



The Association between Food Insecurity and Obesity in Children—The National Health and Nutrition Examination Survey

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ABSTRACT

Background Food insecurity can put children at greater risk of obesity because of altered food choices and nonuniform consumption patterns.

Objective We examined the association between obesity and both child-level food insecurity and personal food insecurity in US children.

Design Data from 9,701 participants in the National Health and Nutrition Examination Survey, 2001–2010, aged 2 to 11 years were analyzed. Child-level food insecurity was assessed with the US Department of Agriculture's Food Security Survey Module based on eight child-specific questions. Personal food insecurity was assessed with five additional questions. Obesity was defined, using physical measurements, as body mass index (calculated as kg/m²) greater than or equal to the age- and sex-specific 95th percentile of the Centers for Disease Control and Prevention growth charts. Logistic regressions adjusted for sex, race/ethnic group, poverty level, and survey year were conducted to describe associations between obesity and food insecurity.

Results Obesity was significantly associated with personal food insecurity for children aged 6 to 11 years (odds ratio=1.81; 95% CI 1.33 to 2.48), but not in children aged 2 to 5 years (odds ratio=0.88; 95% CI 0.51 to 1.51). Child-level food insecurity was not associated with obesity among 2- to 5-year-olds or 6- to 11-year-olds.

Conclusions Personal food insecurity is associated with an increased risk of obesity only in children aged 6 to 11 years. Personal food-insecurity measures may give different results than aggregate food-insecurity measures in children.

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FOOD INSECURITY IN US CHILDREN IS A GROWING public health concern. The highest prevalence of childhood food insecurity since 1995 was recorded in 2009–2010.¹ In 2009, children were food insecure in 4.2 million households (10.6% of households with children).¹ Food-insecure children have limited access to adequate food because of a lack of household money and other resources and, as a result, they can suffer from reduced quality of food, reduced food intake, and disrupted eating patterns. Children living in low-income households and minority children are more likely to experience food insecurity.¹

Childhood obesity is a persistent public health concern with both immediate and long-term consequences. Although the prevalence of childhood obesity appears to have leveled off, the prevalence of obesity among children in 2011 to 2012 was 16.9%.² There are no differences in the prevalence of obesity between girls and boys; however, there are significant race/

ethnic disparities in obesity prevalence among US children.² The prevalence of obesity is lower among non-Hispanic white compared with non-Hispanic black and Hispanic children.² Obesity in children has short-term consequences, such as elevated blood pressure and lipid concentrations,^{3,4} abnormal glucose tolerance, and psychosocial problems.^{5,6} Over the long term, childhood obesity tracks to adulthood.⁷

Food insecurity may put children at greater risk of obesity due to altered food choices and nonuniform consumption patterns.⁸ Some studies have found a positive association,^{9–13} some have found no association,^{14–19} and some have found an inverse association between obesity and food insecurity in US children.^{9,20–22} These inconsistent findings may result from the fact that food insecurity has not been directly measured in individual children²³; instead, it has been measured at the household level, with all children in the household considered to have the same risk of food insecurity. However, food-insecurity status may differ between children within a household, and research has suggested that younger children may be protected from food insecurity.¹ Because child-level food insecurity describes the food-insecurity status of all of the children younger than 18 years old in a household, and food insecurity may differ between children within a household, child-level food-insecurity measures may not

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accurately reflect a young child's food security, which obscures the relationship between food insecurity and obesity in children.

This analysis explores the association between food insecurity and obesity among children aged 2 to 11 years in the United States based on nationally representative data using two measures: "child-level food insecurity" for all children in the household and "personal food insecurity" in individual children.

