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Accessibility of summer meals and the food insecurity of low-income households with children

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Abstract

Objective: Almost no previous research has examined the impact of the US Department of Agriculture's (USDA) Summer Food Service Program and related Seamless Summer Option, which provide meals and snacks to low-income children over the summer. The present study investigated whether geographic accessibility of summer meals programme sites (a proxy for programme participation) was associated with food insecurity for low-income households.

Design: The study used data from the California Health Interview Survey (CHIS) and administrative data on summer meals sites in California. Geocoding was used to calculate driving time between CHIS households and nearby summer meals sites. Geographic accessibility was measured using a gravity model, which accounted for the spatially distributed supply of and demand for summer meals. Food insecurity and very low food security were measured using a standard six-item measure from the USDA.

Subjects: Low-income families with children (n 5394).

Setting: A representative surveillance study of non-institutionalized households in California.

Results: Geographic accessibility was not associated with food insecurity. However, geographic accessibility was associated with a significantly lower probability of very low food security in the full sample and among households with younger children and those living in less urban areas.

Conclusions: The USDA's summer meals programme may be effective at reducing the most severe form of food insecurity for low-income households with children. Expanding the number of summer meals sites, the number of meals served at sites and sites' hours of operation may be effective strategies to promote nutritional health over the summer months.

Keywords
Summer Food Service Program
Seamless Summer Option
Summer meals
Very low food security
Food insecurity
Nutrition and food assistance

The US Department of Agriculture (USDA) maintains a raft of nutrition and food assistance programmes, many of which are directed specifically at children and aim to reduce food insecurity and hunger. In 2013, the fifteen domestic food and nutrition assistance programmes administered by the USDA reached about 25% of Americans at a cost of nearly $US 109 billion[1]. Studies of the largest of these programmes (including the Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)) have most frequently found that they are successful in reducing both household and child food insecurity[2–6]. However, much less is known about how other nutrition programmes impact household food security.

In particular, almost no previous research has investigated the impact of the Summer Food Service Program (SFSP) and related Seamless Summer Option (SSO; hereafter 'summer meals'), which are entitlement programmes that offer free meals and snacks to children over the summer when school is not in session. Sponsor organizations can generally operate SFSP sites in the attendance catchment areas of schools where 50% or more of the student body is eligible for free or reduced-price lunch (i.e. have household incomes <185% of the federal poverty line (FPL)) or in Census block groups where 50% or more of the children are eligible for free or reduced-price lunch. Sites are usually designated as open enrolment and serve all children on a first-come, first-served basis. Sites may elect to serve all three meals and morning and afternoon snacks, but lunch is most commonly available[7,8].

To minimize administrative burden and to encourage participation in summer nutrition programming, the USDA implemented the SSO in 2004. The SSO allows schools that participate in the National School Lunch Program (NSLP)

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and the School Breakfast Program to continue to offer free meals over the summer, although reimbursement rates for meals and snacks served are lower for the SSO[9]. However, in most other ways, SSO sites are indistinguishable from SFSP sites[9], especially for children or families who are seeking free meals.

Although they are small relative to SNAP, the summer meals programmes are nevertheless an important resource to low-income families. In fiscal year 2014, average daily participation in the SFSP was 2·46 million and the programme distributed 159·9 million meals at a total federal cost of $US 464·4 million[8]. Although SSO participation is not reported separately (M Yousefi, personal communication, 23 April 2013), average daily participation for free meals from the NSLP in July 2014 was 1·1 million[8], most of which was accounted for by participation in the SSO, because schools do not typically operate during this month.

While these data demonstrate that the summer meals programmes are a substantial commitment on the part of the federal government to the nutritional well-being of low-income children, participation among eligible children remains fairly low. A comparison between participation in summer meals programming and participation in the NSLP during the academic year is instructive in this regard. In 2014, average participation in the reduced-price and free lunch components of the NSLP was nearly 21·5 million[10]. Thus, based on these data, only one in six NSLP participants also participated in the summer meals programmes, implying a substantial participation gap in summer meals programming. A report from the Food Research Action Center using slightly different estimates of participation arrived at a similar conclusion: in 2013 only one in seven children who needed access to food during the summer was getting it from the USDA's summer meals programmes[11].

The participation gap provides an important impetus for the present study. Unlike SNAP, which already reaches more than 90 % of eligible children[12], the summer meals programmes could be expanded dramatically to improve nutrition and overall well-being in low-income households with children. Over 40 % of American households with children with incomes less than 185 % of the FPL were food insecure in 2013[13]. Food insecurity is of tremendous concern and has been linked to poorer health[14], academic and social problems[15,16] and anxiety and depression[17] in children, and poorer self-reported health[18], chronic disease[19], poorer food consumption and nutrient intake[20–22] and depression[23] in adults. Understanding the effectiveness of the summer meals programmes in reducing food insecurity is thus an essential piece of evidence for policy makers. Two previous studies using data on the number of summer meals sites at the state level have found evidence that these programmes are associated with lower household food insecurity[24,25], but no study has attempted to examine participation directly nor to examine programme sites at a lower level of analysis. Using administrative data from the State of California and surveillance data on a representative sample of Californian households, the present study used geographic accessibility of summer meals sites as a proxy for participation to estimate whether participation is associated with household food security in low-income households with children.

