Food Insecurity Is Associated with Adverse Health Outcomes among Human Infants and Toddlers[1,2]

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ABSTRACT The U.S. Household Food Security Scale, developed with federal support for use in national surveys, is an effective research tool. This study uses these new measures to examine associations between food insecurity and health outcomes in young children. The purpose of this study was to determine whether household food insecurity is associated with adverse health outcomes in a sentinel population ages ≤ 36 mo. We conducted a multisite retrospective cohort study with cross-sectional surveys at urban medical centers in 5 states and Washington DC, August 1998–December 2001. Caregivers of 11,539 children ages ≤ 36 mo were interviewed at hospital clinics and emergency departments (ED) in central cities. Outcome measures included child's health status, hospitalization history, whether child was admitted to hospital on day of ED visit (for subsample interviewed in EDs), and a composite growth-risk variable. In this sample, 21.4% of households were food insecure (6.8% with hunger). In a logistic regression, after adjusting for confounders, food-insecure children had odds of "fair or poor" health nearly twice as great [adjusted odds ratio (AOR) = 1.90, 95% CI = 1.66–2.18], and odds of being hospitalized since birth almost a third larger (AOR = 1.31, 95% CI = 1.16–1.48) than food-secure children. A dose-response relation appeared between fair/poor health status and severity of food insecurity. Effect modification occurred between Food Stamps and food insecurity; Food Stamps attenuated (but did not eliminate) associations between food insecurity and fair/poor health. Food insecurity is associated with health problems for young, low-income children. Ensuring food security may reduce health problems, including the need for hospitalizations. J. Nutr. 134: 1432–1438, 2004.

KEY WORDS: • *food security* • *food insecurity* • *hunger* • *child health* • *children*

Food security is defined as access at all times to enough nutritious food for an active and healthy life, whereas food insecurity is defined as limited or uncertain access to enough nutritious food (1–4). Although lack of access to enough nutritious food can occur for a variety of reasons, the U.S. Household Food Security Scale (U.S. HFSS)[4] was designed to identify food insecurity arising specifically from the lack of adequate financial resources to purchase enough food. This kind of food insecurity is sometimes called "resource-constrained" or "poverty-linked" food insecurity, although some households with incomes above the poverty threshold experience it (1–3).[5]

[1] An earlier version of this paper was presented at the Pediatric Academic Society, April 28-May 1, 2001, Baltimore, MD [Cook, J., Black, M., Casey, P., Frank, D., Berkowitz, C., Cutts, D., Meyers, A. & Zaldivar, N. (2001) Food Insecurity and Health Risks Among Children and Their Caregivers. Pediatric Academic Society: 1].

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[4] Abbreviations used: AOR, adjusted odds ratio; CPS, Current Population Survey; C-SNAP, Children's Sentinel Nutrition Assessment Project; ED, emergency department; HHS, Health and Human Services; SSI, Supplemental Security Income; TANF, Temporary Assistance to Needy Families; U.S. HFSS, U.S. Household Food Security Scale; WIC, Special Supplemental Nutrition Program for Women, Infants and Children.

[5] In the early1990s, Congress mandated development of food security and hunger measures for the U.S. population under direction of the USDA Food and Nutrition Service (then the Food and Consumer Service) and the Health and Human Services (HHS) National Center for Health Statistics. Since 1995, the resulting U.S. Food Security Supplement has been implemented annually by the Census Bureau in the Current Population Survey (CPS), with annual estimates of the prevalence of food insecurity and hunger in the U.S. population derived and reported by USDA. The CPS Food Security Supplement data and survey ques-

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As defined, food insecurity at its least severe levels does not necessarily involve reductions in the quantity of food intake below normal levels, but is evident in adult respondents' concerns about the sufficiency of their household food supply and adjustments to household food management, including reductions in diet quality and variety. At moderately severe levels of food insecurity, food intake for adults in the household is reduced below normal levels by reducing meal or serving sizes or skipping meals, sometimes leading to hunger. At more severe levels, households with children also reduce the children's food intake to an extent that the children experience hunger as a result of inadequate household resources, whereas adults in households with or without children experience even more extensive reductions in food intake, possibly going whole days without food (3). As these definitions imply, hunger and undernutrition may occur as a result of food insecurity, depending on its severity and duration (2). Moreover, recent research suggests that food insecurity may exacerbate the onset or persistence of other adverse health conditions, including overweight and obesity among some subpopulations (5–11).

