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Higher Food Prices May Threaten Food Security Status among American Low-Income Households with Children[1,2]

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Abstract

Children in food-insecure households are more likely to experience poorer health function and worse academic achievement. To investigate the relation between economic environmental factors and food insecurity among children, we examined the relation between general and specific food prices (fast food, fruits and vegetables, beverages) and risk of low (LFS) and very low food security (VLFS) status among low-income American households with children. Using information for 27,900 child-year observations from the Early Childhood Longitudinal Study-Kindergarten Class of 1998–1999 linked with food prices obtained from the Cost of Living Data of the Council for Community and Economic Research, formerly known as the American Chamber of Commerce Researchers' Association, fixed effects models were estimated within stratified income groups. Higher overall food prices were associated with increased risk of LFS and VLFS (coefficient = 0.617; $P < 0.05$). Higher fast food and fruit and vegetable prices also contributed to higher risk of food insecurity (coefficient = 0.632, $P < 0.01$ for fast food; coefficient = 0.879, $P < 0.01$ for fruits and vegetables). However, increasing beverage prices, including the prices of soft drinks, orange juice, and coffee, had a protective effect on food security status, even when controlling for general food prices. Thus, although food price changes were strongly related to food security status among low-income American households with children, the effects were not uniform across types of food. These relations should be accounted for when implementing policies that change specific food prices. J. Nutr. 143: 1659–1665, 2013.

Introduction

"Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (1). Not meeting this standard, or food insecurity, has negative health and social consequences for children, such as a higher risk of hospitalization and need for mental health services, lower mathematics performance, and increased grade repetition (2,3). Healthy People 2020 has set a goal of eliminating the most severe form of household food insecurity among children, very low food security (VLFS)[7], by 2015 (4). Children in families that experience VLFS have consumed foods of lower quality, skipped meals, gone without meals for an entire day, or been hungry, because there was not enough money for food (2,3). Research that identifies solutions to household food insecurity in general and VLFS in particular is urgently needed. Most existing research has highlighted the individual- or household-level sociodemographic determinants of food security, but it is also necessary to direct attention to the role of contextual factors, such as state-level welfare program policies or regional poverty rates (5).

Household food security is only one aspect of the nutrition-related health crisis among American children. Whereas children in food-insecure households have less access to food, the majority of U.S. children have diets that are calorie-rich and micronutrient-poor and therefore are not protective against chronic disease risk. About 24% of 12- to 19-y-old children in the US drink >0.71 L/d of sugar-sweetened beverages, putting them at risk of obesity, dental caries, and kidney disorders (6). One-half of 12- to 19-y olds consume no whole grains and <0.24 L of vegetables, and 28% report eating no fruit. Thus, improving nutrition for all children, including children in households with limited ability to purchase food, is a public policy priority (4).

Pricing strategies to improve child nutrition, such as food taxes and food subsidies, are being debated by policy makers

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[7] Abbreviations used: BPI, beverage price index; C2ER, Council for Community and Economic Research; ECLS-K, Early Childhood Longitudinal Study-Kindergarten Class; FFPI, fast food price index; FVPI, fruit and vegetable price index; LFS, low food security; VLFS, very low food security.
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and scientists. Proponents of taxing follow fairly straightforward reasoning. Energy-dense foods, such as oils and solid fats, sugars, and refined grains cost significantly less per 1000 kcal than lean meats, low-fat dairy, vegetables, and fruits (7), thus promoting consumption of energy-dense foods. This tendency has been reinforced in recent years, because price inflation has not affected the most energy-dense foods, while it has raised the prices of the least energy-dense foods by 20% (8). Because consumers are responsive to price changes in certain foods, even energy-dense foods such as sugar-sweetened beverages (9–11), using taxes to increase the price of sugar-sweetened beverages and other low-nutrition, energy-dense foods should decrease their consumption. However, previous studies have not considered the impact of pricing strategies on food insecurity among children.