Methods

Data

Unlike SNAP, WIC and the NSLP, participation in the SFSP and SSO is not routinely measured in any major survey. Thus, the present study capitalizes on two sources of secondary data which provide a unique opportunity to estimate the impacts of participation. The first is the California Health Interview Survey (CHIS), a health surveillance survey administered biannually since 2001 that is 'representative of California's non-institutionalized population living in households'[26]. In each household, an adult was randomly selected to complete a parent survey; in households with children, a random adolescent (aged 12–17 years) and a random child (younger than 12 years) were also selected[26]. Data for the current project were taken primarily from the 2011–12 adult survey; data from the teen survey were also used to create household variables for programme participation and citizenship status. The CHIS has the merit of being the only statewide surveillance system to include questions about household food insecurity, which were posed to adults in households with incomes below 200 % of the FPL. The final analytic sample included 5394 low-income households with at least one child under the age of 18 years.

The second source is administrative data from 2011 on California's summer meals sponsors and sites. These data were obtained through a public information request to the Nutrition Services Division of the California Department of Education, which is responsible for maintaining the summer meals programmes in that state. The data included information on all summer programmes in the site in the 2010–11 fiscal year, which ran from October 2010 until September 2011. In that year, 431 sponsors operated 1947 SFSP and 1440 SSO sites. Table 1 provides information on the 3372 sites that were used in the analyses.* The vast majority of sites (>90 %) were classified as open. Lunch was the most common meal type offered (at 91·8 % of sites) followed by breakfast (32·7 %) and afternoon snack (23·2 %). Roughly half of the sites served more than one type of meal over the course of the summer. Over the course of the summer, sites were open for lunch for an average of 28·8 d for about 0·88 h/d; breakfast was offered for an average of 8·8 d for an average of about 0·25 h/d.

* Information could not be matched for fifteen sites (0·4 %) and three sponsors (0·7 %).

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Table 1 Characteristics of California summer meals sites (*n* 3372), 2010–11 fiscal year (October 2010–September 2011)

	Proportion	Days and hours of operation	Average	SD	Range
Site type					
Open	0·903	Breakfast (d)	8·776	14·38	0–57
Closed	0·074	Breakfast (h/d)	0·249	0·433	0–3·5
Camp	0·023	Lunch (d)	28·80	15·05	0–57
National Youth Sports Program†	0·000	Lunch (h/d)	0·880	0·503	0–3·5
Meal type		Supper (d)	0·626	4·377	0–57
Breakfast	0·327	Supper (h/d)	0·024	0·160	0–2
Lunch	0·918	AM snack (d)	0·300	3·238	0–57
Supper	0·026	AM snack (h/d)	0·007	0·075	0–2
AM snack	0·010	PM snack (d)	8·411	16·49	0–57
PM snack	0·232	PM snack (h/d)	0·143	0·298	0–2

†One site was operated as a National Youth Sports Program.

Measures

Programme accessibility

The CHIS did not directly assess participation in the summer meals programmes. Thus, the present study relied upon geographic accessibility as a proxy for participation in these programmes among low-income households, a novel approach to the study of nutrition programme utilization. The use of accessibility as a measure of programme utilization has a long history and has been important in the study of health-care utilization in particular[27]. Although it may be categorized in many ways[28], accessibility is presumed to be a predictor of people's ability to obtain goods or services. Recently, the concept of accessibility has figured prominently in the discourse on food deserts[29], which the USDA generally defines as areas without 'ready access to fresh, healthy, and affordable food'[30]. Further, some researchers have suggested the importance of considering availability and accessibility of food as an important framework for understanding food insecurity[31].

Low levels of participation among eligible children as well as previous evaluations of the SFSP both point to accessibility as central to participation in the summer meals programmes. For one, the participation gap makes it clear that there are simply not enough sites to feed all eligible children over the summer[11]. In a recent survey[32], nearly half of a sample of emergency food recipients reported not knowing about the SFSP as the major reason for non-participation, which suggests with some likelihood that there were not summer food sites in close proximity. Further, process evaluations of the SFSP conducted by the USDA have identified transportation as the most consistent barrier to participation and a particular challenge to children living in rural areas[33,34].