Household food insecurity is a concern to pediatricians because it has implications for child health in several ways. Earlier versions of food security measures similar to the 18-item U.S. Food Security Scale were associated with inadequate intakes of several important nutrients (10–15), cognitive developmental deficits (16–23), behavioral and psychosocial dysfunction in children and adults (16,24–27), and poor health in children and adults (11,12,28–30). The association of micronutrient and protein-energy deficits with impaired immunity and wound healing and thus with increased risk of serious illness is also well established (29–37). Recent research also suggests that affective or psychologic stresses such as those accompanying resource-constrained food insecurity can influence child health and well-being adversely, independent of associated nutritional deficits (23–25,29). Not being able to purchase enough nutritious food, and the resultant emotional or psychologic stresses arising in the household, can contribute to adverse health effects or exacerbate poor health caused by other factors, including malnutrition (38–43).

Young, low-income children in households utilizing urban medical centers represent a sentinel population at high risk of adverse health outcomes, and may exhibit health effects of food insecurity at levels of clinical severity or at prevalence rates that are not noted among children in the general population (44–51). This study evaluates whether in inner-city settings, young children in households exposed to food insecurity have significantly different odds of experiencing negative health outcomes than similar children in food-secure families.

SUBJECTS AND METHODS

Setting and instruments. The Children's Sentinel Nutrition Assessment Project (C-SNAP) conducted household-level surveys and medical record audits between August 1998 and December 2001 at central-city medical centers in Baltimore, Boston, Little Rock, Los Angeles, Minneapolis, and Washington, D.C. A convenience sample comprising adult caregivers accompanying 11,539 children age ≤ 36 mo at acute- and primary-care clinics and hospital emergency departments (ED) was interviewed in private settings by trained interviewers scheduled during peak patient-flow times. At 3 sites (Boston, Little Rock, and Los Angeles, $n = 6502$), interviews were conducted in the hospital ED. Caregivers of critically ill or injured children at any site were not approached. Potential respondents were excluded if they did not speak English, Spanish, or Somali (Minneapolis only), were not knowledgeable about the child's household, the child's caregiver had been interviewed within the previous 6 mo, or they refused consent for any reason.

The survey instrument included questions on household characteristics, food security, federal assistance program participation, changes in benefits, child's health status, and child's hospitalization history. Household food security status was derived from responses to the U.S. Food Security Scale in accordance with established procedures (3,4). The questionnaire contains a combination of items drawn from other validated survey instruments (developed by C-SNAP researchers or others) and items specific to C-SNAP study goals and objectives. Where possible, we used wording from existing surveys that had been validated. The core set of 18 food-security items were taken from the U.S. HFSS, and scored and categorized in accordance with established procedures (4). The survey instrument and both the surveillance and interview protocols were pilot-tested at Boston Medical Center on several hundred subjects over 1996–1997. The instrument was revised as necessary before being distributed to all 6 C-SNAP sites for implementation in 1998. Slight modifications were made since 1998, but these have been mainly to improve skip patterns or to clarify aspects of a few questions.

Additional information was obtained from medical record audits of all children whose caregivers were interviewed. These data include anthropometric measures (height and weight) and, for the subsample of children interviewed in the ED, whether the child was admitted to the hospital on the day of the visit. Institutional Review Board approval was obtained at each of the 6 C-SNAP sites through application to the parent institution's IRB.

