PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

# Household Food Insecurity: Associations With At-Risk Infant and Toddler Development

Ruth Rose-Jacobs, Maureen M. Black, Patrick H. Casey, John T. Cook, Diana B. Cutts, Mariana Chilton, Timothy Heeren, Suzette M. Levenson, Alan F. Meyers and Deborah A. Frank

*Pediatrics* 2008;121;65-72
DOI: 10.1542/peds.2006-3717







ARTICLE

# Household Food Insecurity: Associations With At-Risk Infant and Toddler Development

**Ruth Rose-Jacobs, ScD[a], Maureen M. Black, PhD[b], Patrick H. Casey, MD[c], John T. Cook, PhD[a], Diana B. Cutts, MD[d], Mariana Chilton, PhD, MPH[e], Timothy Heeren, PhD[f], Suzette M. Levenson, MEd, MPH[g], Alan F. Meyers, MD, MPH[a], Deborah A. Frank, MD[a]**

[a]Department of Pediatrics, Boston University School of Medicine and Boston Medical Center, Boston, Massachusetts; [b]Department of Pediatrics, University of Maryland School of Medicine, Baltimore, Maryland; [c]Department of Pediatrics, University of Arkansas for Medical Sciences, Little Rock, Arkansas; [d]Department of Pediatrics, Hennepin County Medical Center, Minneapolis, Minnesota; [e]Department of Community Health Prevention, Drexel University School of Public Health, Philadelphia, Pennsylvania; [f]Department of Biostatistics and [g]Data Coordinating Center, Boston University School of Public Health, Boston, Massachusetts

The authors have indicated they have no financial relationships relevant to this article to disclose.

## ABSTRACT

OBJECTIVES. In this study, we evaluated the relationship between household food security status and developmental risk in young children, after controlling for potential confounding variables.

METHODS. The Children's Sentinel Nutritional Assessment Program interviewed (in English, Spanish, or Somali) 2010 caregivers from low-income households with children 4 to 36 months of age, at 5 pediatric clinic/emergency department sites (in Arkansas, Massachusetts, Maryland, Minnesota, and Pennsylvania). Interviews included demographic questions, the US Food Security Scale, and the Parents' Evaluations of Developmental Status. The target child from each household was weighed, and weight-for-age *z* score was calculated.

RESULTS. Overall, 21% of the children lived in food-insecure households and 14% were developmentally "at risk" in the Parents' Evaluations of Developmental Status assessment. In logistic analyses controlling for interview site, child variables (gender, age, low birth weight, weight-for-age *z* score, and history of previous hospitalizations), and caregiver variables (age, US birth, education, employment, and depressive symptoms), caregivers in food-insecure households were two thirds more likely than caregivers in food-secure households to report that their children were at developmental risk.

CONCLUSIONS. Controlling for established correlates of child development, 4- to 36-month-old children from low-income households with food insecurity are more likely than those from low-income households with food security to be at developmental risk. Public policies that ameliorate household food insecurity also may improve early child development and later school readiness.

www.pediatrics.org/cgi/doi/10.1542/peds.2006-3717

doi:10.1542/peds.2006-3717

**Key Words**
child development, infant, child, preschool, child nutrition, hunger, early intervention, risk factors

**Abbreviations**
FI—food insecurity
PEDS—Parents' Evaluations of Developmental Status

Accepted for publication Jun 19, 2007

Address correspondence to Ruth Rose-Jacobs, ScD, Department of Pediatrics, Boston University School of Medicine, 91 East Concord St, Room 5106, Boston, MA 02118. E-mail: rrosejac@bu.edu



THE US DEPARTMENT of Agriculture estimates that 16.7% of all US households with children <6 years of age (2.94 million households; 12.79 million people) had food insecurity (FI) in 2005, reporting limited or uncertain availability of enough food for an active healthy life.[1] The relationships between FI and children's health, behavior, and development seem to vary according to the child's age, gender, and ethnicity. Among children 3 to 8 years of age, FI has been associated with low physical function,[2] poor academic performance, greater weight gain among girls,[3,4] and low psychosocial functioning.[5] Among adolescents, FI has been associated with low psychosocial functioning[2] and overweight.[6] Among children <3 years of age, FI has been associated with caregiver reports of poor infant health and likelihood of hospitalization, suggesting adverse health consequences.[7,8] Among 3-year-old children and their mothers, FI has been associated with self-reported maternal depression and anxiety, as well as child behavior problems.[9]

The first 3 years of a child's life are marked by dramatic changes in cognitive, linguistic, social, and emotional development and in self-regulation, setting the stage for school readiness and adult well-being.[10] Adequate nutrients

are required to support this normal rapid growth and development. Therefore, even mild nutritional deficits during critical periods of brain growth among infants and toddlers may be detrimental.[10–12]

FI may occur with or without reports of hunger.[13–15] Hunger, a term used by the Economic Research Service of the US Department of Agriculture[16] when this study began, occurs when FI is severe enough, or lasts long enough, that household members repeatedly reduce their food intake below normal levels. In the United States, adults in households with FI may ration the available food to try to prevent children from experiencing hunger.