METHODS

In order to obtain an adequate sample size, we combined five survey cycles (2001 to 2010) of the National Health and Nutrition Examination Survey (NHANES). NHANES is a complex, multistage probability sample that is representative of the US civilian noninstitutionalized population. NHANES is conducted by the National Center for Health Statistics, of the Centers for Disease Control and Prevention.²⁴ The survey was reviewed and approved by the National Center for Health Statistics ethics review board. Written parental consent was obtained for all children aged younger than 18 years. Child assent was also obtained for children aged 7 to 17 years. In the current analysis, race/ethnic groups were defined as non-Hispanic whites, non-Hispanic blacks, Mexican Americans, and other (including Asians, American Indian/Pacific Islanders and individuals reporting multiple races).

Data from survey participants were collected in two phases. First, during an in-home family interview, demographic information including socioeconomic status was collected. Second, a private interview and physical examination were conducted in a mobile examination center.

Obesity

Standardized measurements of weight and height were conducted during the physical examination. Body mass index (BMI) was calculated as weight (kg) divided by height (m²), and obesity was defined as a BMI greater than or equal to the age- and sex-specific 95th percentile of the 2000 Centers for Disease Control and Prevention growth charts.^{25,26}

Child-Level Food Insecurity

During the in-home interview, an adult in the household completed the 18 question US Department of Agriculture Food Security Survey Module, the last eight questions of which pertain to household food insecurity in households with children (Figure, second column).¹ Child-level food insecurity was defined as an affirmative response to at least two of the eight child-specific items on the Food Security Survey Module, and applied to all children in the household. Four categories were generated: full food security (no affirmative response), marginal food security (one affirmative response), low food security (two to four affirmative responses), and very low food security (five to eight affirmative responses). Based on the US Department of Agriculture's recommendation, food insecurity corresponds to either low food security or very low food security in children at the household level.¹ It is important to note that child-level food insecurity applies to all children in the household; thus, it is not an individual-level measure unless there is only one child in the household. The child-level food-insecurity questions were referenced over "the last 12 months."

Personal Food Insecurity

Individuals in households with an affirmative response to at least 1 of the 18 Food Security Survey Module questions were asked the five personal food-insecurity questions during the personal interview in the mobile examination center. The questions in the personal food-insecurity module included cutting the size of meals, skipping meals, eating less than one should, being hungry but not eating, and not eating for a whole day (Figure, third column). These questions indicate a specific behavior, condition, or action exercised due to insufficient food. An affirmative answer (often or sometimes) on at least one of these five questions for a child was defined as "personal (or individual) food insecurity" as described by Nord.²⁷ Adults or older siblings from the household responded to the five food-insecurity questions asked for individual children aged 0 to 11 years. The personal food-insecurity questions referenced "the last 30 days."

Covariates

Analysis covariates included age (2 to 5 years and 6 to 11 years); sex (male or female); race/ethnicity (non-Hispanic White, non-Hispanic Black, Mexican American, other); and family poverty-to-income ratio ($\leq 130\%$ vs $> 130\%$). We chose 130% as the cutoff because an income $< 130\%$ of the poverty line is the eligibility cutoff for Federal nutrition support programs, such as the Supplemental Nutrition Assistance Program and the National School Lunch Program.

Sample

NHANES 2001-2010 consisted of 12,306 participants aged 2 to 11 years, 10,802 (87.7%) of which completed in-home interviews, and 10,396 (84.4%) of which were interviewed and examined at the mobile examination center. Children that did not have height and/or weight ($n=420$) or did not have data for child-level and personal food insecurity ($n=275$) were excluded from analysis. The final analytic sample consisted of 9,701 children 2 to 11 years of age, 9,227 of which also had poverty-to-income ratio information and were included in the regression analysis. Analyses were conducted on 2- to 11-year-olds for consistency of both the definition of obesity and the proxy reporting of food insecurity: there is no agreed upon definition of obesity in children younger than 2 years, and children older than 12 years responded for themselves to the food-insecurity questions.