Sample characteristics. The analytic cohort (**Tables 1** and **2**) comprised 11,539 children whose adult caregivers were interviewed at the 6 C-SNAP sites. These children comprise 78% of a larger pool of potential participants approached at the 6 study sites. Of the total approached, 22% did not respond, 7% refused the interview, and an additional 15% were ineligible due to language, lack of knowledge of the child's household, or having been interviewed previously.

Predictor variable. The predictor or exposure variable was each child's household food security status, categorized on the basis of caregivers' responses to questions in the 18-item U.S. HFSS. Food security status appeared in the analyses in 2 separate forms derived from 2 different combinations of the following categories established by developers of the scale. In both cases, food security status was based on conditions occurring in households during the 12 mo preceding the interview.

1. Food secure.
   Caregivers' responses indicate no or minimal evidence of food insecurity, answering no more than 2 of the 18 ordered scale items affirmatively (i.e., the first 2 questions). Responses indicate no or minimal reductions in diet quality or quantity of food intake by any household members due to constrained financial resources.
2. Food insecure without hunger.
   Caregivers answer 3–7 of the 18 ordered scale items affirmatively (i.e., the first 3–7), typically indicating concerns about their household's food supply, adjustments to household food management including reductions in diet quality and variety, and lack of predictable access to an adequate quantity and/or quality of acceptable food.[6]
3. Food insecure with hunger.
   Caregivers answer 8 or more of the 18 ordered scale items affirmatively (i.e., the first 8 or more), indicating a pattern of reductions in food

tions are available for use by researchers, and guidance on their application in original research is available from USDA. The USDA Economic Research Service maintains an excellent "briefing room" on food security in the U.S. on its web site at http://www.ers.usda.gov/briefing/foodsecurity/, where all its reports related to U.S. food security are posted along with guidance on use of food security data and Food Security Supplement questions.

[6] The 18-item scale is "well-ordered" in the sense that if a respondent affirms a particular item, all less-severe items typically also are affirmed. This enables the continuous scale scores to be translated reasonably accurately into the number of affirmative responses out of the 18 scale items.

TABLE 1

Characteristics of caregivers in the analytic cohort by exposure to variation in household food security status, 1998–2002[1–3]

Caregiver characteristics	*n*	% Food insecure
Study site*		
Baltimore	1017	14.8
Boston	3102	19.8
D.C.	725	35.0
Little Rock	1556	8.6
Los Angeles	1844	20.1
Minneapolis	3295	28.6
Subtotal	11,539	21.4
Race/Ethnicity*		
African American	5886	17.4
Hispanic	4052	31.2
Caucasian	1272	10.2
Other	326	13.5
Born in the United States		
Yes*	6801	13.7
No	4713	32.4
Marital status		
Single*	6082	21.1
Married/Partner	5420	21.6
Age		
<21 y*	2177	15.0
≥21 y	9259	22.8
Schooling		
<Grade 12*	4474	28.3
≥Grade 12	7015	16.9
Employed		
Yes*	4710	16.6
No	6692	24.6
Receive SSI		
Yes*	777	25.5
No	10,685	21.0
Subsidized housing		
Yes	2442	21.4
No	8910	21.4
Live in temporary housing		
Yes*	3126	26.3
No	8413	19.5
Receive WIC		
Yes*	9085	22.6
No	2389	16.5
Receive Food Stamps*		
Currently	3718	24.9
Previously	1632	23.8
Never	6089	18.5
Receive TANF*		
Currently	3136	24.9
Previously	1820	23.6
Never	6528	19.0

[1] Group comparisons used χ^2 tests.
[2] Asterisks indicate statistical significance, * $P \leq 0.05$.
[3] Totals may differ due to missing data on some variables.

intake by 1 or more household members of sufficient magnitude or frequency to imply that they experienced hunger at times during the previous 12 mo. Due to lack of household resources, hunger was repeatedly experienced in 2 or more of the previous 12 mo.

For the primary analyses in this study, household food security status was initially entered as a dichotomous (food secure vs. food insecure) variable formed by collapsing the 2 food-insecure subcategories. In separate analyses, food insecurity was entered as a trichotomous (food secure, food insecure without hunger, food insecure with hunger) variable.

