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Children Receiving Free or Reduced-Price School Lunch Have Higher Food Insufficiency Rates in Summer[1,2]

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Abstract

Background: In 2012, 20% of households in the United States with children lacked consistent access to adequate food. Food insufficiency has significant implications for children, including poor physical and mental health outcomes, behavior problems, and low educational achievements. The National School Lunch Program (NSLP) is one policy solution to reduce food insufficiency among children from low-income families.

Objective: The objective of this project was to evaluate the association between NSLP participation and household food insufficiency by examining trajectories of food insufficiency over 10 calendar months. The calendar months included both nonsummer months when school is in session and summer months when school is out of session.

Methods: The study used the data from the Survey of Income and Program Participation and conducted linear growth curve analyses in the multilevel modeling context. Comparisons were made between the trajectories of food insufficiencies among recipients of free or reduced-price lunch and their counterparts who are eligible but choose not to participate in the program.

Results: Heads of households that included children receiving free or reduced-price lunch (n = 6867) were more likely to be female, black, unmarried, and unemployed, and have a lower educational attainment than those whose children were eligible but did not receive free or reduced-price lunch (n = 11,396). For households participating in the NSLP, the food insufficiency rate was consistent from January to May at ~4%, and then increased in June and July to >5%. Meanwhile, food insufficiency among eligible nonrecipients was constant throughout the year at nearly 2%.

Conclusions: The NSLP protects households from food insufficiency. Policies should be instituted to make enrollment easier for households. *J Nutr* 2015;145:2161–8.

Keywords: food insecurity, food security, food insufficiency, National School Lunch Program, school meal programs, summer food insufficiency

Introduction

Food insufficiency is a commonly used measure of household food hardship to indicate whether households have enough food for their members (1–4). There is a high proportion of children and their families facing the challenge of satisfying their nutrition needs. In 2012, 20% of households with children (16 million children) lacked consistent access to adequate food (5). Research consistently suggests that there are negative consequences from inadequate nutrition on various aspects of child well-being, including physical and mental health, behavior problems, and educational achievements (1, 6–11). In response, multiple nutrition assistance programs have been implemented at different levels (e.g., individual, household, school, and community) to protect children from the adverse impacts of food insufficiency. The National School Lunch Program (NSLP)[5] is one of such programs to ensure adequate nutrition among low-income, school-aged children, and it has been operated in over 100,000 schools. In 2011, the program provided nutritional and low-cost or free lunches to >31 million children (12). Children are eligible for free lunches if their household income is ≤130% of the federal poverty level (12). If household income is between 130% and 185% of the poverty level, children are eligible for

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[5] Abbreviations used: NSLP, National School Lunch Program; SIPP, Survey of Income and Program Participation; SNAP, Supplemental Nutrition Assistance Program.

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reduced-priced lunches charging no more than 40 cents per meal served (12).

Although it is consistently found that NSLP participation is associated with improved dietary intake among children (13, 14), it is not clear whether NSLP participation reduces household food insufficiency. Few studies assessed the impact of the NSLP on household food insufficiency; most of the previous literature focused on evaluating household food insecurity among NSLP participants. For example, one study (15) showed that children in the program have decreased odds of the risk of inadequate food access, and that the program may provide greater protection to those receiving a free lunch than to those receiving a reduced price lunch. Similarly, Gunderson et al. (16) reported a reduction of 6 percentage points in low household food security associated with NSLP participation. Arteaga et al. (17) suggested that, compared with households whose children pay for their own lunch, those whose children receive free or reduced price lunch through the NSLP have a much lower probability of food insecurity. Findings on other school meal programs (e.g., School Breakfast Program) also provide indirect evidence of the impact of the NSLP. Bartfeld et al. (18) demonstrated that the availability of the School Breakfast Program decreases households' anxiety over food insufficiency or shortage.