Statistical Analysis

Differences in prevalence of obesity in children with and without food insecurity (child-level and personal) were compared for all children aged 2 to 11 years, then separately for each sex, race/ethnic group, age group (2 to 5 years and 6 to 11 years), and poverty-to-income ratio group using *t* tests. Statistical significance was determined based on a two-sided *P* value < 0.05 . To further explore the association between obesity and food insecurity in children, multivariable logistic regressions adjusted for sex, race/ethnicity, age group, and poverty-to-income ratio were conducted. The association between obesity and personal food insecurity was examined. The association between obesity and child-level food insecurity was also examined in a separate model to determine whether the association with obesity differed between personal food insecurity and child-level food insecurity. We

Specification	Child-level food insecurity	Personal food insecurity
	<i>Respondents instructed to use yes/no responses unless otherwise indicated.</i>	<i>Respondents instructed to answer using often/sometimes/never responses.</i>
Relied on low-cost food for child	In the last 12 months, the household relied on only a few kinds of low-cost food to feed the children because they were running out of money to buy food (Response: often/sometimes/never).	No corresponding question.
Could not feed balanced meal	In the last 12 months, the household could not feed their children a balanced meal, because they could not afford that (Response: often/sometimes/never).	No corresponding question.
Child not eating enough	In the last 12 months, children were not eating enough because the household just could not afford enough food (Response: often/sometimes/never).	No corresponding question.
Cut size of meals	In the last 12 months, did you ever cut the size of any of the children's meals because there was not enough money for food?	In the last 30 days, did you cut the size of your meals because your family did not have enough money for food?
Ate less than felt	No corresponding question.	In the last 30 days, did you eat less than you felt you should because your family did not have enough money for food?
Skipped meals	In the last 12 months, did any of the children ever skip meals because there was not enough money for food?	In the last 30 days, did you skip meals because your family did not have enough money for food?
Skipped meals	If yes to the previous question, how often this happen—almost every month, some months but not every month, or in only 1 or 2 months.	No corresponding question.
Hungry but did not eat	In the last 12 months, were the children ever hungry but you just could not afford more food?	In the last 30 days, were you hungry but did not eat because your family did not have enough food?
Did not eat for whole day	In the last 12 months, did any of the children ever not eat for a whole day because there was not enough money for food? (recoded to ever/never).	In the last 30 days, did you not eat for a whole day because your family did not have enough money for food?

Figure. Survey questions used to determine child-level and personal food insecurity for US children aged 2 to 11 years, the National Health and Nutrition Examination Survey 2001-2010. Source: Centers for Disease Control and Prevention/National Center for Health Statistics, National Health and Nutrition Examination Survey.

tested for interactions between child-level food insecurity or personal food insecurity and sex, race/ethnicity, age group, and poverty-to-income ratio. We used a P value <0.05 to assess significance for effect modification. We examined potential effect modifiers, which were selected a priori based on a review of the literature.

Data were analyzed using SAS (version 9.2, SAS Institute) and SUDAAN (version 10.0.0, RTI International) software. All analyses used examination sample weights to account for differential probabilities of selection into the sample, nonresponse, and noncoverage. Multiple children from the same household may have been enrolled in NHANES; this is taken into account in the analysis using sample weights and accounting for the strata and primary sampling units. To account for the complex sample design, standard errors were estimated with SUDAAN using Taylor series linearization. Relative standard errors were calculated according to study design in order to determine whether estimates were unreliable and thus subject to cautious interpretation.²⁸

RESULTS

Sample size and prevalence estimates for obesity and food insecurity are shown in Table 1. In 2001–2010, 15.2% (standard error [SE] 0.5%) of the children aged 2 to 11 years were obese. Among 6- to 11-year-olds, 17.6% (SE 0.7%) were obese, compared to 11.4% (SE 0.6%) of 2- to 5-year-olds. In 2003–

2010, 9.8% (SE 0.6%) of children had child-level food insecurity, and 2.9% (SE 0.3%) of children had personal food insecurity overall. Personal food-insecurity levels were similar (2.9% [SE 0.4%]) for boys and girls, but differences in personal food insecurity could be seen across race/ethnic groups. Non-Hispanic whites had the lowest child-level and personal food insecurity, while Mexican Americans reported much higher levels of food insecurity. In addition, children from households with a poverty-to-income ratio $\leq 130\%$ had higher levels of both child-level (21% [SE 1.4%]) and personal (6.6% [SE 0.7%]) food insecurity compared to children in households above the poverty threshold.

