to school meal programs among children at risk of food insufficiency in order to ensure adequate nutrition and to mitigate the health problems associated with malnourishment among children.

1. Introduction

A growing number of children and their families in the United States face the risk of food insufficiency, an important indicator of household food hardship (Alaimo et al., 2001) measuring whether families can get enough food for their members. Food insufficiency was the most commonly used indicator of household food hardship before the standardized Food Insecurity Scale (FIS) was developed by the US Department of Agriculture in the late 1990s., The measure of food insufficiency is closest to the most severe form of food insecurity (very low food security) measured by the FIS (Nam et al., 2015). In 2013, nearly 20% of households with children reported food insecurity (including both low and very low food security) at some time during the year (Coleman-Jensen et al., 2014). Extensive literature has shown adverse impacts of inadequate food on children's nutritional, psychological, and educational outcomes (Alaimo et al., 2001; Gundersen & Ziliak, 2014; Kleinman et al., 1998; Rose-Jacobs et al., 2008; Roustit et al., 2012; Weinreb et al., 2002; Whitaker et al., 2006).

To ensure adequate nutrition among low-income, school-aged children, several federally-funded food assistance programs target this vulnerable population, including the Supplemental Nutrition Assistance Program (SNAP), the NSLP, the School Breakfast Program (SBP), and the Summer Food Service Program (SFSP). The present study specifically focuses on the NSLP and examines its association with household food insufficiency. As one of the largest nutrition assistance programs for school-aged children in the United States, the NSLP operates in public schools, nonprofit private schools, and residential child care institutions. The NSLP costs roughly $11.6 billion a year and provides nutritional and low-cost or free lunches to more than 31 million children (USDA Food and Nutrition Service, 2012). Children from families with income at or below 130% of the US federal poverty level are eligible for free meals; those from families with income between 130% and 185% of the poverty level are eligible for reduced-price meals at a rate of less than 40 cents

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http://dx.doi.org/10.1016/j.socscimed.2015.12.020
0277-9536/

(USDA Food and Nutrition Service, 2012). In the 2002–2003 school year, nearly three quarters of eligible children received the benefits of free/reduced-price lunch (Dahl & Scholz, 2011). It is estimated that more than 21 million, or 39% of all school-age children, receive a free/reduced-price lunch from the NSLP (Bartfeld, 2013).

Limited studies examined the extent to which school meal programs, such as the NSLP, affect households' food insecurity or insufficiency (Arteaga & Heflin, 2014; Bartfeld & Dunifon, 2006; Bartfeld et al., 2009; Bartfeld & Ryu, 2011; Gao et al., 2012; Gundersen et al., 2012; Kabbani & Kmeid, 2005). If the program reduces low-income caregivers' expenditure on children's food consumption, it may lower the risk of food insufficiency for the household through transfer of resources to other members' food consumption. The empirical literature has suggested the NSLP participation is associated with higher odds of having adequate food among school-age children (Arteaga & Heflin, 2014; Gundersen et al., 2012; Kabbani & Kmeid, 2005), with some inconsistent findings from other research (Gao et al., 2012). Gundersen et al. (2012) found that NSLP participation was associated with a reduction of 6 percentage points in low household food security. Using the kindergarten cut-off age as an instrumental variable, Arteaga and Heflin (2014) suggested that children who received free/reduced-price lunch through the NSLP had a much lower probability of food insecurity compared to households whose children paid for their own lunch. A third study (Kabbani & Kmeid, 2005) showed that the NSLP may provide a greater protection to those receiving a free lunch than to those receiving a reduced price lunch. Another one (Gao et al., 2012) instead used whether students had enough time to eat school lunch or not as an instrumental variable but did not find a significant association between the NSLP and food insecurity.