Other studies on food prices, nutrition, and nutrition-related health have obtained mixed results. A recent USDA investigation found that, on average, higher prices for soda, juice, starchy vegetables, and sweet snacks were associated with lower BMIs among children, and lower prices for dark green vegetables and low-fat milk were linked with reduced BMIs (12). In a similar study, Powell (13) also found robust effects at the county level of fast food prices on adolescents' BMI change over time, with rising prices being associated with smaller increases in BMI. When stratified by income, the food price effects were concentrated among middle-income families rather than in poor or wealthy families. In a separate paper, Powell et al. (14) did not find a role for fast food or sugar-sweetened beverage prices in the diet quality of adults; however, higher prices of fruits and vegetables were associated with lower fiber intake and less fast food consumption in adults living below 130% of the poverty threshold.

Lipsky (15) points out that energy prices alone, measured in dollars per kilocalorie, are inadequate to capture consumer choices and their price sensitivities, because foods of differing energy density may not be actual substitutes for one another in the eyes of consumers (e.g., someone seeking to purchase chips, which are cheaper in dollars per kilocalorie than lettuce, might not consider lettuce as an alternative to chips). Lin and Guthrie (16) estimate that price subsidies that reduce the prices of fruits and vegetables should shift low-income households' consumption toward these foods, relative to snacks, but Frazao et al. (17) conclude that convenience and enjoyment compete with nutrition for the food dollar, making the effects of price subsidies unclear.

Changes in food prices may improve nutritional status, but they also have the potential to negatively affect the well-being of children and adults by increasing food insecurity. The poorest households may be most at risk of increased food insecurity when higher taxes cause food prices to rise (17,18). There is a general lack of research that carefully investigates the relation between household food security and food prices in the US (19). One exception is a recent study using quarterly regional price data linked with food security responses from the Current Population Survey, 2002–2005. That study finds a positive average effect of food price changes on the probability of food insecurity, with a 1 SD rise in the price of a food basket raising the prevalence of food insecurity for adults and children by 8.4 and 15.9%, respectively (20). The current investigation extends that line of research by examining the price effects of selected food items, as well as general food price effects, using county-level price indices and alternative measures of food insecurity among American households with children.

Materials and Methods

Data

The Early Childhood Longitudinal Study-Kindergarten Class of 1998–1999 (ECLS-K) is a national sample, with a multistage probability design, of 21,260 children who were in 1590 public and private kindergartens during the 1998–1999 school year. For the first stage, counties were selected with probability proportional to size; public or private schools with kindergartens were randomly selected at the second stage; the final stage sampled children at the selected kindergartens. Although the base year sample is nationally representative, the later waves were not always representative of children in the corresponding grades due to sample attrition or because some children were held back or promoted to higher grades early. More technical details are available from the ECLS-K study (21). Because the ECLS-K was designed to examine children's development from kindergarten to eighth grade, longitudinal information was obtained for 7 survey waves, until 2007, with data collected from schools, households, and children. Food security was measured in spring 1999, 2002, 2004, and 2007, so only these 4 data waves were analyzed here.

The Council for Community and Economic Research (C2ER), formerly known as the American Chamber of Commerce Researchers' Association, Cost of Living Data reports quarterly prices of consumer goods in ~250 U.S. metropolitan areas. The C2ER data consist of the prices of 62 different products, including 21 foods typically consumed at home and 3 foods consumed away from home. We merged C2ER data with ECLS-K data by state and county. The analysis sample is limited to persons in approximately one-third of the ECLS-K counties that were also C2ER survey areas. For C2ER metropolitan areas that crossed county boundaries, the C2ER food prices were applied to all counties within the metropolitan area.

This study was approved by the Human Subjects Institutional Review Board at Old Dominion University.

Measurement

Food insecurity. The ECLS-K used the USDA's Household Food Security Survey Module for parents to report food insecurity in the previous 12 mo. The module includes 18 questions pertaining to household food resources during the previous 12 mo, such as "Did you ever eat less than you felt you should because there wasn't enough money for food" (22). The questions assessed a spectrum of issues related to worrying about running out of food, reducing the quality of foods provided to adults or children, and skipping meals. Following USDA recommendations (23) and a previous study using the ECLS-K data (3), food insecurity in the household was measured based on the number of affirmative answers to these 18 questions and was defined as follows: *1*) low food security (LFS): 3 or more affirmative answers (for most households, these 3 items were "worried food would run out," "food bought just didn't last," and "relied on few kinds of low-cost food for children") and *2*) VLFS: 8 or more affirmative answers (in addition to the 3 items mentioned above, these commonly included respondent reports that adults and/or children were cutting the size of meals, skipping meals, or going without food for an entire day).