Table 2 illustrates the relationship between obesity and food insecurity. There were significant differences overall in obesity prevalence between the food-secure and food-insecure children at both the child-level and the personal level. The prevalence of obesity was higher among the food-insecure children. In subgroup comparisons, the prevalence of obesity was significantly higher among food-insecure boys, girls, low-income children, and 6- to 11-year-old children compared to their food-secure counterparts at both the child level and the personal level. Obesity was also significantly higher among 2- to 5-year-old children with child-level food insecurity. No significant differences in obesity prevalence by child-level food-insecurity status or personal food-insecurity status were seen for any race/ethnic group, or in children from households with a poverty-to-income ratio $>130\%$. No

Table 1. Demographics of US children aged 2 to 11 years by obesity and food insecurity status: The National Health and Nutrition Examination Survey 2001–2010^a

Demographic group	Obesity ^b		n	Child-level food insecurity ^d	Personal food insecurity ^d
	n	% (SE ^c)			
				← % (SE) →	
Overall	9,701	15.2 (0.5)	7,866	9.8 (0.6)	2.9 (0.3)
Sex					
Male	4,880	16.4 (0.6)	3,973	9.4 (0.7)	2.9 (0.4)
Female	4,821	13.9 (0.7)	3,893	10.1 (0.7)	2.9 (0.4)
Race/ethnicity ^e					
Non-Hispanic white	2,935	13.3 (0.8)	2,383	5.2 (0.7)	0.9 (0.2)
Non-Hispanic black	2,663	18.8 (0.9)	2,040	13.4 (1.2)	4.6 (0.6)
Mexican-American	2,807	20.0 (0.9)	2,317	20.8 (1.6)	6.5 (0.8)
Age group					
Age 2 to 5 y	4,197	11.4 (0.6)	3,454	9.4 (0.7)	2.7 (0.3)
Age 6 to 11 y	5,504	17.6 (0.7)	4,412	10.0 (0.7)	3.1 (0.4)
Poverty-to-income ratio ^f					
≤130%	4,387	18.2 (0.8)	3,520	21.0 (1.4)	6.6 (0.7)
>130%	4,840	13.5 (0.7)	3,946	4.1 (0.4)	1.0 (0.2)

^aSource: Centers for Disease Control and Prevention/National Center for Health Statistics, National Health and Nutrition Examination Survey).

^bDefined as body mass index (BMI; calculated as kg/m^2) ≥ 95 th percentile of the sex-specific BMI-for-age 2000 Centers for Disease Control and Prevention growth charts.

^cSE=standard error.

^dData from 2003–2008 used for food-insecurity prevalence estimates. Data from 2001–2002 could not be used for prevalence estimates due to survey coding errors, which resulted in underrepresentation of food-insecure households in the National Health and Nutrition Examination Survey dataset.

^eOverall sample size includes race/ethnic groups not shown separately.

^fPoverty-to-income ratio is defined as the ratio of family income to the poverty threshold.