One common challenge to assess the impact of food assistance programs on food insufficiency is a potential selection bias that households without enough food are more likely to participate in these programs (Nord & Golla, 2009). In general regression analyses, the program participation variable often is positively associated with food insufficiency due to this bias (Nord & Golla, 2009). The NSLP provides services during the school year but not summer months when school is not in session. The unavailability of the NSLP program in summer is not caused by parents' self-selection. The seasonal pattern of the NSLP participation is not correlated with parents' self-selection, and, therefore, is useful to address the selection bias in nutrition assistance program evaluation. If the NSLP participation reduces the risk of food insufficiency, households eligible for the NSLP benefits are more likely to experience food insufficiency in the summer when the NSLP is not available.

There are two potential limitations of this strategy due to confounding factors. The seasonal difference in the NSLP participation may be confounded with other seasonal trends, such as child care arrangement and employment status in summer (Brady et al., 2002; Capizzano, 2002). A second potential confounder is the Summer Food Service Program (SFSP) and related Seamless Summer Option (SSO) which are entitlement programs offering free meals and snakes to low-income children in the summer when school is not in session (USDA Food and Nutrition Service, 2015). These summer meal programs are small relative to the NSLP. In fiscal year 2014, an average of 2.5 million children participated in the SFSP daily, with a total federal cost of $464 million (USDA Food and Nutrition Service, 2015). Some NSLP recipients may utilize summer meal programs and reduce their risk of food insufficiency in summer.

Despite these limitations, the seasonal difference in the NSLP participation seems a promising strategy to identify program impacts. Few studies have taken advantage of this feature on program participation to assess the NSLP impacts on food insecurity or insufficiency. Based on a cross-sectional design, Nord and Roming (2006) defined September as the summer month and found a lower level of food security in summer for households with children than those without a child. The study only used September as the summer month because data in other summer months were not available. Another study (Huang et al., 2015) applied growth-curve analyses to describe trajectories of food insufficiency over time for both the NSLP recipients and eligible nonrecipients. It suggested an increase of food insufficiency rate in summer for the NSLP recipients but not for eligible nonrecipients. Based on previous literature, we test the association between the seasonal variation in the NSLP participation and food insufficiency among those receiving free/reduced-price lunches. Our study defines summer months as June, July, and August and uses individual households' longitudinal data over four calendar months. We apply a fixed-effects model on longitudinal household data to control for the unobserved selection bias.

2. Methods

2.1. Data and sample

We used data from four panels (1996, 2001, 2004, and 2008) of the SIPP, a longitudinal and nationally representative household survey operated by the U.S. Census Bureau with sample size ranging from about 37,000 to 52,000 households (US Census Bureau, 2001). The detailed information of the SIPP can be found at the webpage of http://www.census.gov/sipp/. In each panel, the SIPP followed the same households in multiple waves of interviews. There were 12 waves for the 1996 and 2004 panels, 9 waves for the 2001 panel, and 16 panels for the 2008 panel. The time interval between each pair of waves was four months, and each interview then collected information in the last four months (i.e., the reference period of each wave). In order to ease the data collection process and spread the work evenly, the SIPP sample was randomly divided into four rotation groups with nearly equal size. Each rotation group was interviewed in a separate month, and the same wave of interviews thus was conducted in four consecutive calendar months for these rotation groups, respectively. The reference period of each wave covered different calendar months for four rotation groups. For instance, the 1996 SIPP panel has 12 waves of interviews conducted from April 1996 to March 2000. As shown in Table 1, the wave 8 interview of the 1996 panel was conducted in August 1998 for the first rotation group to collect information from April to July. The same interview was conducted instead in November 1998 for the fourth rotation group to collect information from July to October.

Since the 1996 panel, the SIPP included a household food insufficiency question in at least one wave of interviews (see Table 1). Given the survey feature that four rotation groups had different calendar months as the reference period, the SIPP thus collected the information on food insufficiency across seven calendar months for four groups together. If summer months were defined as June, July, and August (months 6–8 in Table 1), the first rotation group of the 1996 panel had the information on food insufficiency from April to July, including two summer months, while the second group had the information from May to August with three summer months.