The substantial literature on health-care access suggests multiple ways to measure accessibility[28], some of which have been used in studies of food security and food access[31,35]. In the present study, accessibility was measured using a gravity model:

$$A_i = \sum_s \frac{Supply_s}{d_{is}^{\beta} v_s},$$

where A_i is the accessibility score for CHIS respondent i and is a summative function of the *Supply* of summer meals at site s, divided by the drive travel time d between respondent i's residence and site s, and a decay coefficient β, which 'represents the change in difficulty of travel as travel time change(s)'[28] (p. 8). Together, these terms in the gravity model account for the supply of summer meals sites that are accessible to CHIS respondents, discounting the value of sites that take longer to reach (i.e. by dividing the *Supply* at site s by the amount of time it would take to drive there, d). The additional term in the denominator, v_s, indexes spatially distributed population demand for summer meals at site s and is defined as:

$$v_s = \sum_k \frac{p_k}{d_{ks}^{\beta}},$$

where p is the population of families with children with incomes below 200 % of the FPL (a measure of the eligible population) in nearby census tract k and d is the drive travel time between site s and the centre of tract k[28,36]. Thus, the addition of the v_s term further adjusts the 'value' of the supply at site s by accounting for the demand for summer meals; higher levels of demand in nearby census tracts would further increase the size of the denominator. Travel was calculated as driving time (in minutes) based on the results of evaluations of the SFSP, which found that three-quarters of all children and 90 % of children at rural sites were dropped off by car[33]. For the present study, $Supply_s$ was an estimate of the total number of meals served at each site over the course of the summer. The online supplementary material describes the process for the construction of this variable in full detail.

One major choice bounds the gravity model: the value of the decay coefficient, β, which effectively discounts the supply of sites that are further away from CHIS respondents as well as the demand from census tracts that are further from summer meals sites. Decay coefficients can be linear, exponential or binary[37]. Although they are ideally developed based on existing empirical data[28], no study has investigated use of the SFSP relative to travel time. Lacking this specific information, a parsimonious

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approach was adopted by setting this coefficient equal to 1. In addition, all analyses were based on an effective upper limit of 30 min of driving. That is, sites that were further than 30 min away were not counted as accessible to CHIS respondents and the low-income population of census tracts greater than 30 min away from programme sites did not contribute to demand. This limit was based on a reasonable approximation of the number of minutes (60 min round trip) that people might be willing to drive to access sites and is tantamount to setting a decay coefficient equal to infinity for driving times greater than 30 min[37].

The gravity model is superior to more basic measures of accessibility such as travel time to the nearest site or the number of sites reachable with a certain time period. Most significantly, the gravity model accounts for the spatially distributed supply and demand for summer meals, unlike these more basic measures, which treat each site equally. Also, the gravity model 'discounts' the value of sites that are harder to reach or which provide a limited supply of meals in areas of high demand.

Food insecurity

The CHIS 2011–12 included the standard six-item version of the USDA's food security module. The six-item scale is widely used and has good sensitivity and specificity and minimal bias relative to the full eighteen-item version of the food security module[38]. Like the full scale, the six-item scale assesses whether households were able to afford the food they needed in the previous 12 months and can be used to establish various levels of household food insecurity severity[39]. Households where parents provided affirmative responses to zero or one question(s) were identified as food secure, those affirming two to four responses were identified as having low food security, and those providing affirmative responses to five or six questions were identified as having very low food security[38]. Based on this procedure, the present study used two indicators as primary outcomes: (i) whether households experienced any food insecurity and (ii) whether households experienced very low food security in the previous 12 months. Very low food security is a particularly severe type of material hardship and indicates that food intake of some household members was reduced and normal eating patterns were disrupted at times during the year due to limited resources[13]. Table 2 provides summary information on both food insecurity indicators as well as all other variables used in the analyses.

Controls

All analyses controlled for a number of additional variables to rule out potential confounding between accessibility of summer meals and food insecurity. From the CHIS, these included demographic variables such as: parental respondent's age in years; the number of teens, children and adults in the household; the race and ethnicity of the parental respondent (White, not Hispanic; Black, not Hispanic; Hispanic, any race; Asian/Pacific Islander; other); the gender of the parental respondent; the marital status of the parental respondent (married, living with partner, widowed/separated/divorced, never married); the citizenship status of the parental respondent (US-born citizen, naturalized citizen, non-citizen); the percentage of the parental respondent's life spent in the USA; and the urbanicity of the parental respondent's home (based on the Claritas Nielsen classification system: urban, second city, suburban, town and rural). Analyses also included economic variables from the CHIS: parent's education (less than high school, high-school graduate, some college, college graduate); parent's work status (not working, working 0–20 h/week, working ≥21 h/week); the natural log of household income; and an indicator for whether the adult or teen in the household reported currently receiving Temporary Assistance for Needy Families. Models also controlled for an indicator of whether the parental respondent experienced severe emotional distress during the most emotionally difficult month is the past year[40]. To account for the influences of participation in other nutrition programmes, analyses included indicators for current participation in SNAP and WIC.

Finally, all analyses included variables to control for area-level factors that might simultaneously be associated with access to summer meals sites and household food insecurity. First was a set of county indicators which accounted for observed and unobserved differences between counties that may be relevant. Second was a census-tract level standardized index (mean = 0, SD = 1) of neighbourhood deprivation developed in previous research[41].