Note that the measurement of food security relies on responses to a series of questions that may not reflect all scenarios of food security.

Food price indices. A general food price index was calculated as the weighted average price for all 24 food items in the C2ER data. Three specific food price indices were selected based on their Energy Density Index, which determines the amount of daily energy consumed and has direct health implications (24): the fast food price index (FFPI), the fruit and vegetable price index (FVPI), and the beverage price index (BPI). These indices included the following baskets of related food items: *1*) FFPI: a 0.11-kg McDonald's hamburger, 0.30–0.33 m thin-crust regular cheese pizza at Pizza Hut or Pizza Inn, and a fried chicken drumstick and thigh at Kentucky Fried Chicken; *2*) FVPI: bananas, lettuce, sweet peas, tomatoes, potatoes, peaches, and frozen corn; and *3*) BPI: coffee, orange juice, and soft drinks.

These indices were calculated using weights provided by C2ER based on spending for each food item relative to overall food expenditure in the Consumer Expenditure Survey, the only federal survey containing a

complete range of consumers' expenditures, including those on food, housing, and transportation (25). Because the specific food price indices partially reflect the general cost of food, we also calculated a set of "relative" food price indices, defined as the ratio of the selected food price index to the general food price index, abbreviated as relative FFPI, relative FVPI, and relative BPI. Food security was measured based on the previous 12-mo access to sufficient food, so we used the 1-y lagged food prices in the analyses.

Covariates. The regression models controlled for child-specific demographics, including age, gender, and race-ethnicity, as well as for household variables, including total income, number of people and siblings in the household, parental employment, highest education of either parent, and participation in the Supplemental Nutritional Assistance Program and National School Lunch Program. Due to incomplete information and low response rates, participation in other welfare programs, such as Temporary Assistance for Needy Families and Supplemental Security Income, were not controlled. Our study respondents were not eligible for the Women, Infants and Children program, because it applies only to children age 5 y and under. Employment status in ECLS-K was defined as ≥35 h/wk, <35 h/wk, looking for work, or not in the labor force. We controlled for both the maternal and paternal employment status in the analysis.

Statistical analysis. All children with complete information on the selected variables were included in the analysis sample, which consisted of 27,900 child-year observations. In addition to full sample estimates, we presented stratified analyses for children in families with incomes up to 300%, 200%, and 100% of the federal poverty line. Because the absolute household income did not adjust for the number of people living in the households, we used another measure, poverty income ratio, to classify the households' income levels. The poverty income ratio is the ratio of household income to corresponding federal poverty threshold, which is adjusted every year based on inflation for different numbers of people in households (26). Descriptive statistics for each wave of the ECLS-K were presented first, including information on the prevalence of food insecurity and food price indices across time. Means, percentages, SDMs, SEEs, and regression coefficients were obtained using Stata 12 (27). We used Stata's "svy" commands to calculate the descriptive statistics in **Table 1**, which account for the complex survey design of the ECLS-K when estimating SEs. For multivariate analyses, fixed effects logistic modeling using the xtlogit command was employed, taking advantage of the panel design of the ECLS-K, to account for within- and between-child variation in food security transitions and their associations with differences in food price trajectories across metropolitan areas. Alpha was set to 0.05. State fixed effects were also included to account for location-specific but time-invariant correlates of food insecurity. Because we used only 4 waves of the panel data, there was no appropriate longitudinal sampling weight available in the original data. Therefore, we did not apply the panel sampling weight in the final regression analyses. We conducted sensitivity analyses with alternative sampling weights, including cross-sectional weights or longitudinal weights, for selected waves of data. However, the results consistently showed that almost all covariates had highly significant results ($P < 0.001$) in the model specifications we tested. All regression coefficients and Huber-White robust SEs were reported in the tables to account for the clustering effects within each metropolitan area.

