AMERICAN JOURNAL OF
Preventive Medicine

RESEARCH ARTICLE

Food Security and Weight Status in Children: Interactions With Food Assistance Programs

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Introduction: It is unclear whether Supplemental Nutrition Assistance Program (SNAP) or National School Lunch Program (NSLP) participation modifies the relationship between food insecurity and obesity in children.

Methods: Data were included for 4,719 children aged 9–17 years who participated in the National Health and Nutrition Survey between 2003–2004 and 2011–2012. Linear regression was used to examine the relationship between household food security (full, marginal, low, and very low) and BMI percentile. Adjusted models were also stratified by SNAP and NSLP participation.

Results: There was no significant overall relationship between household food security and BMI percentile. In SNAP non-participants, there was no apparent overall relationship between BMI percentile and household food security. However, BMI percentile in children from households with low food security was significantly higher than that of children from fully food-secure households (risk difference [RD]=5.95, 95% CI=1.11, 10.80). Among SNAP participants, there was no significant relationship between household food security and BMI percentile. By NSLP participation category, there was a non-significant trend toward increasing BMI percentile with decreasing household food security in those reporting two or fewer (RD=1.75, 95% CI= −0.79, 4.29) and two to three (RD=1.07; 95% CI= −1.74, 3.89) lunches/week. There was no apparent relationship between household food security and BMI percentile in those reporting four or more lunches/week.

Conclusions: Although the overall relationship between household food security and weight status in school-aged children was not statistically significant, there was some evidence that the relationship may differ by SNAP or NSLP participation, suggesting the need for more research.

INTRODUCTION

One in six (16.9%) U.S. children aged 2–19 years suffers from obesity,[1] presumed to be the result of overconsumption of calories and insufficient physical activity.[2] Although the high prevalence of obesity would suggest a widespread abundance of calories in the diets of U.S. children, a significant number of children do not have sufficient access to nutritious foods. In 2014, nearly 9.4% of U.S. households with children reported having inadequate or inconsistent access to nutritious food on one or more occasions during the past year, and 422,000 households reported that children went hungry or without food as a result of severe food insecurity.[3] Though the coexistence of obesity and food insecurity might seem counterintuitive, some research suggests that food insecurity may increase the risk of obesity in children.[4,5]

Although prior studies have examined how food insecurity relates to weight status in children, the overall relationship remains unclear. Foremost, the interpretation

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This article is part of a supplement issue titled The Supplemental Nutrition Assistance Program's Role in Addressing Nutrition-Related Health Issues.

0749-3797/$36.00
http://dx.doi.org/10.1016/j.amepre.2016.09.009

of the extant literature is complicated by the conflation of child-specific food insecurity and household food insecurity. Nonetheless, findings from studies of the relationship between weight status in children and child-specific[6–12] and household food insecurity[5,7,8,10,13–18] have been equally inconsistent. One source of such inconsistencies may be participation in the Supplemental Nutrition Assistance program (SNAP) or the National School Lunch Program (NSLP), which, by improving access to nutritious foods,[19,20] could minimize the extent to which food insecurity adversely affects weight status in low-income children. In fact, at least two studies have found NSLP participation to be inversely related to weight status, particularly in children from the lowest income households.[21,22] The relationship between SNAP participation and weight status in children is less clear. Two studies found no evidence of a relationship between SNAP participation and weight status in children,[23,24] whereas another found that SNAP participation was associated with higher BMI only in children from households earning <130% of the Federal Poverty Level (FPL) living in cities where food prices were high.[22] Moreover, although studies examining the relationship between participation in SNAP and NSLP and weight status in school-aged children are scant, the authors are aware of no prior studies that have explored whether SNAP or NSLP participation modifies the relationship between food insecurity and weight status in school-aged children.

To address these gaps in the literature, this study used data on children and adolescents from the National Health and Nutrition Examination Study (NHANES). The overall relationship between household food security and weight status in children was examined, and participation in SNAP or NSLP was evaluated as a potential modifier of the relationship between food security and weight status in school-aged children. Lastly, all analyses were repeated using a child-specific measure of food security. By addressing these specific objectives, this study aimed to further the understanding of the complex relationship between food insecurity and weight status in children, and inform public health efforts to reduce both food insecurity and obesity among U.S. children.

METHODS

Data Sample

Five waves of NHANES data were used: 2003–2004, 2005–2006, 2007–2008, 2009–2010, and 2011–2012. NHANES comprises a multistage, cross-sectional, nationally representative survey conducted by the National Center for Health Statistics at the Centers for Disease Control and Prevention on an ongoing basis to monitor the health and nutrition status of the U.S. population.[25] Data were included for children with complete Day 1 dietary intake data and non-missing data for SNAP and NSLP participation who were aged 9–17 years, as children aged ≥9 years have been shown to report dietary intake with greater accuracy than younger children.[26–28] Additionally, the sample was restricted to children from households with an annual income ≤185% FPL to capture children who qualify for free or reduced-price lunches through NSLP, and in an effort to minimize bias due to residual confounding by household income level.[29] The current analysis did not require IRB approval.

Measures

The primary outcome, weight status, was represented using BMI percentile, computed from height and weight (kg/m^2) using Centers for Disease Control and Prevention growth charts.[30] Height and weight were measured in the mobile examination center by trained examiners following a standardized protocol. A description of these procedures has been previously published,[31] and more information can be found on the National Center for Health Statistics website (www.cdc.gov/nchs/nhanes/nhanes2011-2012/manuals11_12.htm). BMI percentile was modeled as a continuous outcome to capture subtle changes in weight status not otherwise reflected by a binary (e.g., normal weight versus obese) or ordinal measure (e.g., normal weight, overweight, or obese). This approach maximizes statistical power,[32] while allowing for the detection of subtle between-group differences in weight status.

As the primary exposure, food security was categorized as full, marginal, low, or very low based on responses to the NHANES Food Security Survey Module questionnaires, the details of which are available online.[25] NHANES characterizes household- and child-specific food security, but household food security status was chosen to represent food security status in all primary analyses. Households with full food security reported no food access problems or limitations; those with marginal food security reported concerns over food sufficiency or food shortage; households with low food security generally reported reduced quality, variety, or desirability of diet; and those with very low food security generally reported reduced food consumption and disrupted eating patterns.[24]

Food assistance program participation was characterized by participation in SNAP or NSLP. SNAP participation was determined by an affirmative response to the question *In the last 12 months, did [you, or any member of your household] receive food stamp benefits?* within the NHANES Food Security module.[25] NSLP participation was ascertained using responses to the following question in the NHANES Diet Behavior and Nutrition module: *During the school year, about how many times a week do you usually get a complete school lunch?* In all models, SNAP participation was modeled as a binary (yes/no) variable. NSLP participation was characterized by the number of weekly school lunches reported (continuous). To facilitate representation of model estimates, NSLP participation was categorized into three groups in stratified models: (1) zero to one lunch/week; (2) two to three lunches/week; and (3) four or more lunches/week. The three-category version of NSLP participation was modeled using disjoint indicator variables.

Statistical Analysis

Ordinary least squares regression was used to examine the relationship between food security status and BMI percentile. BMI percentile was modeled as a continuous variable to capture small differences in weight status between groups. Food security