Analyses

Because the present study used the geocoded addresses of CHIS 2011–12 respondents, analyses for the project were completed via a restricted data agreement with the University of California, Los Angeles' Center for Health Policy Research. This agreement stipulated that all analyses be completed by staff at the Center. Because drive time calculations required working directly with both the CHIS and SFSP data, all drive-time estimates were developed by CHIS staff. Analyses were run using the Stata statistical software package and ordinary least squares regression to first assess the association between accessibility of summer meals sites and the indicator for food insecurity and then separately between accessibility and very low food security. Alternative models (available upon request) used logistic regression and arrived at nearly the same conclusions. All models clustered standard errors at the county level to control for the non-independence of observations. In addition, two sets of subgroup analyses were run. Previous process evaluations of the SFSP have indicated that more than three-quarters of meals were fed to younger children (of elementary school age or younger)[33] and that access to summer meals is a

Table 2 Descriptive statistics for the full analytic sample: low-income families with children (*n* 5394), California Health Interview Survey, 2011–12

	Mean	SD (for continuous variables)	Range
Outcome measures			
Any food insecurity	0·431		0–1
Very low food security	0·151		0–1
Accessibility of summer meals sites			
Travel time to nearest site (*n* 5141)	4·46	5·47	1–30
Accessibility score	19·31	32·83	0–1243·75
Control variables			
Parent's age in years	39·62	13·57	18–96
No. of children (aged 0–11 years) in the household	1·35	1·15	0–7
No. of teens (aged 12–17 years) in the household	0·78	0·84	0–7
No. of adults in the household	2·56	1·15	1–9
Parent's race/ethnicity			
White, not Hispanic	0·21		0–1
Black, not Hispanic	0·05		0–1
Hispanic, any race	0·62		0–1
Asian/Pacific Islander	0·09		0–1
Other	0·03		0–1
Parent's gender (male)	0·34		0–1
Parent's marital status			
Married	0·50		0–1
Living with partner	0·11		0–1
Widowed/separated/divorced	0·18		0–1
Never married	0·21		0–1
Parent's citizenship status			
US-born citizen	0·44		0–1
Naturalized citizen	0·18		0–1
Non-citizen	0·38		0–1
Percentage of parent's of life spent in the USA	68·54	31·72	1–100
Urbanicity of parent's residence			
Urban	0·38		0–1
Second city	0·33		0–1
Suburban	0·12		0–1
Town and rural	0·17		0–1
Parent's education			
Less than high school	0·34		0–1
High-school graduate	0·32		0–1
Some college	0·23		0–1
College graduate	0·11		0–1
Parent's work status			
Not working	0·46		0–1
Working part time (0–20 h/week)	0·10		0–1
Working full time (≥21 h/week)	0·44		0–1
Household income ($US)	23 465·96	13 323·26	0–90 000
Adult or teen receiving TANF	0·11		0–1
Parent's serious psychiatric distress	0·11		0–1
Adult or teen receiving SNAP	0·27		0–1
Adult or teen receiving WIC	0·16		0–1
Standardized measure of neighbourhood deprivation	0·55	1·00	−1·61 to 4·77

TANF, Temporary Assistance for Needy Families; SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women Infants and Children.

particular problem for children in rural areas. Accordingly, all analyses were replicated after splitting the sample by age of children in the households (any children aged 0–11 years or only adolescents aged 12–17 years) and by urbanicity (urban/second city or suburban/town or rural).

Addressing selection bias

Selection bias is an important concern in the study of food and nutrition assistance programmes[42]. It is well documented that naïve estimates of the impact of programmes like SNAP tend to suggest that participation is associated with increased rates of food insecurity. This finding may initially seem counterintuitive, but is in fact a natural consequence of the fact that the programme and others like it are reaching families with the greatest need. However, as noted above, carefully constructed empirical designs that take advantage of natural experiments to address selection have found that participation in SNAP and other programmes is associated with decreased food insecurity[2–6]. In this sense, the use of geographic accessibility as a proxy for participation is a boon, since it is far less likely that families with high levels of need (food

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insecurity) choose where to live because of proximity to a summer meals site. Analyses controlled for characteristics of CHIS respondents and their families as a check against selection bias.

In the case of summer meals programmes, however, selection might be also relevant to supply. That is, sponsors might operate sites or expand site supply in areas of high demand. Thus, as a further check, county-level indicators and a standardized measure of neighbourhood-level disadvantage (measured at the census tract level) are important area-based controls. Collectively, these variables control for unobserved differences between counties (like differences in the food environment and access to public transportation) that could be associated with both access to summer meals sites and household food insecurity, and generate results based on within-county variation in accessibility of summer meals for CHIS respondents living in areas of comparable neighbourhood disadvantage.