The purpose of this investigation was to evaluate the relationship between household FI and infant and toddler development for children <36 months of age. Specifically, we hypothesized that, after controlling for important child and caregiver factors associated with poverty and/or known to influence early development, children in food-insecure, compared with food-secure, households would be more likely to be at risk for developmental problems, even at the least-severe end of the food security scale (ie, household FI without reported hunger).

## METHODS

### Setting and Instruments

The Children's Sentinel Nutritional Assessment Program conducted household-level surveys and medical chart audits (July 2004 to June 2005) at 5 central-city medical centers. The sample was recruited from primary care clinics (Baltimore, MD, and Minneapolis, MN) and hospital emergency departments (Baltimore, MD, Boston, MA, Little Rock, AR, and Philadelphia, PA). Sites were staffed by interviewers during times of peak patient flow. At each site, as staffing permitted, all caregivers who met the study criteria were approached, with the exception of caregivers of critically ill or injured children. Eligibility criteria included child age of <37 months, state resident, caregiver able to speak English, Spanish, or Somali (Minneapolis only), caregiver knowledgeable about the child's household, and no Children's Sentinel Nutritional Assessment Program interview within the previous 6 months. Institutional review board approval was obtained at each site. Children were weighed and measured and caregivers were interviewed in private settings.

The Children's Sentinel Nutritional Assessment Program survey instrument includes questions regarding demographic information, including caregiver employment, and the child's lifetime history of hospitalizations since discharge from the newborn nursery, household food security questions,[17] a maternal depression screen,[18] and the Parents' Evaluations of Developmental Status (PEDS).[19] Household food security status was derived from the 18-item US Food Security Scale, a valid, reliable, household-level measure of food security that was scored and scaled in accordance with established procedures.[17] Households were classified as food insecure if they reported that they could not afford enough food for an active healthy life for all household members (ie, caregivers endorsed ≥3 of the 18 core food security questions).[1,20] Households were classified as having FI with hunger if household members reduced their food intake in ≥3 of the past 12 months.[1,15] Caregivers' depressive symptoms were measured by using a 3-item maternal depression screening instrument.[18] The depression screening instrument has sensitivity of 100%, specificity of 88%, and positive predictive value of 66%, compared with the 8-item Rand screening instrument.[18] The depression screen was scored as positive if a respondent endorsed any 2 of the 3 items.

Developmental risk was measured with the PEDS,[19,21] a screening instrument for children from birth through 7 years of age that meets the standards set by the American Academy of Pediatrics for developmental screening tests.[21–23] The PEDS includes 10 questions and is largely unaffected by sociodemographic variables, geographic location, parental education and employment, and parent and child gender.[19,21] Caregivers are asked to report any concerns (no, yes, or a little) about the child's development in 8 areas, as follows: expressive and receptive language, fine and gross motor, behavior, social/emotional, self-help, and school. In addition, caregivers are asked 2 open-ended questions about concerns in the global/cognitive area and "other concerns." In standard scoring of the PEDS,[19,21] endorsed items (yes or a little) are classified as significant or nonsignificant concerns depending on the age of the child. Children with ≥2 significant concerns are at developmental risk. The sensitivity and specificity of the PEDS are better for children >4 months of age than for newborns.[19] Therefore, we restricted our sample to children >4 months of age.

Caregivers of children at developmental risk, as determined by PEDS scoring, were offered information about local early intervention service agencies, and follow-up consultation with the child's pediatrician was recommended. Caregivers of children with 1 significant concern or ≥1 nonsignificant concern were encouraged to discuss their concerns with the child's pediatrician.

At the time of the caregiver interview, child weight and length were recorded. To ensure that weights and lengths were recorded in the same manner, equipment and training were standardized across sites. Child weight and length were obtained either by project staff members or from medical chart reviews conducted on the same day as the caregiver interview. Because of practical constraints within emergency departments, length was not always measured. Weight-for-age is a composite measure of growth.[24,25] Weight-for-age $z$ scores were calculated by using the US Centers for Disease Control and Prevention age- and gender-specific reference values.[26] Underweight was defined as a $z$ score ≥2 SDs below the mean weight-for-age value; overweight was defined as ≥2 SDs above the mean weight-for-age value.[27]