Previous research has discussed the challenges assessing the effects of food assistance programs, because households with a higher risk of food insufficiency are also more likely to participate in benefits (19–22). To address the self-selection bias issue, we employed a strategy to evaluate the impact of the NSLP by comparing changes in food insufficiency rates between nonsummer and summer months for households with children that receive free or reduced-price lunch. When all other factors are fixed, this difference may reflect the NSLP effect, because the NSLP is operated during school sessions and does not provide services in summer months. One study (20) has applied this strategy, and compared the probabilities of getting enough food in April and September in households with school-age children. One challenge for such a comparison is that the difference in food insufficiency between nonsummer and summer months may be associated with other factors with seasonal trends. To further evaluate the association between NSLP participation and household food insufficiency, we used longitudinal household data from the Survey of Income and Program Participation (SIPP), and examined trajectories of food insufficiency over 10 calendar months (including both summer and nonsummer months). In addition, we compared trajectories of food insufficiencies between recipients of free or reduced-price lunch and their counterparts who are eligible but choose not to participate in the program.

Methods

Data and samples

The study used data from 4 panels (1996, 2001, 2004, and 2008) of the SIPP. The SIPP is a nationally representative longitudinal household survey conducted by the US Census Bureau; it includes continuous series of panels since 1984. Each SIPP panel ranges from 2.5 to 4 y, and has a sample size of from 14,000 to 36,700 households (23).

The SIPP interviews respondents in multiple waves to collect information on demographics, economic resources, employment, and public assistance program participation in the last 4 months (i.e., the reference period of each wave). The same wave of interview is conducted in 4 consecutive calendar months, respectively, for 4 rotation sample groups randomly generated by the SIPP. For instance, if one interview is conducted in calendar month t for the first rotation group to collect information between the months $t - 1$ and $t - 4$, the same interview is operated in calendar month $t + 1$ for the second group to collect information between t and $t - 3$, in calendar month $t + 2$ for the third group to collect information between $t + 1$ and $t - 2$, and in calendar month $t + 3$ for the fourth group to collect information between $t + 2$ and $t - 1$. The SIPP includes a household food insufficiency question in its adult well-being topical module (i.e., wave 8 in the 1996 and 2001 panels, wave 5 in the 2004 panel, and waves 6 and 9 in the 2008 panel). Because 4 rotation groups have different calendar months as the reference period, the SIPP thus collects information on food insufficiency across 7 calendar months (from $t - 4$ to $t + 2$) for 4 groups together, which can be used to model trajectories or changes in household food insufficiency during this period. The calendar months included in the reference period for the adult well-being topical module are presented in **Table 1** in 4 SIPP panels. For example, the first rotation group in the 2001 panel has food insufficiency information from February to May 2003, whereas the second group covers from March to June.

We used the data from one wave before the adult well-being topical module to generate a study sample (n = 18,263) that included households with children aged 5–18 y and with income lower than 185% of the federal poverty line. For example, in the 2001 panel of SIPP, food insufficiency information in the adult well-being topical module was collected in wave 8, and we thus used the information in wave 7 for the purpose of sample selection. We did so to avoid the potential influence of summer months in wave 8 on children's NSLP participation in that wave. According to our sample selection criteria, all households in the study sample were eligible for free or reduced-price lunch from the NSLP, including recipients and eligible nonrecipients.

Measures

Dependent variable. The food insufficiency question in SIPP asked respondents to choose the best of the following statements describing household food experiences in each of 4 reference 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." In keeping with previous research on food insufficiency (1, 2, 24, 25), we coded households reporting "sometimes" or "often" not enough to eat as "1" on a dichotomous indicator of monthly food insufficiency, and coded others as "0." For each household included in the sample, we had 4 repeated measures of food insufficiency across 4 consecutive months.