Table 2. Prevalence of obesity^a in US children aged 2 to 11 years with and without food insecurity, 2001-2010: The National Health and Nutrition Examination Survey^b

Demographic group	n	Child-Level Food Insecurity			Personal Food Insecurity		
		Obese		P value ^c	Obese		P value
		Insecure	Secure		Insecure	Secure	
		← % (SE) ^d →			← % (SE) →		
Overall	9,701	20.6 (1.3)	14.6 (0.6)	<0.001	24.7 (2.4)	14.9 (0.5)	<0.001
Sex							
Male	4,880	20.7 (1.8)	15.9 (0.7)	0.015	25.5 (3.5)	16.1 (0.6)	0.008
Female	4,821	20.4 (1.8)	13.2 (0.7)	<0.001	23.8 (3.1)	13.6 (0.7)	0.002
Race/ethnicity							
Non-Hispanic white	2,935	17.2 (2.7)	13.1 (0.8)	0.136	23.3 (6.7) ^e	13.2 (0.8)	0.138
Non-Hispanic black	2,663	18.6 (2.4)	18.8 (0.8)	0.918	16.2 (3.5)	18.9 (0.9)	0.435
Mexican American	2,807	20.8 (1.6)	19.7 (1.0)	0.522	25.7 (3.8)	19.6 (1.0)	0.129
Age group							
2 to 5 y	4,197	15.4 (1.6)	11.0 (0.7)	0.012	12.3 (2.8)	11.3 (0.6)	0.730
6 to 11 y	5,504	23.5 (1.8)	16.9 (0.8)	0.002	30.7 (2.9)	17.1 (0.7)	<0.001
Poverty-to-income ratio ^f							
≤130%	4,387	22.5 (1.7)	17.0 (0.7)	0.003	26.3 (2.8)	17.6 (0.8)	0.004
>130%	4,840	15.5 (2.7)	13.4 (0.7)	0.443	20.4 (5.4) ^e	13.4 (0.7)	0.196

^aDefined as body mass index (BMI; calculated as kg/m²) ≥95th percentile of the sex-specific BMI-for-age 2000 Centers for Disease Control and Prevention growth charts.^bSource: Centers for Disease Control and Prevention/National Center for Health Statistics, National Health and Nutrition Examination Survey.^cSatterthwaite adjusted *F* test.^dSE=standard error.^eDoes not meet standard of statistical reliability and precision, relative standard error ≥30% but <40%.^fPoverty-to-income ratio is defined as the ratio of family income to the poverty threshold.

significant differences in obesity prevalence were seen by personal food-insecurity status by any race/ethnic group, children aged 2 to 5 years, or in children from households with a poverty-to-income ratio >130%.

Multivariable logistic regression models adjusted for sex, race/ethnic group, age group, and poverty level showed that obesity was associated with child-level food insecurity and

personal food insecurity (Table 3). Separate multivariable logistic regression analyses testing the association between child-level food insecurity and obesity were conducted for children aged 2 to 5 years and 6 to 11 years. Although in the overall model, obesity was significantly associated with child-level food insecurity (odds ratio=1.24; 95% CI 1.02 to 1.52), it was not significantly associated with food insecurity

Table 3. Associations between childhood obesity and food insecurity in US children aged 2 to 11 years, stratified by age group: The National Health and Nutrition Examination Survey 2001-2010^a

Demographic group	Child-Level Food Insecurity			Personal Food Insecurity		
	Odds ratio	95% CI	P value ^b	Odds ratio	95% CI	P value ^b
2 to 5 y (n=3,974)^c						
Food insecure	1.22	0.92-1.63	0.098	0.88	0.51-1.51	0.642
Food secure	1.00			1.00		
6 to 11 y (n=5,253)^c						
Food insecure	1.25	0.96-1.64	0.088	1.81	1.33-2.48	<0.001
Food secure	1.00			1.00		

^aSource: Centers for Disease Control and Prevention/National Center for Health Statistics, National Health and Nutrition Examination Survey.^bSatterthwaite adjusted *F* test.^cModels adjusted for sex, race/ethnic group, poverty-to-income ratio, and survey period.

for the 6- to 11-year-old or 2- to 5-year-old age groups, possibly because of small sample sizes.