We created a sample including households with children aged 5–18 years and with at least one child receiving free/reduced-price lunch from the NSLP one wave before the information of food insufficiency was collected. We did so because the number of summer months in the wave when the information of food insufficiency was collected may affect children's NSLP participation status and household food insufficiency simultaneously in that wave, and becomes a confounding factor for evaluating the NSLP

Table 1
Calendar months for the SIPP wave with food insufficiency information.

Panel	Wave	Interview year	Rotation group	Calendar Month										Number of summer Months	Number of households	Number of observations
				1	2	3	4	5	6	7	8[a]	9	10			
1996	8	1998	1				3.17	3.56	4.00	5.34[b,c]				2	654	2608
			2					3.47	3.44	3.79	3.42			3	594	2370
			3						3.96	4.06	4.10	3.92		3	578	2311
			4							4.74	4.92	4.79	4.70	2	621	2478
2001	8	2003	1		4.71	3.36	3.77	4.38						0	571	2280
			2			3.83	4.36	3.74	3.93					1	562	2238
			3				2.50	2.50	6,57	6.63				2	561	2231
			4					3.37	2.62	3.49	2.05			3	554	2213
2004	5	2005	1		2.82	3.08	3.25	2.80						0	886	3528
			2			2.19	3.03	2.84	2.77					1	886	3536
			3				3.61	3.01	4.04	4.32				2	906	3599
			4					3.53	3.97	5.09	5.20			3	892	3561
2008	6	2010	1	2.79	2.49	3.04	2.99							0	888	3537
			2		2.82	2.78	2.80	2.74						0	896	3574
			3			3.72	4.04	4.53	4.08					1	948	3778
			4				3.34	2.81	3.84	4.41				2	863	3450
2008	9	2011	1	4.34	3.43	4.19	4.38							0	864	3451
			2		4.05	4.58	3.96	4.74						0	846	3371
			3			5.00	4.39	5.10	5.77					1	849	3385
			4				3.77	3.56	5.23	4.66				2	822	3277

[a] Summer Months are defined as from June to August.
[b] The shaded areas in each row show the reference period for each rotation group in the wave when food insufficiency information is collected.
[c] Monthly food insufficiency rate in the reference period for each rotation group is reported.

impact. For example, the information of food insufficiency was collected in wave 8 of the 1996 panel, and we used the information in wave 7 to select recipients of free/reduced-price lunch. A household with a child receiving free/reduced-price lunch from the NSLP in wave 7 may have reported nonparticipation if its reference period for wave 8 includes multiple summer months (e.g., the third rotation group in the 1996 panel). Therefore, the sample selection based on the NSLP participation status in the wave when food insufficiency information was collected may exclude recipient households. The exclusion of these recipient household is likely to generate underestimated effects of the NLSP participation on food insufficiency.

Combining four SIPP panels, the final sample included 15,241 households, referred to as recipients of free/reduced-price lunch below. Using the 1996 panel as an example, there were 28,168 households interviewed in wave 7 and 2592 having at least one child receiving free/reduced-price lunch. Among these recipients, 145 (5.6%) had no valid information in wave 8. The final sample for this panel is 2447 households with children. Similarly, only a small proportion of recipients of free/reduced-price lunch in other panels were excluded due to missing values. The last two columns of Table 1 report the number of households and number of monthly observations for each rotation group in four SIPP panels.