TABLE 2

Characteristics of children in the analytic cohort by exposure to variation in HFSS, 1998–2002[1,2]

Child characteristics	*n*	% Food insecure
Age		
≤1 y	6595	21.8
>1 to ≤2 y	3051	20.6
>2 to ≤3 y	1890	20.9
Birth weight		
<2500 g	1434	22.9
≥2500 g	9763	21.0
Child's insurance status**		
Public	8693	23.1
Private	1202	9.7
None	1547	20.8
In daycare**		
Yes	3757	17.0
No	7696	23.3
Weight-for-age Z-score		
(Mean, 95% CI)	−0.006 (−0.033, 0.021)	0.031 (−0.023, 0.085)
(SD, 95% CI)	1.29 (1.27, 1.31)	1.34 (1.31, 1.39)

[1] Group comparisons used a χ^2 test for categorical variables and *t* test for means.
[2] Asterisks indicate statistical significance, * $P < 0.05$; ** $P \leq 0.01$.

Outcome variables. The outcome measures were defined as follows (**Tables 3** and **4**): Each caregiver was asked the following question about their child's overall health status, "In general, would you say (the child's) health is excellent, good, fair, or poor?" For this study, responses were collapsed into 2 categories ("fair/poor" vs.

TABLE 3

Child health outcomes by exposure to variation in HFSS, 1998–2002[1–5]

Outcome variables	Food secure (*n* = 9075, 78.6%)	Food insecure (*n* = 2464, 21.4%)
Child health fair/poor		
% Unadjusted	11.2%	20.2%
Multivariate OR (95% CI)	1.00	1.90 (1.66, 2.18)*
Lifetime hospitalizations		
% Unadjusted	21.0%	23.9%
Multivariate OR (95% CI)	1.00	1.31 (1.16, 1.48)*
Admit on ED visit (*n* = 6502)		
% Unadjusted	11.6%	10.0%
Multivariate OR (95% CI)	1.00	0.92 (0.73, 1.16)
At risk for growth problems		
% Unadjusted	14.9%	14.6%
Multivariate OR (95% CI)	1.00	1.09 (0.94, 1.25)

[1] Multivariate odds ratios (OR) are adjusted for study site, race/ethnicity of child, child's health insurance status, whether mother born in the U.S., caregiver's age, caregiver's employment status, caregiver's marital status, caregiver's education, whether child in daycare, household receiving SSI, whether child's family receives WIC, whether child's household received Food Stamps, and whether the household received TANF.
[2] The reference category for all ORs is "food secure."
[3] Asterisks indicate statistical significance, * $P \leq 0.05$.
[4] Subsample from ED sites only: Boston, Little Rock, Los Angeles.
[5] Child considered at risk for growth problems if weight-for-age Z-score <5th percentile or weight-for-height Z-score < 10th percentile.

TABLE 4

Child health outcomes by exposure to variation in HFSS using a 3-category food security status variable, 1998–2002[1]

		Food insecure	
	Food secure	No hunger	Hunger
Outcome variables	(n = 9075, 78.6%)	(n = 1680, 14.6%)	(n = 784, 6.8%)
Child health fair/poor			
% Unadjusted	11.2%	18.5%	23.9%
Multivariate OR (95% CI)	1.00	1.73 (1.48, 2.02)*	2.31 (1.89, 2.82)*
Lifetime hospitalizations			
% Unadjusted	21.0%	23.9%	24.0%
Multivariate OR (95% CI)	1.00	1.32 (1.15, 1.52)*	1.29 (1.06, 1.56)*
Admit on ED visit (n = 6502)			
% Unadjusted	11.6%	10.2%	9.7%
Multivariate OR (95% CI)	1.00	0.92 (0.70, 1.21)	0.92 (0.63, 1.34)
At risk for growth problems			
% Unadjusted	14.9%	14.9%	14.0%
Multivariate OR (95% CI)	1.00	1.12 (0.96, 1.32)	1.01 (0.80, 1.27)

[1] See footnotes to Table 3.