A significant interaction was found between age group and personal food insecurity, while no interaction was observed between age group and child-level food insecurity. Therefore, separate multivariable logistic regression analyses testing the association between personal food insecurity and obesity were conducted for children aged 2 to 5 years and 6 to 11 years. Results were similar to those on child-level food insecurity (Table 3). In models adjusted for sex, race/ethnic group, and poverty-to-income ratio level, personal food insecurity was associated with obesity in children aged 6 to 11 years (odds ratio=1.81; 95% CI 1.33 to 2.48). Obesity was not associated with personal food insecurity in children aged 2 to 5 years (odds ratio=0.88; 95% CI 0.51 to 1.51) (Table 3).

DISCUSSION

This analysis of a nationally representative cohort of children found that obesity was significantly associated with personal food insecurity for children aged 6 to 11 years, but not in children aged 2 to 5 years. However, child-level food insecurity was not associated with obesity among 2- to 5-year-olds or 6- to 11-year-olds. Personal food-insecurity measures may give different results than aggregate food-insecurity measures in children.

Prior studies of food insecurity in children have examined food insecurity at the child level and not at the personal level.^{9,10,29} A review of studies that have examined the association between food insecurity and childhood overweight and/or obesity in children suggests that the prevalence of overweight is relatively higher in food-insecure children relative to food-secure children.²³ However, comparisons between these studies are complicated because of the following methodological differences: food-insecurity terminology (ie, food secure, marginally food secure, food sufficient), measure of weight status (ie, at risk for overweight, overweight, obesity), age groups, and epidemiologic design.

Previous studies of nationally representative data exploring the association between childhood obesity and food insecurity have found that children from food-insecure households are more likely to be overweight.^{9,10,30-33} For example, Alaimo and colleagues⁹ analyzed data from the third National Health and Nutrition Examination Survey, and found that 8- to 16-year-old non-Hispanic white girls with food insufficiency (ie, family respondents reported that their family sometimes or often did not get enough food to eat) were almost 3.5 times more likely to be overweight (BMI for age \geq 85th percentile). On the other hand, compared to girls with food sufficiency, 2- to 7-year-old girls with food insufficiency were 1.6 times less likely to be overweight. Findings of this study are similar to our study; that is, younger children (at preschool level) from food-insecure households are not likely to be overweight; however, older children (elementary school and older) exhibit a positive association between food insecurity and overweight. However, the findings by Alaimo and colleagues were sex-specific, the outcome measure included food insufficiency and not food insecurity, and the authors included both overweight and obese children in their analysis.

Our results in preschool children aged 2 to 5 years are similar to other studies of this age group in the literature. The Fragile Families and Child Well-Being study of 3-year-olds found no

association between household food-insecurity status and obesity.¹⁹ Kaiser and colleagues¹⁷ also found no significant relationship between household food insecurity and overweight among Mexican-American children aged 3 to 6 years.

In multivariable analyses after controlling for other covariates, we found significant associations between childhood obesity and personal food insecurity in 6- to 11-year-old children. The association between child-level food insecurity and obesity in 6- to 11-year-old children was not significant. This could be because at the household interview, an adult (anyone 18+ years of age) responded to the food-insecurity questions for the entire household, thereby identifying food insecurity at the aggregate level and not discriminating intra-household food insecurity between adults and children.^{27,34} Similarly, child-level food-insecurity questions are asked for all children in the household and not for the index child. It is possible that there are intra-household differences in food insecurity among children, and food insecurity for the index child is better captured with proxy interviews at the personal level.³² In addition, the survey respondent in the household may be different from the person reporting during the personal interview and the child may assist in answering the personal or individual questions.