Independent variables. We created 3 focal independent variables. The first one was the calendar month in which survey participants' information was collected. As shown in Table 1, this variable ranges from January to October in our sample. We used the numbers from 0 to 9 to represent these 10 calendar months. The second independent variable was a dichotomous indicator of summer months. We defined summer months as from June to August. Thus, survey participants' observations with the first independent variable ranging from June to August were assigned a value of "1" on this summer month indicator, and other observations were assigned a value of "0." The third independent variable (1 = Yes and 0 = No) indicated whether the sample households had any child who received free or reduced-price lunch from the NSLP in the wave before the adult well-being topical module in the SIPP. For example, food insufficiency information was collected in wave 8 of the 2001 SIPP panel; households with children receiving free or reduced-price lunch in wave 7 were coded as "1" on the NSLP participation indicator.

Covariates. The study included characteristics of households and household heads as control variables. Household head characteristics included age, gender, race (white, black, and other), marital status (married or not), education (below high school, high school, some college, and bachelor and above), and employment status (employed or not). Household characteristics included household size, household monthly income, metropolitan status (living in a metropolitan area or not), and participation in the Supplemental Nutrition Assistance Program (SNAP).

TABLE 1 Reference periods of the adult well-being module in the SIPP (United States, 1996 panel–2008 panel)[1]

	Calendar month									
Panel/wave, interview year[2]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1996/8, 1998										
Rotation group										
1				X	X	X	X			
2					X	X	X	X		
3						X	X	X	X	
4							X	X	X	X
2001/8, 2003										
Rotation group										
1		X	X	X	X					
2			X	X	X	X				
3				X	X	X	X			
4					X	X	X	X		
2004/5, 2005										
Rotation group										
1		X	X	X	X					
2			X	X	X	X				
3				X	X	X	X			
4					X	X	X	X		
2008/6, 2010										
Rotation group										
1	X	X	X	X						
2		X	X	X	X					
3			X	X	X	X				
4				X	X	X	X			
2008/9, 2011										
Rotation group										
1	X	X	X	X						
2		X	X	X	X					
3			X	X	X	X				
4				X	X	X	X			

[1] The 4 mo reference period of the adult well-being module is delineated with Xs. Summer months are defined as from June (Jun) to August (Aug) in this study. Each SIPP sample was randomly divided into 4 rotation groups. Rotations groups are interviewed in different calendar months, and have different reference periods for the adult well-being module. SIPP, Survey of Income and Program Participation.
[2] Panel and wave numbers in the SIPP for the adult well-being module.

Analysis

The study examined the trajectory of household food insufficiency across 10 calendar months and its association with NSLP participation with the use of linear growth curve analysis in the multilevel modeling context:

$$Level\,1: Y_{ti} + \beta_{0i} + \beta_{1i}M_{ti} + \beta_{2i}S_{ti} + \varepsilon_{ti} \quad for\, t = 0, \ldots 9\, and\, i = 1, \ldots, n, \quad (1)$$

$$Level\,2: \beta_{0i} = r_{00} + r_{01}N_i + r_{02}X_i + u_{0i} \quad (2)$$

$$\beta_{1i} = r_{10} + r_{11}N_i + r_{12}X_i + u_{1i} \quad (3)$$

$$\beta_{2i} = r_{20} + r_{21}N_i + r_{22}X_i + u_{2i} \quad (4)$$

where Y_{ti} indicated monthly food insufficiency (1 = Yes and 0 = No) of a household i at calendar month t; M_{ti} denoted the order of calendar month (from 0 to 9) of household i at month t; S_{ti} referred to the dichotomous indicator of summer months; N_i denoted whether any child in a household received free or reduced-price lunch from the NSLP; and X_i was a vector of control variables discussed above. The Level 1 equation can be considered an unconditional growth-curve model on changes in household food insufficiency across 10 calendar months from January to October. The intercept (β_{0i}) and the regression coefficients on calendar months (β_{1i}) and summer months (β_{2i}) in the Level 1 equation were allowed to be varied by household and were furthered explained by NSLP participation and other demographic and socioeconomic characteristics in the Level 2 equations. To combine the equations in 2 levels, the following model was obtained:

$$\begin{aligned} Y_{ti} = {} & r_{00} + r_{10}M_{ti} + r_{20}S_{ti} + r_{01}N_i + r_{11}(N_i \times M_{ti}) + r_{21}(N_i \times S_{ti}) \\ & + r_{02}X_i + r_{12}(X_i \times M_{ti}) + r_{22}(X_i \times S_{ti}) + u_{0i} + u_{1i}M_{ti} + u_{2i}S_{ti} + \varepsilon_{ti} \end{aligned} \quad (5)$$

In addition to regression coefficients' demonstrating trajectories of food insufficiency and its changes in summer months, we were also interested in r_{21}, which indicated whether recipients of free or reduced-price lunch had food insufficiency trajectories in the summer months that were different from those of eligible nonrecipients. For all statistical analyses, weighted estimates were reported to account for the survey design. Descriptive statistics were conducted in Stata 13.0 and growth curve analysis was implemented in Mplus 7.0. Statistical significance was set at the 0.05 level.

Results

Descriptive statistics. The demographic and socioeconomic characteristics of households eligible for free or reduced-price

lunch in the sample are listed in **Table 2**. The monthly food insufficiency rate in the whole sample was 3.19%. Slightly >60% of households in the sample had at least one child who received free or reduced-price lunch from the NSLP one wave before the adult well-being topical module. Less than 40% of households received SNAP benefits. The mean age of household heads was ~40, and approximately two-thirds of heads were female, white, and employed. More than one-half of household heads were married, and ~10% had a college degree. On average, the household size was 4.2. Approximately three-quarters of households lived in metropolitan areas, and the mean household monthly income in the sample was less than $2000.

We also report sample characteristics by NSLP participation in Table 2. The food insufficiency rate was much higher for NSLP recipients than eligible nonrecipients (4.06% vs. 1.79%). Heads of households that included children receiving free or reduced-price lunch were more likely to be female, black, unmarried, and unemployed, and have a lower educational attainment than those whose children were eligible but did not receive free or reduced-price lunch. NSLP recipients also had lower household income and a higher level of SNAP participation than did eligible non–NSLP-recipient households.

Monthly food insufficiency rates from January to October by NSLP participation are presented in **Figure 1**. The trajectory for eligible nonrecipients (solid line with black dots) suggests that the food insufficiency rate for this group remained stable at ~2% from January to October. The rate decreased slightly after May, and reached its minimum number in October (1.79%). This implies that the slope of the trajectory for eligible nonrecipients may be close to 0. The curve of food insufficiency for NSLP recipients (dashed line with white dots) shows a different pattern: The food insufficiency rate was consistent from January to May (at ~4%), and then had a steep increase in June and July to ~5–5.5%. Although the curve for NSLP recipients dropped in August, the food insufficiency rate remained high (at ~5.5%) in September and October.

Consistent with our hypothesis, the comparison of 2 curves indicates that NSLP recipients were more likely to suffer from food insufficiency, and the rate was even higher in summer months—even the lowest point in summer (August) was greater than those from January to May. One unexpected finding in Figure 1 is that NSLP recipients had higher food insufficiency rates in September and October, which may be explained by the fact that, as shown in Table 1, only the 1996 SIPP panel covers the months of September and October; household food insufficiency was more severe in the late 1990s than in the 2000s.