Results

Descriptive results from Table 2 show that 43·1 % of low-income CHIS households (<200 % of the FPL) with children were food insecure, a figure roughly consistent with data from federal reports[13]; 15·1 % of households experienced very low food security. Summer meals sites were generally accessible to CHIS respondents: on average the nearest site was reachable in about 4·5 min of driving, although for a small minority (253 respondents; 4·7 %) no site was reachable within 30 min. Over 60 % of sample respondents were Hispanic of any race, more than half were naturalized citizens or non-citizens, nearly a third lived in suburban or town or rural areas, and 66 % had a high-school education or less. Average household income was approximately $US 23 500, more than 25 % of households were receiving SNAP benefits and average neighbourhood deprivation was more than half an SD greater (0·55) than the overall mean.

Table 3 presents results from ordinary least squares models, which examined associations between geographic accessibility of summer meal programme sites and household food insecurity. Table 3 reports results for the full sample and for the subgroups identified above. To improve interpretation, the accessibility score variable was rescaled to units of 100. As reported in Table 3, although coefficients were uniformly negative, the accessibility score was not significantly ($P < 0·05$) associated with food insecurity in the full sample of low-income CHIS households with children or in any sub-sample.

Table 4 is the same in form as Table 3 but presents results for very low food security. For the full sample, a 100-unit increase in the accessibility score was associated with a significant decrease of 0·028 ($P = 0·033$) in the probability of very low food security. Likewise, an increase of 100 in the accessibility score was significantly associated with lower probability of very low food security in households with younger children (−0·026, $P = 0·021$) and among low-income families living in suburban or town or rural areas (−0·049, $P = 0·002$).

Discussion

The current paper examined the association between accessibility of summer meals programme sites and food insecurity in low-income households with children in the state of California. Models that controlled for numerous individual and household factors along with county indicators and measures of neighbourhood deprivation found that geographic accessibility was associated with significant decreases in the probability of very low food security in the full sample and among households with younger children and those living in less urban areas. This predicted association was strongest (−0·049) for children in suburban or town or rural areas; and in the full sample, the decrease of 0·028 was large relative to the average level of very low food security in the sample (18·4 %). It is important to note, however, that these predicted associations are related to a 100-unit increase in the accessibility score; as indicated below, 100 is close to the mean level of accessibility for CHIS respondents with the highest accessibility scores and so this level of increase suggests a substantial increase in supply relative to demand. Geographic accessibility was not associated with the probability of overall household food insecurity.

These results are broadly consistent with the two previous studies that used state-level data on the summer meals programmes. Nord and Romig[24] found that seasonal differences in very low food security were more pronounced (i.e. even higher in the summer) in states that provided a low number of summer meals, although results were only evident for school-aged children. Bartfeld and Dunifon[25] likewise found some evidence that state-level measures of participation in summer meals programmes were associated with reductions in household food insecurity. As noted above, no previous study has attempted to directly assess participation in the programme at the household level.

The gravity model, which produced the accessibility score, accounted for spatially distributed programme supply and demand by discounting sites that were further away in distance as well as the demand from areas that were relatively far away. Thus, while the accessibility score coefficients are difficult to directly interpret, they imply that summer meals sponsors may have an impact on very low household food insecurity in two general ways (assuming fixed demand for the programme, measured here by the proportion of families living below 200 % of the FPL in census tracts proximal to programme sites): (i) by opening more sites in high-need areas; or (ii) by increasing the supply of meals at existing sites.

Although both strategies are likely important in light of previous evaluations of the SFSP that have indicated that transportation to sites is a major barrier for

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Table 3 Accessibility of summer meals sites and any food insecurity in low-income households with children (*n* 5394), California Health Interview Survey, 2011–12†