"good/excellent")[7]. Two hospitalization variables were available. For all children in the analytic cohort, caregiver interview data were obtained on the number of times the child had been hospitalized since discharge after birth. This information was used to create a categorical (yes-no) variable indicating whether the child had been hospitalized at all since birth (excluding the day of the interview).

In 3 study sites, caregivers were interviewed in conjunction with ED visits. Overall, 6502 (56%) of the 11,539 interviews in the analytic cohort were obtained from 3 ED sites: Boston (n = 3102, 48% of the 6502 ED subsample), Little Rock (n = 1556, 24%), and Los Angeles (n = 1844, 28%). Separate analyses were conducted using data from the ED subsample, with hospital admission on the day of the visit as the outcome.

Potential confounding variables. Potential confounding variables, shown to influence child health in bivariate analyses and other research (44–51), were included in the regression models (Tables 1 and 2). These included study site, child's race/ethnicity, child's health insurance status, child's daycare attendance, whether the child's mother was born in the United States (99% of children were born in the United States), caregiver's age, employment status, marital status and education level, whether the household received Supplemental Security Income (SSI), Special Supplemental Nutrition Program for Women, Infants and Children (WIC), Food Stamps, or Temporary Assistance for Needy Families (TANF).

Analytic approach. Separate logistic regression models were specified to model differences in the odds of "fair/poor" health status, lifetime hospitalization, same-day hospitalization (for the ED subsample only), and being at risk for growth problems, between children exposed to food insecurity and those not exposed to food insecurity, controlling for likely confounding factors (52,53). Additional logistic regressions were performed using interaction terms to examine whether currently receiving Food Stamps or TANF modified the effects of exposure to food insecurity on the child health outcomes. χ^2 tests were used for all categorical bivariate comparisons, and t tests for continuous bivariate comparisons. All hypothesis tests used a significance level of $\alpha = 0.05$. Data management, manipulation, and analyses were conducted using SAS version 8.2.

RESULTS

Food insecurity, child health status, and hospitalization. Overall, 21.4% of all households in the C-SNAP sample were food insecure, compared with 16.1% of all U.S. households with children any age and 17.4% of U.S. households with children age < 6 y in 2001. The prevalence of food insecurity among non-Hispanic Caucasian C-SNAP households was 10.2% compared with 11.3% of all U.S. non-Hispanic Caucasian households with children any age < 18 y in 2001.[8] Among non-Hispanic African American households in the C-SNAP sample, 17.4% were food insecure compared with 27.8% of all African American households with children in the United States. Among Hispanic households in the C-SNAP sample, 31.2% were food insecure compared with 26.4% of all Hispanic households with children in the United States. Overall, 6.8% of C-SNAP children lived in households in which measurable hunger was experienced, compared with 4.0% of children in households in the general U.S. population with children < 6 y old in 2001 (54).

In models using a dichotomous (food-secure vs. food-insecure) food security status predictor (Table 3), children in the C-SNAP sample living in food-insecure households had nearly twice as great odds of having their health status reported as "fair/poor" as those for similar children in food-secure households [adjusted odds ratio (AOR) 1.90; 95% CI 1.66–2.18] after adjusting for study site, child's race/ethnicity, health insurance and daycare status, mother born in the U.S, caregiver's age, employment, marital and education status, household receipt of SSI, WIC, Food Stamps, or TANF. Children in food-insecure households had approximately a third again as great odds of being hospitalized since birth as food-secure children (AOR 1.31; 95% CI 1.16–1.48) after adjusting for potential confounders.