Results of growth curve analysis. As reported in **Table 3**, regression results from growth curve analysis are generally consistent with findings demonstrated in Figure 1. After controlling for

TABLE 2 Weighted sample characteristics of households eligible for free/reduced-priced lunch (SIPP, United States, 1996 panel–2008 panel)[1]

Variable	All households	NSLP recipients	NSLP nonrecipients
n	18,263	11,396	6867
Dependent variable			
Monthly food insufficiency	3.19	4.06	1.79
Independent variables			
Summer months during the reference period			
0	30.86	32.82	27.71
1	20.21	20.75	19.34
2	29.85	29.41	30.56
3	19.08	17.03	22.40
NSLP participants	61.73	100.00	0.00
Other variables			
Household head characteristics			
Age, y	39.94 ± 0.08	39.13 ± 0.13	41.24 ± 0.11
Male	37.93	32.88	46.08
Race			
White	71.06	65.84	79.47
Black	22.56	27.89	13.95
Other	6.39	6.27	6.57
Married	53.38	47.02	63.64
Education			
Below high school	25.78	31.96	15.81
High school	31.41	31.61	31.09
Some college	32.64	30.93	35.39
Bachelor and above	10.18	5.50	17.71
Employed	63.35	58.32	71.47
Household characteristics			
Household members, *n*	4.19 ± 0.01	4.33 ± 0.02	3.98 ± 0.02
Living in metropolitan area	76.43	76.35	76.56
Income, thousand dollars	1.99 ± 0.02	1.62 ± 0.04	2.59 ± 0.02
SNAP participants	32.79	46.25	11.07

[1] Values are means ± SEs or percentages. NSLP, National School Lunch Program; SIPP, Survey of Income and Program Participation; SNAP, Supplemental Nutrition Assistance Program.

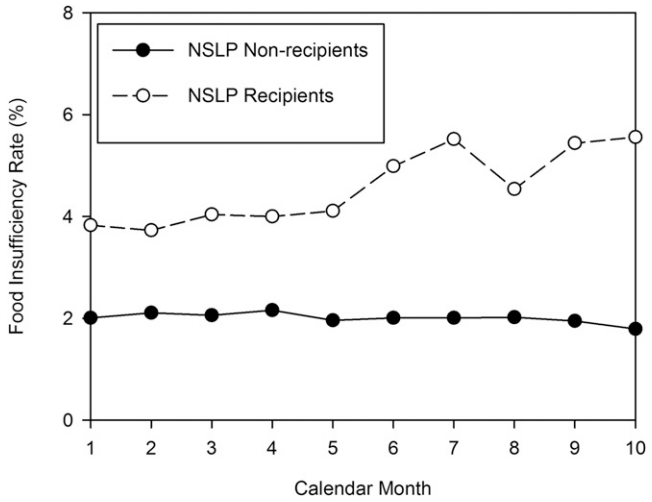

FIGURE 1 Food insufficiency over calendar months by NSLP participation. Mean monthly food insufficiency rates for NSLP recipients and nonrecipients are presented. NSLP, National School Lunch Program.

demographic and socioeconomic variables in the model, eligible nonrecipients (i.e., the indicator for NSLP participation is set to "0") had a food insufficiency rate of 2.4% in January (r_{00} = 0.024, 95% CI: 0.007, 0.040; $P < 0.01$). Overall, the change in food insufficiency for eligible nonrecipients from January to October is very small, with a nonsignificant slope coefficient of 0.001 for the indicator of calendar months (r_{10} = 0.001, 95% CI: –0.003, 0.005). It seems that NSLP nonrecipients had a lower food insufficiency rate in summer months (r_{20} = –0.005, 95% CI: –0.021, 0.010), but, again, this coefficient is not statistically different from 0 at the 0.05 level.

NSLP recipients had a food insufficiency rate 1.4 percentage points higher than eligible nonrecipients in January (r_{01} = 0.014, 95% CI: 0.008, 0.019; $P < 0.001$), increasing their food insufficiency rate to 3.8% at baseline. This difference does not reflect the impact of NSLP participation on food insufficiency, because those at risk of food insufficiency are more likely to choose participation in the program. The interaction term from calendar months and NSLP participation ($M_{ti} \times N_i$) suggests that there is no statistical difference in changes in food insufficiency by calendar month between NSLP recipients and eligible nonrecipients (r_{11} = −0.001, 95% CI: −0.002, 0.001). However, we found a significant interaction term between summer months and NSLP participation ($S_{ti} \times N_i$). Both curves have a flat slope between January and May, but in summer months, NSLP recipients had a mean food insufficiency rate that was 0.5 percentage points higher than eligible nonrecipients (r_{21} = −0.005, 95% CI: 0.001, 0.011; $P < 0.05$) (Figure 1).