			Subgroup analysis by child age				Subgroup analysis by urbanicity			
	Full sample (*n* 5394)		Any children aged 0–11 years (*n* 4012)		Only adolescents aged 12–17 years (*n* 1382)		Urban or second city (*n* 3846)		Suburban or town or rural (*n* 1548)	
	OLS coeff.	SE	OLS coeff.	SE	OLS coeff.	SE	OLS coeff.	SE	OLS coeff.	SE
Accessibility score (units of 100)	−0·010	0·021	−0·006	0·022	−0·023	0·045	−0·020	0·017	−0·006	0·036
Parent's age in years	0·001	0·001	0·001	0·001	0·001	0·002	0·001	0·001	0·001	0·001
No. of children (aged 0–11 years) in the household	0·002	0·008	−0·001	0·009			−0·001	0·010	0·005	0·011
No. of teens (aged 12–17 years) in the household	0·017(*)	0·010	0·018	0·011	0·027	0·029	0·017(*)	0·010	0·020	0·017
No. of adults in the household	−0·007	0·006	−0·003	0·006	−0·017	0·014	−0·005	0·007	−0·013	0·011
Parent's race/ethnicity										
White, not Hispanic‡										
Black, not Hispanic	0·054*	0·025	0·032	0·031	0·116**	0·043	0·078*	0·033	−0·024	0·071
Hispanic, any race	0·019	0·020	0·001	0·023	0·068*	0·027	0·032	0·027	−0·013	0·040
Asian/Pacific Islander	−0·131***	0·033	−0·167***	0·045	−0·039	0·036	−0·120**	0·035	0·152*	0·069
Other	0·099**	0·034	0·114**	0·037	0·031	0·087	0·104(*)	0·061	0·070*	0·033
Parent respondent is male	−0·029(*)	0·016	−0·029(*)	0·015	−0·034	0·039	−0·025	0·018	−0·048	0·034
Parent's marital status										
Married‡										
Living with partner	−0·003	0·019	0·001	0·020	−0·002	0·056	−0·007	0·023	0·014	0·041
Widowed/separated/divorced	0·029	0·021	0·046(*)	0·026	−0·017	0·028	0·020	0·022	0·048	0·044
Never married	−0·062*	0·024	−0·047(*)	0·028	−0·109***	0·023	−0·064**	0·023	−0·057	0·044
Parent's citizenship status										
US-born citizen‡										
Naturalized citizen	0·009	0·030	0·022	0·038	−0·011	0·043	−0·016	0·031	0·096	0·059
Non-citizen	0·044	0·037	0·032	0·049	−0·082	0·056	0·034	0·036	0·068	0·079
Percentage of parent's life spent in the USA	−0·000	0·001	−0·001	0·001	0·001	0·001	−0·000	0·000	0·000	0·001
Urbanicity of parent's residence										
Urban‡										
Second city	−0·023*	0·009	−0·047*	0·022	0·055	0·046	−0·022(*)	0·011		
Suburban	−0·023	0·020	−0·035	0·034	0·010	0·043				
Town and rural	−0·017	0·024	−0·036	0·030	0·050	0·054			0·001	0·036
Parent's education										
Less than high school‡										
High-school graduate	−0·068***	0·012	−0·073***	0·015	−0·049(*)	0·027	−0·073***	0·015	−0·055(*)	0·031
Some college	−0·055**	0·018	−0·056*	0·024	−0·047	0·036	−0·057*	0·026	−0·051	0·033
College graduate	−0·122***	0·021	−0·114***	0·025	−0·118**	0·038	−0·119***	0·023	−0·133**	0·044
Parent's work status										
Not working‡										
Working part time (0–20 h/week)	0·046	0·034	0·068(*)	0·036	−0·002	0·046	0·082*	0·034	−0·046	0·044
Working full time (≥21 h/week)	0·029*	0·012	0·046**	0·016	−0·014	0·024	0·039**	0·012	−0·003	0·030
Household income ($US, logged)	−0·008(*)	0·004	−0·007	0·006	−0·012	0·009	−0·006	0·005	−0·015(*)	0·009
Adult or teen receiving TANF	0·018	0·028	0·005	0·031	0·060	0·066	−0·004	0·031	0·083	0·051
Parent's serious psychiatric distress	0·258***	0·022	0·246***	0·039	0·286***	0·044	0·274***	0·028	0·229***	0·030
Adult or teen receiving SNAP	0·112***	0·017	0·117***	0·021	0·095**	0·033	0·103***	0·018	0·138***	0·036
Adult or teen receiving WIC	−0·021	0·016	−0·015	0·018	−0·431***	0·034	−0·007	0·022	−0·060(*)	0·033
Standardized measure of neighbourhood deprivation	0·015*	0·006	0·012(*)	0·007	0·025(*)	0·015	0·019**	0·005	−0·001	0·017

OLS coeff., coefficient from ordinary least squares regression; TANF, Temporary Assistance for Needy Families; SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women Infants and Children.
(*)$P<0·10$; *$P<0·05$; **$P<0·01$; ***$P<0·001$.
†All models include indicators for county of residence and standard errors clustered at the county level.
‡Omitted category.

participation[33,34], increasing supply at existing sites may be a more immediately effective strategy. As noted above, descriptive analyses suggest that the nearest site was less than a 5 min drive on average from low-income CHIS households. Further, additional analyses of California census tracts (available upon request) indicate that summer meals sites are already located in areas with the highest level of need. In 2011, the proportion of households with incomes below 185 % of the FPL in census tracts with no summer meals sites was 0·272, compared with 0·416 in tracts with any site and 0·477 in tracts that had four or more sites. After controlling for total

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Table 4 Accessibility of summer meals sites and very low food insecurity in low-income households with children (*n* 5394), California Health Interview Survey, 2011–12†

