



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

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