2.2. Measures

Outcome Measure. To collect information on household food insufficiency, the SIPP asked respondents to choose the statement best describing the food eaten in the household in the last four months: "*enough of the kinds of food we want*", "*enough but not always the kinds of food we want*", "*sometimes not enough to eat*", and "*often not enough to eat*". Households reporting "sometimes" or "often" not enough to eat were coded as "1" on a dichotomous indicator of the four-month food insufficiency, and others are coded as "0". For those with responses that indicate food insufficiency in the last four months (i.e., households with the value "1" on the four-month food insufficiency indicator), the SIPP further asked respondents in which month during the reference period they experienced food insufficiency, and thus provides monthly information about food insufficiency in four consecutive calendar months for each household. A dichotomous indicator of household monthly food insufficiency (Yes = 1 and No = 0) was generated. For example, each household has four data observations for the wave of interview, one for each calendar month in the reference period. If the household suffered from food insufficiency in the first calendar month only, the household had a positive response on the monthly food insufficiency indicator in the first observation, but not the other three. At the same time, this household had a positive response on the four-month food insufficiency indicator in all four observations.

Independent Variable. A dichotomous measure of summer month (Yes = 1 and No = 0) was created for each calendar month in the reference period. The calendar month between June and August was considered summer months, and others were defined as non-summer months.

Covariates. The study included characteristics of households and household heads as control variables in different analyses. Household characteristics were household size, household monthly income, metro status (living in metro areas or not), the participation of Supplemental Nutrition Assistance Program (SNAP), and public housing status (whether receiving public housing benefits or not). Household head's characteristics included age, gender, race (White, Black, and others), marital status (married or not), education (below high school, high school, some college, and bachelor and above), employment status (employed or not). In some analyses, we also controlled for the order of the reference month (i.e., the first, second, third, or fourth month in the reference period), indicators of states, and indicators of interview years. All analysis variables were drawn from the wave when household food insufficiency information was collected.

2.3. Statistical analysis

Since the SIPP data had the longitudinal information of food insufficiency in four months, the association between the NSLP participation and food insufficiency was estimated by a fixed-effects OLS regression model:

$$Y_{it} = \alpha_i + \beta s_{it} + \gamma m_{it} + X_{it}\delta + \varepsilon_{it} \text{ for } t = 1, \ldots, 4 \text{ and } i = 1, \ldots, N \quad (1)$$

where Y_{it} is the monthly food insufficiency indicator for household i at month t; α_i is the unobserved time-invariant individual effect; s_{it} is a dichotomous summer month indicator for household i at month t; m_{it} is the order of the reference month (first, second, third, or fourth) for household i at month t; X_{it} is time-variant control variables, including demographic and socioeconomic characteristics; and ε_{it} is the error term. We controlled for the order of the reference month, because participants reported monthly food insufficiency status for four previous months at the interview time and may have more accurate information on food insufficiency for the month closer to the interview. Most covariates on characteristics of households and household heads remained the same in the short observation period of four months; the number of time-variant control variables included in fixed-effects analyses thus was relatively small.

The parameter of interest is the regression coefficient of the summer month indicator, β, which indicates the average change in the probability of food insufficiency from non-summer months to summer months for a household with a recipient of free/reduced-price lunch. If the NSLP reduces food insufficiency, β will be statistically significant and positive: Recipients and their households are more likely to be food insufficient in summer months when the program is not available.

We conducted four sensitivity tests. First, we used a different definition of summer months and considered July as the only summer month in the reference period, because children in some states may not be completely out of school session in the calendar months of June and August. Second, we reran the analysis to a smaller sample, recipients with household income lower than 130% of the poverty line and examined the association between the NSLP participation and food insufficiency among those eligible for free lunch. The impact of the NSLP participation may vary by whether children received free or reduced-price lunch. Third, assuming that the NSLP participation may have various impacts for children with different ages, we tested the model on two separate samples—households with at least one child aged 5–11 and those with at least one child aged 12–18. Finally, disregarding the longitudinal nature of the data, we used pooled cross-sectional analyses in OLS and Logit regressions to include time-invariant covariates. Results from these sensitivity tests are similar to those from main analyses. All analyses were adjusted with the sampling weight variable generated by the SIPP for the households in the wave when food insufficiency information was collected.