Another reason for differences in results between the child-level and personal results is the time reference for the questions. The child-specific food-insecurity questions reference the last 12 months, and the personal food-insecurity questions reference the last 30 days. Food insecurity in the United States is generally episodic and not chronic³⁵; therefore, this method of collecting food-insecurity data might make it more difficult to measure food insecurity at the personal level.^{27,32} In addition, personal food insecurity indicates a severe form of food insecurity; therefore, its relationship with obesity may be more noticeable at the personal level compared to child-level food insecurity, which is based on all children in the household.²⁷ In addition, response categories in the household-level and personal-level modules were different. Child-level food-insecurity questions asked questions with both “often/sometimes/never” and “yes/no” responses, while the personal food-insecurity questions only asked questions with “often/sometimes/never” responses. Research suggests that the proportion of affirmative responses increases with number of response categories.³² It is possible that the number of response choices may have influenced subject’s responses to the food-insecurity questions, which may have resulted in a more significant association between food insecurity and obesity at the personal level than at the child level. Finally, based on the survey design, analysis of personal food insecurity in children was only possible if there was an indication of food insecurity at the household level. Thus, children may be personally food insecure even though they are not food insecure at the household level, which means we may not detect their personal food insecurity because they would have been screened out of the personal food-insecurity questions.³⁶

Various hypotheses exist for the observed positive relationship between food insecurity and obesity in children, including consumption of cheaper foods that are energy-dense, periods without sufficient foods leading to overeating when food is available, and fluctuations in eating habits.⁹ Children who have low food security are less likely to meet recommended dietary guidelines,¹⁷ they also tend to

have higher intakes of fats, saturated fats, sweets, and fried foods.³⁷ A study of children aged 6 to 11 years of Mexican origin revealed that very low food security was associated with greater intakes of total energy, calcium, and percentage of calories from fat and added sugar. In fact, 3-day mean dietary intakes of total calories, protein, and percent of calories from added sugars had an inverse relationship with food-insecurity status; that is, as intakes of total calories, fat, and added sugars increased, the food-insecurity status of children decreased.³⁸ These findings may seem contradictory; however, studies have shown reliance on high energy-dense foods when families struggle economically and hunger is imminent.³⁹ Studies also suggest that school-aged children (6 to 11 years) who experience higher rates of food insecurity internalized behavior problems,⁴⁰ such that they deliberately reduce their food intake.²⁷

A lack of association between obesity and food insecurity among younger children or presumed preschoolers may reflect parents or caretakers having more direct knowledge of the food intake of younger children compared to older children.⁴¹ Also, younger children may be more likely to be protected from hunger than older children.¹¹ For example, parents may allocate resources in a way to protect younger children from effects of poverty.⁴² However, in view of the mixed results among younger children, more studies will help to clarify the relationship between food insecurity and obesity in young children 2 to 5 years of age.

The strengths of the current study include the nationally representative analysis sample, the oversampling of demographic groups at greater risk for food insecurity, the young age of the children for whom food-insecurity data were obtained, and the availability of food-insecurity data at both the child level and the personal level. Although previous studies have used overweight (BMI ≥ 85 th percentile) as an outcome, we used obesity (BMI ≥ 95 th percentile), a more stringent measure of excess weight in children, as the outcome. Limitations include the cross-sectional nature of the data and small sample sizes for some subgroups due to the low prevalence of food insecurity in the US pediatric population. Also, the income level used to determine which households should be administered the Food Security Survey Module varied throughout the time period examined. Finally, we were unable to report prevalence estimates of either personal or child-level food insecurity in 2001-2002 due to survey coding errors that resulted in under-representation of food-insecure households in the NHANES dataset.²⁷

CONCLUSIONS

An association between obesity and personal food insecurity was seen in children aged 6 to 11 years, but not children aged 2 to 5 years. No association between food insecurity and obesity was observed at the household level for either age group. Investigations of the association between food insecurity and childhood obesity should use instruments that measure each child's risks and outcomes individually, because household food-insecurity measures may mask associations that may be revealed by personal food-insecurity measures. The evidence in this analysis of an association between personal food insecurity and obesity in school-aged children lends support to programs designed to improve consistent access to healthy foods for schoolchildren.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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