Table 3 does not provide detailed results on control variables, which can be requested from the authors. Among these control variables, several had significant associations with households' random intercept (β_{0i}) in January. For example, male, married, employed household heads with a bachelor degree or above were statistically more likely to have a low food insufficiency rate in January. Household income was negatively and SNAP participation was positively associated with the probability of falling into food insufficiency at baseline (i.e., January). None of these control variables had a statistically significant association with changes in food insufficiency over time. Similarly, none of these control variables except the NSLP participation discussed above had a statistically significant relation with the additional changes in food insufficiency in summer months.

Predicted probability of food insufficiency based on the growth curve analysis of 2 typical cases (one receives free or reduced-price lunch from the NSLP and the other does not) are presented in **Figure 2**. We defined typical cases as those having control variables set at their median values. More specifically, 2 predicted lines are for white, male, married, and employed heads aged 39 with a high school degree living in a household with 4 members and a household income of $1600 in a metropolitan area. The predicted lines show that eligible nonrecipients have a greater decrease in food insufficiency rates in summer months when recipients cannot participate in the NSLP. The predicted lines in Figure 2 have steeper slopes than those in Figure 1, probably because the estimated slopes in the growth curve analysis are influenced by higher food insufficiency rates for recipients in September and October.

We addressed the inconsistencies between Figures 2 and 3 by using an alternative growth curve model and constraining the values of r_{10} and r_{20} to 0. As expected, this specification does not change the results for other variables, because both r_{10} and r_{20} are not statistically different from 0. The predicted lines based on results of the constrained model are presented in **Figure 3**.

Discussion

We examined the association between NSLP participation and the probability of food insufficiency in 10 calendar months from January to October. Based on 4 panels of SIPP, higher rates of food insufficiency for NSLP recipient than NSLP-eligible nonrecipient groups are consistently found over time. Recipients had a greater food insufficiency rate than eligible nonrecipients in

TABLE 3 Linear growth curve analysis: trajectories of food insufficiency and NSLP participation (SIPP, United States, 1996 panel–2008 panel)[1]

Variable	Regression coefficient	SE	95% CI
Intercept (r_{00})	0.024**	0.009	0.007, 0.040
Calendar months[2] (r_{10})	0.001	0.002	−0.003, 0.005
Summer months[3] (r_{20})	−0.005	0.008	−0.021, 0.010
NSLP participants (r_{01})	0.014***	0.003	0.008, 0.019
Calendar months × NSLP participants (r_{11})	−0.001	0.001	−0.002, 0.001
Summer months × NSLP participants (r_{21})	0.005*	0.003	0.001, 0.011

[1] Sample size is 18,263. r for all variables is from Equation *5*. Linear growth curve analysis controls for demographic and socioeconomic variables are listed in Table 1. Results for control variables are not reported in the table, and can be requested from the authors. *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. NSLP, National School Lunch Program; SIPP, Survey of Income and Program Participation.

[2] Value ranges from 0 (January) to 9 (October).

[3] Dichotomous indicator (1 = summer month and 0 = non-summer month).