3. Results

3.1. Sample characteristics

Table 2 reports weighted characteristics of sample households. In the observation period of four months, nearly 7% of recipient households suffer from food insufficiency; in any given month during this four-month period, the food insufficiency rate is 3.9%. Food insufficiency rates by calendar month and rotation group are reported in Table 1. For example, the mean food insufficiency rate is 5.34% (SE = .009) for the first rotation group of the 1996 panel and 3.79% (SE = .007) for the second rotation group increases to 4.00% and 5.34% in August 1998, respectively. While there are some discrepancies on monthly food insufficiency rates in summer months across rotation groups, the inter-rogation group difference generally is not statistically significant in our sample.

Also reported in Table 2, aggregated over four panels, the mean age of household heads is about 40, and nearly two-thirds of heads are female, white, and employed. About half of household heads are married, and less than 10% have a college degree. On average, the household size is 4.3. Nearly three quarters of households live in metro areas, and average monthly household income is $2800. Less than 40% of households receive SNAP benefits, and less than 10% participate in public housing programs.

Table 2
Weighted sample characteristics of households receiving free/reduced-price lunch (N = 15,241).

Variables	Mean or %
Dependent Variables	
Four-month food insufficiency rate	6.91
Monthly food insufficiency rate	3.86
Independent Variable	
Number of summer months	
0	32.99
1	21.26
2	29.10
3	16.64
Covariates	
Household head's characteristics	
Age (mean)	40.71
Gender (female)	64.33
Race	
White	66.42
Black	26.75
Others	6.84
Married (Yes)	50.49
Education	
Below high school	28.48
High school	31.04
Some college	32.85
Bachelor and above	7.63
Employed	68.53
Household characteristics	
Household size (mean)	4.31
Metro areas	77.35
Monthly income (mean, by thousand)	2.85
Public housing (Yes)	9.76
SNAP participation	38.01

3.2. Food insufficiency across calendar months

Fig. 1 presents food insufficiency rates among recipient households from January to October aggregated over four SIPP panels. As shown in the solid line, the average monthly food insufficiency rate stays at about 3.5% from January to May, and increases in summer months—4.3% in June, 4.6% in July, and 3.9% in August. However, different from our hypothesis, the food insufficiency rate continues to increase after summer months—4.6% in September and 5.0% in October. One possible explanation is that only the 1996 panel, which has a higher food insufficiency rate than recent panels, includes September and October in the reference period. Table 1 shows that the fourth rotation group in the 1996 panel includes both September and October in its reference period and the third rotation group in the 1996 panel includes September in the reference period. We further present food insufficiency rates excluding these two rotation groups in the dotted line, which has a pattern of food insufficiency consistent with our hypothesis.

3.3. Results of regression analyses

Results of fixed-effects analyses on recipients of free/reduced lunch are presented in Table 3. As shown in the first column, the dichotomous indicator of summer months is positively related to the probability of food insufficiency (b = .007; 95%CI: .001, .012), statistically significant at the .01 level. The result suggests that the monthly food insufficiency rate is .7 percentage points higher in