### Data Analyses

Of the 3052 caregivers who were approached for recruitment, 226 (7%) were ineligible because the caregivers did not speak English or Spanish (or Somali, in Minne-

apolis), did not have knowledge of the child's household, were not state residents, had been interviewed in the past 6 months or the potential child in the dyad was <4 months of age. Of the remaining 2826 caregivers (93%), 347 (12%) refused to be interviewed and 469 (17%) were missing ≥1 of the analysis variables and therefore were not included in the analyses. The final analysis sample included 2010 caregiver/child dyads. The subjects with complete data, compared with incomplete data, were less likely to be foreign-born caregivers (26% vs 32%; $P = .01$) or employed (46% vs 53%; $P = .01$) or to have children with low birth weights (14% vs 18%; $P = .04$). Caregiver country of birth and employment status, as well as child's low birth weight status, were among the variables included as covariates in the study regression analyses.

Multivariate logistic analyses were used to evaluate FI (yes or no) as a predictor of developmental risk. Covariates were identified on the basis of their theoretical or empirical importance to child development during preliminary analyses. Child-related covariates were gender, age at time of interview, weight-for-age *z* score, low birth weight (≤2500 g or >2500 g), ever breastfed (yes or no), history of previous hospitalizations (yes or no), and type of health insurance (public, private, or none). Caregiver-related covariates were education (less than high school graduation, high school diploma, or more than high school education), marital status (married or not married), employment status (yes or no), positive depressive symptoms on the screening instrument, country of birth (United States or other), and geographic site of interview. Ethnicity was tested as a covariate but was not included because it was highly collinear with caregiver country of birth and geographic site of interview and was not associated with PEDS status (Table 1). We calculated an adjusted odds ratio for the multivariate analysis to determine the statistical significance and strength of the relationship between FI and developmental risk.

We evaluated whether the threshold for the effect on developmental risk occurred at the level of household FI without hunger. We constructed a subsample ($n = 1891$) of the original sample of 2010 by excluding caregivers who reported FI with hunger and reanalyzed the covariate-controlled logistic regression models.

**TABLE 1 Sample Demographic Characteristics According to FI ($N = 2010$)**

| | Food Secure ($n = 1583$) | Food Insecure ($n = 427$) | *P* |
|---|---|---|---|
| Site of data collection, % | | | |
| Baltimore | 29 | 19 | <.0001 |
| Boston | 28 | 30 | |
| Little Rock | 25 | 14 | |
| Minneapolis | 12 | 33 | |
| Philadelphia | 6 | 4 | |
| Child variables | | | |
| Age, % | | | |
| 4–12 mo | 38 | 45 | .05 |
| 13–24 mo | 40 | 36 | |
| 25–36 mo | 22 | 19 | |
| Gender, % | | | |
| Female | 53 | 56 | .28 |
| Male | 47 | 44 | |
| Low birth weight (<2500 g), % | 15 | 14 | .46 |
| Weight-for-age *z* score, mean | 0.034 | 0.021 | .87 |
| Weight-for-age *z* score ≥2 SD below mean, % | 6 | 6 | .50 |
| Weight-for-age *z* score ≥2 SD above mean, % | 6 | 4 | .21 |
| Breastfed, % | 50 | 64 | <.0001 |
| Health insurance, % | | | |
| Public | 83 | 92 | <.0001 |
| None | 2 | 4 | |
| Private | 15 | 4 | |
| Any previous hospitalizations, % | 26 | 30 | .15 |
| Caregiver variables | | | |
| <21 y of age, % | 15 | 11 | .03 |
| Race/ethnicity, % | | | |
| Asian | 1 | <1 | <.0001 |
| Black | 61 | 53 | |
| Hispanic | 16 | 34 | |
| White | 22 | 11 | |
| Native American | <1 | 1 | |
| Born in United States, % | 79 | 55 | <.0001 |
| Married, % | 32 | 34 | .61 |
| Employed, % | 49 | 36 | <.0001 |
| Education, % | | | |
| Some high school | 26 | 37 | <.0001 |
| High school graduate | 41 | 41 | |
| College graduate | 34 | 22 | |
| Maternal report of depressive symptoms, % | 29 | 48 | <.0001 |

## RESULTS

In the sample of 2010 families, 21% ($n = 427$) reported household FI, including 6% ($n = 119$) that reported FI with hunger. The majority (91%; $n = 1486$) of the respondents were the birth mother of the child. Compared with children in food-secure households, children in food-insecure households were younger and more likely to have been breastfed and to receive public health insurance (Table 1). Groups did not differ significantly ($P \geq .05$) with respect to child's gender, incidence of low birth weight, mean weight-for-age *z* score, categorical classification as underweight or overweight, or prior hospitalizations. Caregivers who reported household FI were less likely to be <21 years of age, to have been born in the United States, and to be employed. They had less education and were more likely to report depressive symptoms than were caregivers who reported household food security. Food-secure and food-insecure caregivers differed with respect to ethnicity but did not differ with respect to marital status. FI rates did differ according to site of data collection. Regardless of FI status, underweight and overweight were documented at >3 times the number of children expected with weight-for-age values of <5th percentile (~16%) and >95th percentile (~20%). Almost 14% ($n = 278$) of the 2010 caregivers reported developmental risk on the PEDS.