Due to the multicollinearity between food price indices, we included controls for specific food price indices in separate models. Marginal elasticity effects were estimated, defined as the ratio of estimated percent change in the risk of food insecurity given a 1% change in the food price index, with all other covariates evaluated at their original values. For instance, if a 1% increase in food prices results in a 0.1% rise in food insecurity risk, then the marginal elasticity is 0.1 (0.1%/1%). The Stata command "margins" was used to estimate the marginal elasticity. The figure reported the average marginal elasticity, meaning that when the price index was set as equal to the average across regions, there was a varying percent change in the probability of food insecurity given a 1% change in the food price index.

Results

The analytical sample, across 4 waves, contained 27,900 child-year observations (Table 1). Approximately 50% of these children were white; Hispanic children were the second-largest racial/ethnic group. The average household size was ~4.5 people, suggesting that most respondent families had more than one child. However, siblings were unlikely to be selected in the ECLS-K survey unless they were twins and thus of the same age. More than 16% of the children were in families with household incomes below 100% of the poverty line. More than 85% of the parents had a high school diploma or higher education.

Table 1 also shows the variations across time of the food price indices and the prevalence of LFS and VLFS. The variation of general food prices, (max − min)/min, was ~29% across time; the variations of FFPI, FVPI, and BPI were 14, 37, and 31%, respectively. We also conducted further analyses on geographic variations of price changes between waves to confirm that the main explanatory variables had sufficient changes across regions and time (results not shown). Specifically, we defined the relative price change as $(P_t - P_{t-1})/P_{t-1}$. For example, the mean relative change in FVPI between analytic period 2 (2002) and period 3 (2004) across metropolitan areas was 14.4%. Seventy percent of these areas had more than a 10% change in FVPI between the 2 periods and 25% of these areas had more than a 20% change, whereas 6% of these areas had negative changes.

The prevalence of LFS and VLFS were both highest in 2004 and lowest in 2002. The national poverty rates were 11.9, 12.1, 12.7, and 12.5% in 1999, 2002, 2004, and 2007, respectively (28). As Bartfeld and Dunifon (5) pointed out, poverty and food insecurity are "distinct phenomena." For example, one-half of poor households were food secure, while one-half of food-insecure households were not poor (29). Therefore, general trends for national poverty rates might not fully reflect the general trends of food insecurity among American children.

The coefficients of fixed-effect logistic regressions (**Table 2**) showed the estimated effects of food price indices on LFS and VLFS among ECLS-K children during the period of 1999 to 2007. All coefficients of the general food price indices were positive, indicating that higher overall food prices were correlated with greater risk of food insecurity. The general food price effects were not significant for LFS among lower income groups but were significant for VLFS among households with an income ≤300% of the poverty line. Higher fast food prices were significantly or marginally significantly associated with greater risk of LFS and VLFS among all income groups, except for LFS among households with incomes ≤200% of the poverty line. Higher prices of fruits and vegetables were also associated with a higher risk of LFS and VLFS. The impact on LFS was significant in the all-income group and among the children living at <300% of the federal poverty line. However, for VLFS, the coefficients were significant in almost all income groups, except for being marginally significant among children living at <100% of the poverty line ($P = 0.07$). Conversely, higher beverage prices were associated with a significantly lower risk of LFS for children in families with incomes <200% of the poverty line, where the estimates were marginally significant for all income groups and families with an income <300% of the poverty line. The estimated effects were in the same direction for VLFS but were not significant.

To understand the relative effect of the selected food prices over the general food prices, we have presented the coefficients for the relative price indices in **Table 3**. The coefficients on relative FVPI and relative BPI those identified in Table 2. This

TABLE 1 Sociodemographic statistics of analysis sample from ECLS-K children of the 1998–1999 cohort[1]