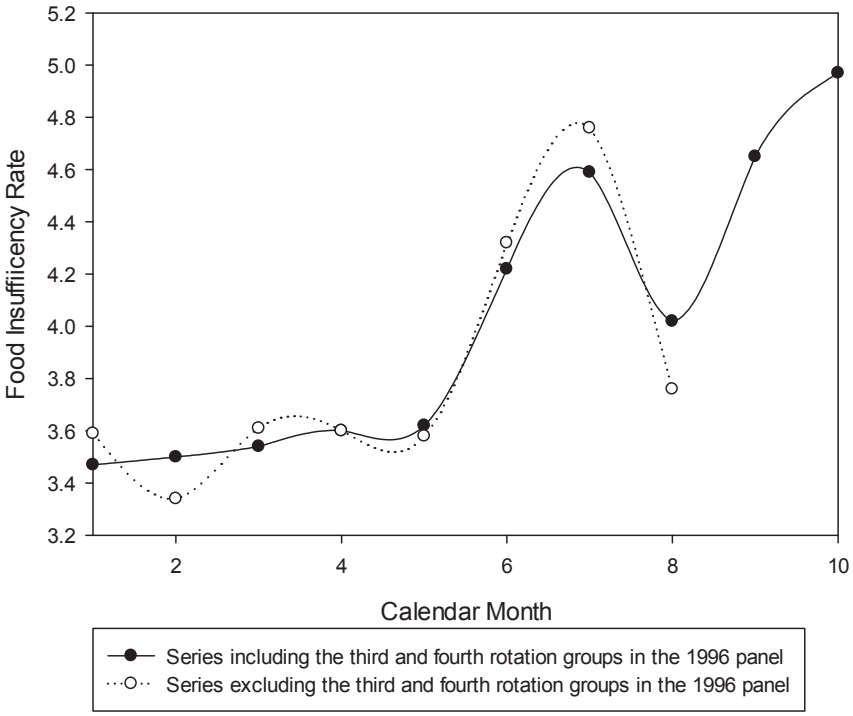

Fig. 1. Food insufficiency among households receiving free/reduced-price lunch.

summer months for households with children receiving free/reduced-price lunch. This model only includes the order of four reference months as a control variable, and does not adjust demographic and socioeconomic covariates. We add several time-variant control variables in the second column, including household heads' employment and marital status and monthly household income. Since the reference period covers a short period of time (four months), many variables the SIPP collects do not change within the household unit during these four consecutive calendar months, and cannot be included in the fixed-effect analysis. Result in the second column ($b = .007$; 95%CI: .001, .012; $p < .01$) is consistent with that in the first one.

Four sensitivity tests obtain consistent results on the association between the NSLP participation and household food insufficiency. If we define July as the only summer month, the monthly food insufficiency rate is .7 percentage points higher in July than other non-summer months (the third column of Table 3; $b = .007$; 95%CI: .001, .012; $p < .01$). The magnitude of the regression coefficient on the summer month indicator becomes slightly smaller ($b = .005$; 95%CI: .000, .010; $p < .05$) when the model is tested only on households eligible for free lunch (the fourth column of Table 3). Similarly, the regression coefficient of the summer month indicator is positive and statistically significant for the sub-sample of households with children aged 5–11 or those with children aged 12–18.

The pooled OLS analysis, reported in the seventh column, controls for both time-variant and time-invariant characteristics of households and household heads. It has similar results ($b = .007$; 95%CI: .002, .012; $p < .01$) to those of fixed-effect OLS analyses, probably because the summer month indicator is not related to any demographic and socioeconomic characteristics, and recipients of free/reduced-price lunch are relatively homogenous. The pooled OLS analysis in Table 3 does not adjust for households' SNAP participation status as it is likely to carry the selection bias demonstrated in previous studies. If we do add it in the analysis, the indicator of SNAP participation is positively associated with food insufficiency ($b = .007$; 95%CI: .002, .012; $p < .01$) but does not change the result on the summer month indicator. Another sensitivity test, the logit analysis in the eighth column, shows higher odds of food insufficiency in summer months (OR = 1.21; 95%CI: 1.07, 1.37; $p < .01$) for recipients of free/reduce-price lunch.

4. Discussion

To assess the association of the NSLP participation and household food insufficiency, the study uses the seasonal difference in the NSLP participation to address the potential selection bias. Fixed-effect analyses do not show a positive association between household food insufficiency and receiving free/reduced-price lunch from the NSLP, which implies that the seasonal difference in the NSLP participation is a valid identification strategy to control for the potential selection bias. Results reported in Table 3 suggest that regression coefficients of the summer month indicator in general are similar across fixed-effects and other sensitivity analyses and are similar across models control and do not control for demographic and socioeconomic characteristics. This demonstrates that the indicator of summer months is not associated with individual behaviors and, therefore, is not affected by households' self-selection into the NSLP. The study finds that the NSLP reduces food insufficiency among low-income households with children. In summer months when the NSLP is not available, the food insufficiency rate among recipients is about .7 percentage points higher than that in non-summer months. Since the average monthly food insufficiency rate is 3.9% in the sample, our finding indicates that the NSLP participation is associated with a 14% reduction in the risk of experiencing food insufficiency.