			Subgroup analysis by child age				Subgroup analysis by urbanicity			
	Full sample (*n* 5394)		Any children aged 0–11 years (*n* 4012)		Only adolescents aged 12–17 years (*n* 1382)		Urban or second city (*n* 3846)		Suburban or town or rural (*n* 1548)	
	OLS coeff.	SE	OLS coeff.	SE	OLS coeff.	SE	OLS coeff.	SE	OLS coeff.	SE
Accessibility score (units of 100)	−0·028*	0·013	−0·026*	0·011	−0·038	0·050	−0·017	0·015	−0·049**	0·015
Parent's age in years	0·001*	0·000	0·001*	0·000	−0·000	0·001	0·001	0·000	0·001	0·001
No. of children (aged 0–11 years) in the household	−0·002	0·005	0·001	0·006			−0·004	0·007	0·002	0·009
No. of teens (aged 12–17 years) in the household	0·011	0·007	0·016*	0·008	−0·018	0·011	0·010	0·006	0·010	0·014
No. of adults in the household	−0·004	0·004	−0·004	0·005	−0·003	0·012	−0·002	0·004	−0·009	0·008
Parent's race/ethnicity										
White, not Hispanic‡										
Black, not Hispanic	0·030	0·020	0·042	0·028	0·006	0·041	0·030	0·035	0·053	0·073
Hispanic, any race	−0·013	0·017	−0·016	0·018	−0·004	0·035	−0·011	0·024	−0·008	0·031
Asian/Pacific Islander	−0·072***	0·015	−0·079***	0·021	−0·043	0·029	−0·074**	0·019	−0·050	0·040
Other	0·108**	0·032	0·102**	0·035	0·138(*)	0·072	0·146*	0·055	0·057	0·038
Parent respondent is male	−0·012	0·010	−0·015	0·011	−0·004	0·014	−0·001	0·011	−0·049*	0·018
Parent's marital status										
Married‡										
Living with partner	−0·007	0·015	0·001	0·015	−0·025	0·039	−0·018	0·013	0·038	0·030
Widowed/separated/divorced	0·034*	0·014	0·050**	0·015	−0·011	0·023	0·030*	0·014	0·040	0·029
Never married	−0·001	0·019	0·014	0·022	−0·064*	0·030	−0·009	0·019	0·026	0·032
Parent's citizenship status										
US-born citizen‡										
Naturalized citizen	−0·005	0·030	−0·016	0·029	0·039	0·045	−0·019	0·035	0·051	0·037
Non-citizen	0·026	0·029	0·009	0·030	0·074	0·045	0·026	0·028	0·015	0·049
Percentage of parent's life spent in the USA	0·001	0·000	0·000	0·000	0·001(*)	0·001	0·000	0·000	0·001	0·001
Urbanicity of parent's residence										
Urban‡										
Second city	−0·022(*)	0·012	−0·040*	0·018	0·034	0·034	−0·032(*)	0·017		
Suburban	−0·027	0·017	−0·049	0·030	0·037	0·029				
Town and rural	−0·064**	0·019	−0·075**	0·025	−0·017	0·039			−0·026	0·028
Parent's education										
Less than high school‡										
High-school graduate	−0·030**	0·010	−0·028*	0·013	−0·034	0·024	−0·032*	0·012	−0·015	0·021
Some college	−0·018	0·012	−0·025(*)	0·015	0·005	0·026	−0·030(*)	0·015	0·013	0·026
College graduate	−0·027(*)	0·014	−0·023	0·019	−0·017	0·023	−0·037*	0·013	0·001	0·034
Parent's work status										
Not working‡										
Working part time (0–20 h/week)	0·012	0·018	0·031	0·023	−0·020	0·030	0·028(*)	0·016	−0·030	0·032
Working full time (≥21 h/week)	0·007	0·011	0·022(*)	0·011	−0·028	0·024	0·010	0·010	−0·001	0·027
Household income ($US, logged)	−0·003	0·002	−0·002	0·003	−0·008(*)	0·005	−0·003	0·003	−0·003	0·004
Adult or teen receiving TANF	0·036*	0·016	0·022	0·016	0·074	0·050	0·031(*)	0·018	0·067(*)	0·036
Parent's serious psychiatric distress	0·212***	0·016	0·201***	0·019	0·212***	0·037	0·237***	0·024	0·155***	0·033
Adult or teen receiving SNAP	0·039**	0·014	0·049**	0·017	0·010	0·026	0·034*	0·014	0·050(*)	0·028
Adult or teen receiving WIC	0·013	0·014	0·016	0·015	−0·079**	0·025	0·017	0·016	0·008	0·030
Standardized measure of neighbourhood deprivation	0·005	0·005	−0·000	0·005	0·026(*)	0·013	0·002	0·005	0·016	0·010

OLS coeff., coefficient from ordinary least squares regression; TANF, Temporary Assistance for Needy Families; SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women Infants and Children.
(*)$P<0·10$; *$P<0·05$; **$P<0·01$; ***$P<0·001$.
†All models include indicators for county of residence and standard errors clustered at the county level.
‡Omitted category.

population, neighbourhood deprivation was significantly associated with the number of summer meals sites at the census tract level (incident rate ratio = 1·35, $P<0·001$), an association that was consistent even among the highest-poverty census tracts where greater than 50 % of households lived below 185 % of the FPL (incident rate ratio = 1·23, $P<0·001$). These data also have the important benefit of arguing against an alternative interpretation of the present study's findings, namely that the negative predicted association between accessibility and very low security is a consequence of the fact the programme is not reaching its intended targets.