Year	1999	2002	2004	2007
n	9360	7540	6150	4850
Age, *y*	6.24 ± 0.36	9.27 ± 0.39	11.2 ± 0.39	14.3 ± 0.40
Male, %	52.2 ± 0.57	51.7 ± 0.86	49.8 ± 1.17	52.3 ± 1.18
Race/ethnicity, %				
White	50.1 ± 1.82	51.6 ± 2.02	51.1 ± 2.28	49.7 ± 2.00
Black	18.1 ± 1.36	17.0 ± 1.45	17.6 ± 1.40	18.2 ± 1.59
Hispanic	25.3 ± 1.72	24.5 ± 1.85	25.0 ± 2.14	25.2 ± 2.09
Household size, *n*	4.56 ± 1.42	4.61 ± 1.36	4.59 ± 1.41	4.53 ± 1.40
Poverty status, %				
Poor (≤100% PIR)	19.4 ± 1.24	16.8 ± 0.96	17.1 ± 1.45	18.0 ± 1.39
Near poor (>100 and ≤300% PIR)	45.5 ± 1.10	46.4 ± 1.29	43.8 ± 1.52	36.8 ± 1.31
Not poor (>300% PIR)	35.2 ± 1.54	36.8 ± 1.49	39.1 ± 1.72	45.2 ± 1.66
Highest parental education, %				
Less than high school	12.5 ± 0.80	10.4 ± 0.83	8.63 ± 0.90	8.94 ± 0.91
High school graduate	26.3 ± 0.98	19.1 ± 0.98	21.6 ± 1.15	17.3 ± 1.07
Some college	33.0 ± 0.90	35.9 ± 1.09	35.5 ± 1.27	35.3 ± 1.31
Bachelor or higher	28.3 ± 1.42	34.6 ± 1.63	34.3 ± 1.61	38.5 ± 1.81
GFPI	1.83 ± 0.15	2.03 ± 0.17	2.25 ± 0.24	2.36 ± 0.30
FFPI	4.58 ± 0.32	4.76 ± 0.26	4.93 ± 0.33	5.21 ± 0.41
FVPI	1.15 ± 0.14	1.27 ± 0.15	1.50 ± 0.23	1.58 ± 0.26
BPI	2.18 ± 0.23	2.03 ± 0.24	1.68 ± 0.18	2.20 ± 0.31
LFS, %	10.4 ± 0.55	8.48 ± 0.59	10.7 ± 0.87	10.3 ± 0.83
VLFS, %	2.46 ± 0.23	2.00 ± 0.26	3.62 ± 0.62	3.34 ± 0.48

[1] Means ± SDMs or proportions ± SEEs were reported. BPI, beverage price index; ECLS-K, Early Childhood Longitudinal Study-Kindergarten Class; FFPI, fast food price index; FVPI, fruit and vegetable price index; GFPI, general food price index; LFS, low food security; PIR, poverty income ratio; VLFS, very low food security.

higher fruit and vegetable price increased food insecurity, whereas higher beverage prices reduced it, even after controlling for the effects of general food price fluctuations. However, the relative fast food price index was not associated with food insecurity (Table 2).

The coefficients in Tables 2 and 3 showed the directions of the associations of food price and the risk of LFS and VLFS. To indicate the scale of these effects, in **Figure 1** we presented the marginal elasticity effects of the food price indices for the all-income group. These estimates were based on the models in Table 2 (rather than Table 3), because policy makers can more easily target actual rather than relative food prices. As mentioned, the elasticities indicated the average percentage change in the probability of LFS or VLFS given a 1% change in food price indices at the mean value of the latter. The estimated elasticity of LFS to changes in the FFPI was greater than that of VLFS (compare the heights of the black bars of the 2 panels); however, the marginal elasticity of LFS to prices of fruits and vegetables was smaller than that of VLFS (the white bars in panels *A* and *B*), whereas the estimated responsiveness of LFS and VLFS to changes in beverage prices were similar (the gray bars in the figure). Therefore, the scale of the price effects on food insecurity

TABLE 2 Coefficients of fixed-effect logistic regression on food price indices on LFS and VLFS among ECLS-K children of 1998–1999 cohort[1]