In models using a 3-category (food secure, food insecure without hunger, food insecure with hunger) food security status predictor (Table 4), children in households categorized as food insecure without hunger had odds of health being reported fair/poor nearly three-quarters again as great as those in food-secure households (AOR 1.73; 95% CI 1.48–2.02), whereas children in households that were food insecure with hunger had almost two and one-third times as great odds of their health being reported as fair/poor as children in food-secure households (AOR 2.31; 95%CI 1.89–2.82). Children

[7] This question is asked in the NHANES III with 5 response alternatives instead of 4. In that version "very good" is also an alternative. To simplify creation of a dichotomous variable, we used only 4 response alternatives.

[8] The prevalence of food insecurity for households with children < 6 y old is not available by race/ethnicity in the USDA data. Prevalence is reported by race/ethnicity only for households with children any age < 18 y.

in both food-insecure groups (without and with hunger) had nearly a third greater odds of being hospitalized than children in food-secure households, after controlling for potential confounders (AOR 1.32; 95% CI 1.15–1.52 and AOR 1.29; 95% CI 1.06–1.56, respectively).

For children whose caregivers were interviewed at 1 of the 3 ED sites (Boston, Los Angeles and Little Rock; $n = 6502$), after controlling for potential confounding factors, there was no significant association between food insecurity and admission to hospital on the day of the ED visit. In addition, there was no significant association between food insecurity and a composite growth-risk variable, defined as either weight-for-age Z-score below the 5th percentile or weight-for-height Z-score below the 10th percentile.

Tests of Food Stamps and TANF as effect modifiers. Separate sets of models with interaction terms were estimated to test whether receiving Food Stamps or TANF benefits modified the associations between food insecurity and health status or hospitalization (results not shown in tables). For the analysis of risk factors for fair/poor health, a significant interaction was found between currently receiving Food Stamps and food insecurity. This interaction indicated that receiving Food Stamps attenuated (but did not eliminate) the association between food insecurity and fair/poor health. For children in households *not* receiving Food Stamps, being food insecure increased the odds of fair/poor health by 2.11 times, controlling for the other covariates in the model, whereas for those receiving Food Stamps, being food insecure increased the odds of fair/poor health by 1.52 times. A similar pattern was seen for TANF, although the interaction was not significant. In the analysis of hospitalization since birth, there was no significant interaction between receiving Food Stamps or TANF and food insecurity.

DISCUSSION

Advances in nutrition research over the past several decades have greatly expanded knowledge about nutrient requirements and the consequences of many nutrient deficiencies for growth, development, and health. However, understanding of the effects of chronic fluctuations in availability, variety, and nutritional adequacy of household food resources and related stresses accompanying household food insecurity (e.g., emotional or psychological distress), on micronutrient adequacy, morbidity, immune system development and functioning, and subsequent incidence of chronic disease, eating behavior, ability to self-regulate energy intake, physical activity, adiposity, and other health status measures in children is still at an inchoate stage.

Development of the U.S. HFSS provided an effective standard tool for measuring household food insecurity and hunger, and for clarifying the effects of these conditions on child health. Yet, to date, little research has examined the influence of food insecurity as measured by this new scale on specific health outcomes among children. This research examines the relation between food insecurity and direct measures of health outcomes among infants and toddlers. These results show that food insecurity, even without evidence of hunger, is associated with adverse health outcomes in young children.

Results of this analysis obtained when a 3-category food security predictor variable (including food insecurity without hunger and with hunger as separate categories) was used are particularly noteworthy (Table 4). The significantly higher odds of having fair/poor health reported, and of being hospitalized since birth, for children in households that are food insecure without hunger indicate that overall food insecurity is associated with adverse health outcomes in young children even when it does not involve reductions in the quantity of food intake sufficient to involve measurable hunger. This could be a response to overall family stress as discussed above. In addition, this could occur if the nutritional quality of food in households that are food insecure without hunger were reduced to such an extent that micronutrient deficiencies result, or if the variety of foods available in these households were severely constrained (e.g., if fresh fruits and vegetables were not available).