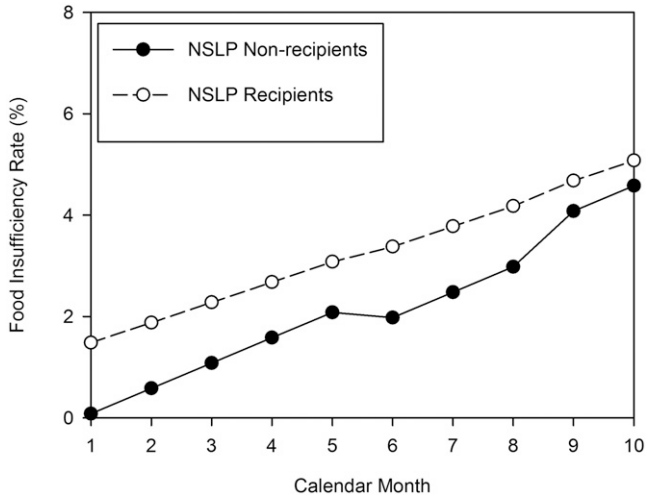

FIGURE 2 Predicted monthly food insufficiency by NSLP participation with the use of growth curve analysis. Monthly food insufficiency rates for typical NSLP recipients and NSLP nonrecipients predicted from linear growth curve analysis are presented. Typical cases are defined as those having control variables set at their median values—white, male, married, and employed heads aged 39 with a high school degree living in a household with 4 members and a household income of $1600 in a metropolitan area. NSLP, National School Lunch Program.

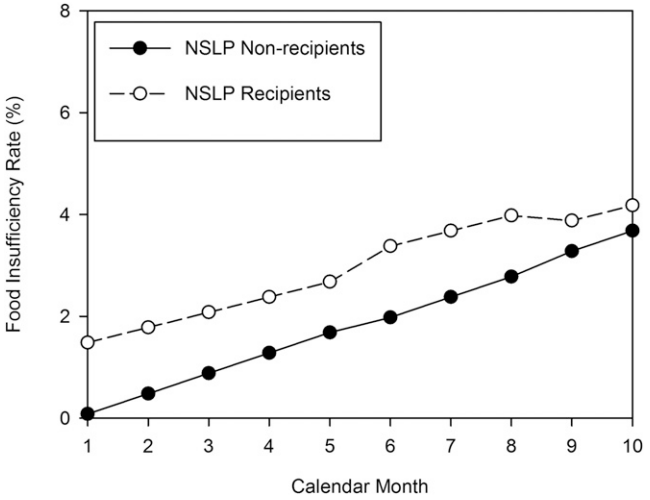

FIGURE 3 Predicted monthly food insufficiency by NSLP participation with the use of constrained growth curve analysis. This figure presents monthly food insufficiency rates for typical NSLP recipients and NSLP nonrecipients predicted from the constrained growth curve analysis in which the regression coefficient values of r_{10} and r_{20} (Equation *5*) are constrained to 0. Typical cases are defined as those having control variables set at their median values—white, male, married, and employed heads aged 39 with a high school degree living in a household with 4 members and a household income of $1600 in a metropolitan area. NSLP, National School Lunch Program.

nonsummer months (1.4 percentage points, $P < 0.01$). More importantly, recipients and eligible nonrecipients had different trajectories of food insufficiency in summer months. The difference in food insufficiency rates between the 2 groups increased by 0.5 percentage points in summer months ($P < 0.05$). This represents an increase of 13% in food insufficiency among recipients, because the estimated food insufficiency rate in nonsummer months is ~3.8%. That is, recipients are more likely to suffer from food insufficiency in summer months when the NSLP benefit is not available. This implies that the program has an impact, protecting low-income households from food insufficiency.