		Coefficient ± SEE[2]			
	n	GFPI	FFPI	FVPI	BPI
LFS					
All income groups	1580	0.617 ± 0.29**	0.632 ± 0.21***	0.879 ± 0.33***	−0.352 ± 0.21*
≤300% poverty line	1470	0.415 ± 0.30	0.489 ± 0.22**	0.669 ± 0.34**	−0.366 ± 0.21*
≤200% poverty line	1260	0.176 ± 0.32	0.238 ± 0.25	0.474 ± 0.36	−0.455 ± 0.23**
≤100% poverty line	580	0.549 ± 0.46	0.727 ± 0.40*	0.658 ± 0.53	−0.502 ± 0.35
VLFS					
All income groups	570	1.54 ± 0.53***	0.983 ± 0.39**	2.03 ± 0.57***	−0.257 ± 0.37
≤300% poverty line	540	1.38 ± 0.55**	0.954 ± 0.41**	1.82 ± 0.59***	−0.218 ± 0.37
≤200% poverty line	460	1.01 ± 0.56*	0.794 ± 0.44*	1.53 ± 0.59**	−0.219 ± 0.39
≤100% poverty line	240	1.28 ± 0.89	1.51 ± 0.74*	1.66 ± 0.92*	−0.010 ± 0.60

[1] The logistic regression models also control for the child and household characteristics described in the text. *** $P < 0.01$; ** $P < 0.05$; * $P < 0.10$. BPI, beverage price index; ECLS-K, Early Childhood Longitudinal Study-Kindergarten Class; FFPI, fast food price index; FVPI, fruit and vegetable price index; GFPI, general food price index; LFS, low food security; VLFS, very low food security.
[2] Huber-White robust SEs were reported for all cells except for the last row (VLFS: ≤100% poverty line) due to the singular observation in most clusters.

TABLE 3 Coefficients of fixed effects logistic regression on the relative food price indices (specific food price/general food price) on LFS and VLFS among ECLS-K children[1]

		Coefficient ± SEE[2]		
	n	Relative FFPI	Relative FVPI	Relative BPI
LFS				
All income groups	1580	−0.203 ± 0.37	3.39 ± 1.6**	−0.723 ± 0.33**
≤300% poverty line	1470	−0.108 ± 0.38	3.03 ± 1.6*	−0.606 ± 0.34*
≤200% poverty line	1260	0.029 ± 0.40	2.96 ± 1.7*	−0.551 ± 0.36
≤100% poverty line	580	−0.254 ± 0.57	2.22 ± 2.6	−0.772 ± 0.53
VLFS				
All income groups	570	−1.01 ± 0.68	6.26 ± 2.7**	−1.163 ± 0.56**
≤300% poverty line	540	−0.860 ± 0.69	5.67 ± 2.7**	−0.996 ± 0.56*
≤200% poverty line	460	−0.641 ± 0.68	5.19 ± 2.8*	−0.786 ± 0.61
≤100% poverty line	240	−0.511 ± 1.06	6.20 ± 4.1	−0.595 ± 0.92

[1] The logistic regression models also control for the child and household characteristics described in the text. ** $P < 0.05$; * $P < 0.10$. BPI, beverage price index; ECLS-K, Early Childhood Longitudinal Study-Kindergarten Class; FFPI, fast food price index; FVPI, fruit and vegetable price index; LFS, low food security; VLFS, very low food security.

[2] Huber-White robust SEs were reported for all cells except for the last row (very low food insecurity: ≤100% poverty line) due to the singular observation in most clusters.

depended on the type of food prices considered and the measurement of food insecurity.

Discussion

Food pricing policies, such as subsidies and taxes, are hotly debated as strategies to reduce obesity risk (30–32). Our analysis broadens the perspective on child nutrition risks by considering the impact of food prices on household food security. We found that higher food prices generally increased the risk of food insecurity among low-income households with children. However, a particularly interesting finding is that increased beverage prices were estimated to be protective against food insecurity. Previous research also suggests that low-income households are responsive to beverage price changes; e.g., a 10% increase in the price of nonalcoholic beverages may reduce their consumption by as much as 8% (33). Such price variations could also affect low-income households' consumption of selected food categories, such as dairy or fruits and vegetables (16), which could ultimately provide more nutritious food resources at home. Further research is needed to fully understand the complex relation between beverage prices and food security.

The finding that the prices of fruits and vegetables are associated with an increased risk of food insecurity raises potential concerns for policy makers. Most children and adults do not eat the recommended amounts of fruits and vegetables and this dietary pattern is associated with high health care costs and societal burden of disease (34). Yet no federal programs are currently in place to systematically promote the production of fruits and vegetables and thus encourage their consumption. The price of fruits and vegetables fluctuates tremendously over the course of a year and has increased more dramatically than prices of other foods in the past decade (35). The American Public Health Association published a position paper in 2007 calling for more government action to restore a better health-promoting food system (36). For example, planting restrictions and border controls are expected to increase the consumer prices of fruits and vegetables (37). Policy makers need to consider the impact on food insecurity when making decisions on planting restrictions and immigration policy to promote food security and healthy eating.