Several limitations of this study should be noted. First, as mentioned above, the summer month variable may be confounded by other seasonal trends. Food insufficiency may occur less frequently if caregivers are more likely to have a job or food prices

Table 3
Food insufficiency among households receiving free/reduced-price lunch (N = 15,241).

Variables	Col 1: Fixed-effects[a]	Col 2: Fixed-effects[a]	Col 3: Fixed-effects[a,b]	Col 4: Fixed-effects[a,c]	Col 5: Fixed-effects[a,d]	Col 6: Fixed-effects[a,e]	Col 7: Pooled OLS[a,f]	Col 8: Logit[f,g]
Independent Variable								
Indicator of summer months (1 = Yes)	.007** [.01, .12]	.007** [.01, .12]	.007** [.003, .012]	.005* [.000, .010]	.007* [.000, .014]	.005* [.000, .009]	.007** [.002, .012]	1.21** [1.07, 1.37]
Control Variables								
Order of the reference month	.001 [−.000, .002]	.001 [−.000, .002]	.002** [.001, .003]	.002* [.000, .003]	.002** [.000, .003]	.001 [−.001, .002]	.001 [−.001, .003]	1.03 [1.07, 1.37]
Household income ($, by thousand)		−.002* [−.004, −.000]	−.002** [−.004, −.000]	−.002 [−.007, −.000]	−.002 [−.004, .000]	−.001 [−.003, .001]	−.004*** [−.004, −.003]	.82*** [.99, 1.08]
Household head's employment (1 = Yes)		−.006 [−.018, .006]	−.006 [−.018, .006]	−.003 [−.017, .010]	.000 [−.013, .015]	−.006 [−.020, .007]	−.016*** [−.021, −.12]	.76*** [.68, .86]
Household head's marital status (1 = Yes)		.026* [.002, .051]	.026* [.002, .051]	.023 [−.012, .058]	.031* [.005, .057]	.021 [−.008, .050]	−.005 [−.009, .000]	.93 [.81, 1.07]
Household head's age							.000 [−.000, .000]	1.00 [1.00, 1.01]
Household head's gender (1 = Female)							.008*** [.004, .012]	1.30*** [1.15, 1.48]
Household head's race (reference group: White)								
Black							−.000 [−.005, .005]	.97 [.85, 1.10]
Others							.000 [−.007, .007]	.99 [.82, 1.20]
Household head's education (reference group: below high school)								
High school							−.007*** [−.012, −.003]	.84** [.74, .94]
Some college							−.004 [−.008, .001]	.94 [.83, 1.06]
Bachelor and above							−.017*** [−.022, −.011]	.54*** [.41, .69]
Household size							.002** [.001, .003]	1.07*** [1.03, 1.11]
Metro areas (1 = Yes)							.007* [.001, .012]	1.21* [1.04, 1.41]
Public housing (1 = Yes)							−.000 [−.007, .006]	.94 [.81, 1.09]
Calendar years (reference group: 1998)								
2003							.001 [−.007, .009]	1.03 [.83, 1.27]
2005							−.003 [−.008, .003]	.94 [.81, 1.10]
2010							−.003 [−.008, .003]	.94 [.80, 1.10]
2011							.009** [.003, .015]	1.29*** [1.10, 1.50]
Number of Observations	60,776	60,776	60,776	30,757	42,699	36,453	60,776	60,776
Number of Households	15,241	15,241	15,241	7712	10,708	9143	15,241	15,241