The estimated effect of NSLP participation is obtained through the comparison between recipients and eligible nonrecipients in the context of growth curve analyses, indicated by the interaction term of the summer month and NSLP participation indicators. Essentially, this is a difference-in-difference estimator for a 2-group pre–post research design; a sensitivity test that used the difference-in-difference approach obtained a similar but greater impact from NSLP participation. This strategy enjoys 3 benefits in evaluating the association between NSLP participation and food insufficiency. First, growth curve analysis indicates the trajectory of food insufficiency for recipients from nonsummer months, when the NSLP benefit is available, to summer months, when the NSLP benefit is not available. Second, the analysis allows households to have different individual trajectories of food insufficiency over time. As shown in Equation *1*, each individual household has its own slope coefficients. Third, and, most importantly, the trajectory of food insufficiency for eligible nonrecipients is used as a comparison in analyses, because the change in food insufficiency from nonsummer to summer months for recipients may be confounded with other factors having a similar seasonal trend. For example, households with children may have more child care expenses in summer months. The inclusion of eligible nonrecipients allows us to control for such factors if both groups show a similar pattern with these confounding factors. Results suggest that this could be a valid strategy to identify the accurate impact of the NSLP on food insufficiency. As discussed above, no other control variables, even SNAP participation, have a statistical association with the change in food insufficiency in summer months. The statistical association between NSLP participation and changes in the outcome measure in summer demonstrates the unique connection between NSLP participation and the seasonal trend of food insufficiency.

However, the study has several limitations. Eligible nonrecipients may not be a good comparison group if they do not share a similar seasonal trend with NSLP recipients with food insufficiency or other confounding factors. For example, eligible nonrecipients are more likely to be married men, and child care may be more easily arranged without additional expense for households headed by 2 persons than those headed by 1 person. Our result may also overestimate the NSLP impact if it also carries the impact of other school meal programs, such as the School Breakfast Program. In addition, to ease the computation process, we did not conduct nonlinear growth curve analyses for the dichotomous measure of food insufficiency. Nonetheless, the results presented in Figures 2 and 3 are similar to those in Figure 1, suggesting that linear growth curve analysis fits the data well. Finally, the greater food insufficiency rate in summer months among recipients could be explained by other mechanisms, and should be tested in future research. For example, because of the NSLP benefit received in school sessions, families may divert economic resources to other consumption needs. To maintain this consumption pattern and food management strategy may increase the risk of food insufficiency in summer when the NSLP benefit is not available.

The findings of the study have 2 important policy implications. First, NSLP participation can play an important role in reducing food insufficiency rates among low-income households with children. Approximately 40% of children eligible for free or reduced-price lunch did not receive these benefits (Table 2).

Although the choice not to participate in the program may reflect their low need for food assistance, it may be the result of program participation barriers. A number of studies have reported that eligible households with children do not participate in food assistance programs because of little knowledge about the program or eligibility, a complex application process, or stigma attached to the use of benefits (26, 27). Several approaches are offered to further reduce such barriers and increase access to school meal programs among children at risk. For example, categorical eligibility allows children to receive free school meals if they are in foster care, in Head Start, homeless, or living in a household receiving Temporary Assistance for Needy Families benefits (28). Direct certification requires schools operating the NSLP to directly certify children for free meals if their families participate in the SNAP (29). Also, community eligibility is implemented so that free meals are served to all students if ≥40% of students in the school are directly certified for the program (30). These policy alternatives and outreach efforts should be promoted to increase awareness of and access to school nutrition programs and prevent food insufficiency for all children.

Second, our findings also suggest that low-income children who participate in the NSLP had a higher level of food insufficiency in summer. States partner with schools, local governments, and local community organizations to provide summer nutrition programs, such as the Summer Food Service Program and the NSLP Summer Seamless Option, to make sure that needy children can continue to receive nutrition assistance in summer when school is not in session. A study based on Current Population Survey data (31) suggests that households with children in states with more participants in summer meal programs—the Summer Food Service program or the Summer School Lunch program—report a significantly lower rate of food insufficiency than those in states with low participation rates. In recent years, compared with school meal programs in operation during regular school years, summer nutrition programs have served eligible low-income children at much lower rates, in part because of budget cuts (32, 33). Therefore, efforts should be made with policy to meet the needs of households and expand services for all children at risk of food insufficiency.

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