The negative association observed between fast food prices and food security requires careful consideration when it comes to formulating policies. On the one hand, American families heavily rely on food prepared away from home (38), and quick-service restaurants often offer low-cost items that some food-insecure families may use in times when money for food is limited (39). The lower cost of unhealthy foods was mainly driven by technological advancement and the growth in productivity in the last 4 decades (40). Consumption of low-cost fast food is associated with greater nutritional risk of obesity and a variety of chronic diseases, and the poorest adults and children are already disproportionately affected by these health conditions (41,42). However, maintaining the low prices for these commodities may promote food security, particularly for children in low-income households.

More generally, our results suggest that the elimination of subsidies, the imposition of taxes, or the creation of other policies that increase food prices are likely to decrease food security, although they may sometimes also yield other benefits such as reductions in obesity. Further empirical research is needed to gauge the scale of these effects. However, our findings suggest that the same tradeoff may not exist for beverage prices. For instance, a tax that raises the price of soft drinks may decrease both body weight and food insecurity, although the mechanisms driving the second effect are not well understood and require further research.

Our findings should be interpreted with caution in light of several caveats. First, C2ER price indices cover only a limited number of food items, which were selected to represent a middle-income household's grocery basket (43). Second, the geographic areas covered by the C2ER price indices were primarily metropolitan and some of the areas may not have been selected across time, so the results may not be generalizable to rural areas and may be limited only to those areas that continuously remained in the C2ER survey. Moreover, the food prices are only nominal prices, which are not adjusted by the cost of living across regions. Other

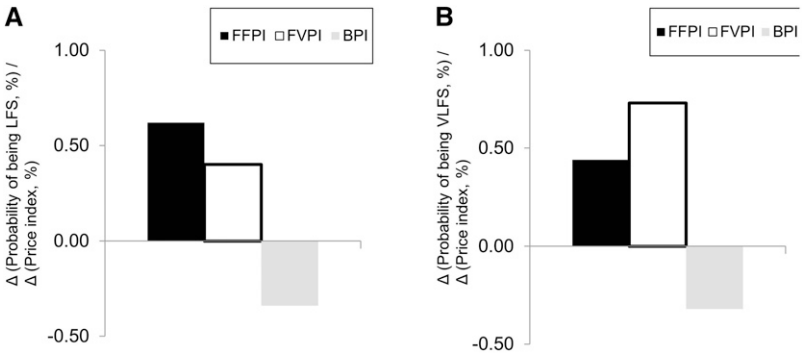

FIGURE 1 Average effects of food price indices on food security status, LFS, and VLFS among children in the ECLS-K of 1998–1999 [LFS, $n = 1580$ (*A*); VLFS, $n = 570$ (*B*)]. Values were the average changes in the probability of LFS or VLFS given a 1% change in the food price index, with other covariates evaluated at the actual values provided by survey respondents. BPI, beverage price index; ECLS-K, Early Childhood Longitudinal Study-Kindergarten Class; FFPI, fast food price index; FVPI, fruit and vegetable price index; LFS, low food security; VLFS, very low food security.

economic factors, such as housing prices, may also be related to the risk of food insecurity. Fourth, issues of multi-collinearity make it difficult to fully separate the effects of price changes for the 3 specific food groups from each other or from fluctuations in general food prices, although we have presented results for relative price indices that attempt to account for the contribution of general food prices. For most estimates, the directions of the food price effects were the same whether using the specific or the relative food price indices. Finally, we did not fully examine the underlying factors contributing to the price effects, which may consist of changes in national poverty rates or inflation. We will explore these factors in our future research.

The results of this study indicate that pricing strategies not only affect health risk and business profitability but also the ability of families to ensure an adequate, high-quality diet for their children. With careful planning and coordination of public policy strategies, food pricing policies aimed at eliminating VLFS may prove beneficial to both health and food security.

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