*p < .05,**p < .01,***p < .001.
[a] Regression coefficient and 95% confidence interval are reported for fixed-effects analyses and pooled OLS analysis.
[b] This sensitivity test defined July as the only summer month.
[c] This sensitivity test only included households with income not greater than 130% of the poverty line.
[d] This sensitivity test included households with at least one child aged 5–11.
[e] This sensitivity test included households with at least one child aged 12–18.
[f] The analysis controls for indicators of states as well. Results on indicators of states are not reported in Table.
[g] Odds ratio and 95% confidence interval are reported for the logit analysis.

are lower in summer. Food insufficiency in summer months may be associated with household expenditures when school is out of session. Families may have different child care costs or utility bills because people are in the home more often. For example, it has been found that, relying more on relative care, low-income families spend less on child care during the summer compared to the school year (Capizzano, 2002). In agricultural counties and rural areas, low-income families' participation in welfare programs increases dramatically from summer to winter (Brady et al., 2002); there are more seasonal jobs available for low-income families in summer, and it may protect them from food hardship as well. Nonetheless, one recent study (Huang et al., 2015) provided indirect evidence that the association between the NSLP participation and food insufficiency may not be affected by those confounders mentioned above. Using a growth-curve analysis to describe the seasonal trends of food insufficiency for both the NSLP recipients and eligible nonrecipients, the study suggested that eligible nonrecipients did not experience an increase in food insufficiency in summer. It further compared the differences in food insufficiency between summer and non-summer months for both groups and found a greater risk of food insufficiency in summer for the NSLP recipients. Second, our result may overestimate the NSLP impact if it also

carries the impact of other school meal programs such as the School Breakfast Program. Alternatively, it may underestimate the NSLP impact as well since we do not control for participation in summer meal programs. Third, reporting accuracy of program participation in the SIPP data is difficult to assess. Parents may overreport their children's participation in school meal programs, in particular for the School Breakfast Program (Bartfeld, 2013). Another data issue shown in Table 1 is the inter-rotation group difference in monthly food insufficiency rates, and should be explored in future research as well.

Nonetheless, a 14% reduction in the risk of household food insufficiency seems substantial, in particular, given that the program targets children only. The findings suggest that the NSLP plays a significant role in protecting low-income families from food insufficiency. Yet, there is opportunity to further increase access to school meal programs among risky children (Frentz & Neuberger, 2012). Our analysis of the SIPP data suggests that nearly 70% of children eligible for free/reduced-price lunch received such benefits in the 2008 SIPP panel. Although one study (USDA Food and Nutrition Service, 2009) shows that states are not enrolling many income-eligible children into the NSLP, implementation of new policy tools in recent years suggests progress (USDA Food and Nutrition Service, 2013). Categorical eligibility allows children to receive free school meals if they are in foster care, Head Start, homeless, or living in a household receiving TANF benefits. Direct certification requires schools operating the NSLP to directly certify children for free meals if their families receive SNAP benefits. Among children eligible for the direct certification process, the certification rate increased from 68% in the school year 2007–2008 to 89% in the school year 2012–2013. As a new policy option in the 2013–2014 school year, community eligibility allows schools to provide free meals to all students if schools have 40% or more students directly certified for the program. Community eligibility eliminates the need for individual enrollment and increases access to school lunch for all children.

The higher food insufficient rate in summer months among recipients of free/reduced-price lunch also suggests that it is important to provide nutrition assistance to low-income children in summer when school is not in session. Both the Summer Food Service Program (SFSP) and the Seamless Summer Option (SSO) were established by the US Department of Agriculture to continue the provisions of nutrition assistance to low-income children in the summer. Currently, participation in the SFSP and the SSO is much lower than participation in the NSLP and the SBR; therefore, these programs should be expanded and applied to all children at risk of food insufficiency.

Acknowledgments

The authors are grateful for support from the U.S. Department of Agriculture Research Innovation and Development Grants in Economics (RIDGE) through the Institute for Research on Poverty at University of Wisconsin-Madison (Grant Number: 471K516) and Saint Louis University President Research Fund and Faculty Leave Program. The content is solely the responsibility of the authors.

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