Moreover, although the overall multivariate results obtained when the trichotomous form of the food security status predictor was used are not different from those obtained using the dichotomous form (Tables 3 and 4), the adjusted odds of health being reported fair/poor in Table 4 suggest a dose-response relation between severity of food insecurity and odds of caregivers reporting children's health being fair/poor in these data, even at the lowest measured level of food insecurity. The unadjusted percentages for lifetime hospitalizations also are consistent with a dose-response effect, although adjusting for confounders eliminates this aspect of the relation.

The significant modification of the effects of food insecurity on child health status by receipt of Food Stamps suggests that the nation's largest and most important nutrition safety-net program is protective of young children's health. However, the finding that receipt of Food Stamps only attenuates the adverse effects of food insecurity on child health status but does not eliminate them altogether suggests that more extensive support for and use of the Food Stamp Program could lead to greater improvements in child health. The similar [although nonsignificant ($P = 0.38$)] pattern of effect modification found for receipt of TANF is consistent with a hypothesis that this safety-net program is also protective of child health, although inconclusive.

These results support the need for further research on the relations between food and cash assistance program participation and food security, and subsequent effects of food insecurity on child health. They also support the importance of effective safety-net policies in preventing health problems in low-income infants and toddlers.

The absence of significant associations between food insecurity and risk of growth problems in these data was somewhat unexpected. This may be due in part to the young ages of children in the C-SNAP sample (57% are ≤1 y old, and 84% are ≤2 y old) and the fact that caregivers of 79% of all children in the sample received WIC benefits, which may have helped buffer children from adverse effects of food insecurity on their anthropometric measurements. In addition, other research showed that most U.S. parents attempt to buffer their children from food insecurity and hunger by rationing and other coping strategies that can result in adults in the household experiencing hunger so that their children do not (2,3,20,22,29). Moreover, prior research also showed that food insecurity can affect the health of children through psychologic mechanisms involving increased family stress, worry, depression, and feelings of deprivation as well as through biological mechanisms involving reduced food intake, lower food quality, or micronutrient deficiencies (20,22,24,25,29). Thus, our finding of a significant association between food insecurity and adverse health outcomes in the absence of significant association with anthropometric measures is not totally inconsistent.

The C-SNAP sample is a cross-sectional sentinel surveillance sample of young, high-risk, low-income children. Data were obtained over a 2.5-y period in 6 geographically, ethnically, and economically diverse sites, broadly reflecting several

major geographic regions and types of welfare policies. However, the sample is neither random nor nationally representative, and the extent to which these findings can be generalized is limited.

Possible selection bias and lack of specified a priori temporal sequencing of events, longitudinal data, and random assignment of children to different benefit categories preclude drawing inferences about causal relations. Although potentially confounding effects of many relevant factors were statistically controlled in analyses, other unmeasured confounders may have influenced the outcomes. Exclusion of the most severely ill or injured cases from the ED subsample may have biased the results of that analysis, and may have contributed to the failure to find significant associations between food insecurity and same-day hospital admission in the analysis of the ED subsample.

Exposure of infants and toddlers ages ≤ 36 mo to food insecurity, with or without measurable hunger, was associated with greater odds of fair/poor health status and of experiencing health problems requiring hospitalization, after adjusting for relevant confounders. A dose-response relation appeared between severity of food insecurity and the odds of caregivers reporting their children's health fair/poor as opposed to excellent/good. Receiving Food Stamp benefits attenuated but did not eliminate the adverse effects of food insecurity on child health.

Cautious interpretation of these results from a large and diverse sample suggests that exposure to food insecurity, with or without measurable hunger, is associated with a greater likelihood of poor health among infants and toddlers, including illness severe enough to require hospitalization. This implies that policies to reduce or prevent food insecurity, especially among families with young children, are likely to prevent illness, reduce hospitalization, and lead to lower health care costs. Although receipt of Food Stamps and TANF may moderate the effects of food insecurity on child health, they do not at present appear to be sufficient to eliminate these effects. These results indicate a need for additional research on the effects of food insecurity on directly observable health outcomes in children, and on the role of assistance programs in ameliorating adverse health effects.

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