Sponsors can increase supply of meals in two ways. For one, sites can remain open more days and for longer hours

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in the summer. Descriptive information on California's summer meals sites (Table 1) suggests that the average site was open for lunch for half of all possible days (28·8 d out of 57) and breakfast for only 15 % of the summer (8·8 d). Sites could also expand their hours of operation to offer meals and snacks for more hours during open days. Second, sponsors could open new sites and states could push for new sponsors to enrol in the SFSP and SSO. The USDA and many state agencies are actively engaged in such outreach efforts[11,43], which have increased supply in California[44] and elsewhere, but the participation gap points to the need for many more sponsors and sites.

Descriptive information on accessibility (Table 1) indicates that this variable had significant positive skew (mean = 19·31, maximum value = 1243·75). Supplemental analyses (not shown, but available upon request) assessed for the influence of outliers on the results reported above. After dropping 255 positive outliers (mean accessibility = 105·84), accessibility was not associated with either food insecurity or very low food security. These supplemental results further underscore the importance of increasing the supply of summer meals, as it appears that the results in the main analyses were driven by CHIS respondents with particularly high accessibility levels.

Although accessibility was strongly associated with very low food security in the main analyses, the accessibility of summer meals sites was not associated with overall household food insecurity in low-income households with children. The reason for this may be due to the nature of very low food security, which implies a reduction in food intake or disruption of normal eating patterns[13], a particularly severe form of material hardship. Thus, while participation in the summer meals programmes may be sufficient to offset this most profound level of food insecurity, the limited duration and intensity of typical summer meals programmes may not be enough to eliminate food insecurity altogether. Future research is necessary to understand how participation in the SFSP and SSO helps to affect the dynamics of food consumption for low-income families during the summer months.

The CHIS data set included the six-item version of the food security module, which assessed food insecurity for the entire household. Although this scale is minimally biased relative to the full eighteen-item module[38], it is not able to distinguish between food insecurity among adults and children. As a result, the present study focused on household food insecurity and might underestimate the impact of summer meals accessibility on the food insecurity of children, who are most likely to benefit from summer meals programmes.

The study was also limited by an inability to observe direct participation in summer meals programmes. However, geographic accessibility measures used here are proxies for utilization, similar to previous studies[24,25] that used state-level indicators data on summer meals participation and programme supply to estimate programme impacts. Although geographic accessibility has been used extensively in research on health-care access and utilization and in previous studies of food access, gravity models (and other models of accessibility) require a number of assumptions. Of particular import to gravity models is the form and size of the decay coefficient, which quantifies the difficulty in accessing sites that are further away from CHIS residents and the demand for summer meals from census tracts that are far away from summer meals sites. As noted above, the present study adopted a parsimonious approach of using a decay coefficient equal to 1. In alternative models (not shown), exponential coefficients (powers of 2 and 3) were used. In these models, the coefficients attached to the accessibility measure for very low food security were smaller in size but P values were also smaller than those reported above. In addition, in these models, accessibility was associated with significant decreases in the probability of household food insecurity and very low food security among households with adolescents and household food insecurity for CHIS respondents living in urban areas. Results (not shown) also varied in models that used different upper limits for driving time. For example, in models with a cut-off of 60 min, accessibility was still significantly associated with decreases in the probability of very low food security but with significant increases in the probability of household food insecurity. However, 60 min is likely too high a value to reasonably index accessibility, as it unlikely that people are willing to travel 2 h (round trip) to access summer meals sites or that programme sites are attendant to demand for summer meals from census tracts an hour away. Indeed the cost of gasoline or fares for public transportation for this trip would probably offset the benefit of receiving a meal. Further, among the 95 % of CHIS respondents with access to a summer meals site, the nearest site was less than a 5 min drive away, making long travel times highly unlikely.

It is also important to note that geographic accessibility and actual access are not one and the same, particularly for programmes like the SFSP and SSO. As alluded to above, lack of knowledge about the summer meals programmes was identified as major impediment to participation[32], which is plausible even when sites are located in proximity to low-income households. And while the lack of explicit asset or income tests for the SFSP might mean that stigma is less of a factor than for other programmes, worries about such stigma may negatively affect perceptions of accessibility for potential participants.

More to the point, the limitations attached to the use of geographic accessibility as a proxy for programme participation speak to the need for novel and high-quality data on participation in the SFSP and SSO. Although the results reported here are consistent with the very small number of previous studies, given the lack of information on summer meals participation in the data used to generate national estimates of nutrition programme participation (the Current

Population Survey – Food Security Supplement) and other sources of data typically used by policy analysts, researchers should include questions about participation in ongoing and new data collection efforts and continue to develop innovative strategies to understand these important programmes.

Despite these minor limitations and given the almost total lack of research on the impact of the SFSP and SSO, the present study provides an important complement to existing knowledge on these programmes and to the extensive body of literature that has examined other food and nutrition programmes. Decreasing the participation gap between the NSLP and summer meals programmes may be an effective way to reduce very low food security for low-income households with children.

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Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1368980016000033

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