Table 2 shows the proportions of children with developmental risk in unadjusted and covariate-adjusted analyses and the strength of the relationships stratified according to child and caregiver characteristics. With

TABLE 2 **Descriptions of Sample According to Developmental Risk ($N = 2010$), Unadjusted and Adjusted for Covariates**

| | Unadjusted for Covariates | | | Adjusted for Covariates | |
|---|---|---|---|---|---|
| | Developmental Risk ($n = 278$), % | Odds Ratio (95% CI) | *P* | Odds Ratio (95% CI) | *P* |
| Category of FI | | | | | |
| FI | 18 | 1.48 (1.11–1.97) | .007 | 1.76 (1.26–2.46) | .001 |
| Food security | 13 | 1.00 | | 1.00 | |
| Site of data collection | | | | | |
| Baltimore | 16 | 1.00 | .001 | 1.00 | .0003 |
| Boston | 13 | 0.79 (0.56–1.11) | | 0.93 (0.62–1.40) | |
| Little Rock | 16 | 1.01 (0.72–1.42) | | 0.95 (0.65–1.40) | |
| Minneapolis | 7 | 0.41 (0.26–0.66) | | 0.44 (0.23–0.81) | |
| Philadelphia | 21 | 1.40 (0.83–2.36) | | 1.42 (0.79–2.55) | |
| Child variables | | | | | |
| Age | | | | | |
| 4–12 mo | 7 | 1.00 | <.001 | 1.00 | <.0001 |
| 13–24 mo | 16 | 2.48 (1.78–3.47) | | 2.43 (1.70–3.48) | |
| 25–36 mo | 23 | 3.96 (2.78–5.64) | | 4.22 (2.87–6.21) | |
| Gender | | | | | |
| Female | 10 | 1.00 | <.001 | 1.00 | <.001 |
| Male | 17 | 1.75 (1.35–2.28) | | 1.69 (1.27–2.53) | |
| Birth weight | | | | | |
| Low birth weight (<2500 g) | 22 | 1.97 (1.44–2.71) | <.001 | 1.81 (1.26–2.59) | .001 |
| Birth weight of >2500 g | 13 | 1.00 | | 1.00 | |
| Weight-for-age *z* score | | | | | |
| >2 SD below mean | 30 | 2.98 (1.98–4.47) | <.001 | 2.66 (1.68–4.24) | .0002 |
| Within normal range | 13 | 1.00 | | 1.00 | |
| >2 SD above mean | 16 | 1.30 (0.80–2.11) | | 1.25 (0.74–2.11) | |
| Breastfeeding status | | | | | |
| Breastfed | 13 | 1.00 | .22 | 1.00 | .949 |
| Not breastfed | 15 | 1.18 (0.92–1.52) | | 1.01 (0.75–1.37) | |
| Health insurance | | | | | |
| Public | 13 | 1.00 | .40 | 1.00 | .600 |
| None | 19 | 1.54 (0.79–3.02) | | 1.35 (0.65–2.80) | |
| Private | 15 | 1.12 (0.77–1.63) | | 1.17 (0.74–1.85) | |
| Previous hospitalizations | | | | | |
| Any | 22 | 2.39 (1.83–3.12) | <.0001 | 1.80 (1.35–2.40) | <.0001 |
| None | 11 | 1.00 | | 1.00 | |
| Caregiver variables | | | | | |
| Age | | | | | |
| <21 y | 12 | 0.87 (0.59–1.27) | .46 | 1.02 (0.66–1.56) | .936 |
| ≥21 y | 14 | 1.00 | | 1.00 | |
| Race/ethnicity | | | | | |
| Asian | 15 | 0.97 (0.21–4.47) | .41 | NA | NA |
| Black | 14 | 0.85 (0.62–1.17) | | | |
| Hispanic | 12 | 0.71 (0.47–1.07) | | | |
| White | 16 | 1.00 | | | |
| Native American | 25 | 1.77 (0.47–6.74) | | | |
| Country of birth | | | | | |
| United States | 15 | 1.00 | .009 | 1.00 | .763 |
| Other | 10 | 0.66 (0.48–0.90) | | 0.93 (0.60–1.46) | |
| Marital status | | | | | |
| Married | 14 | 1.00 | .60 | 1.00 | .304 |
| Not married | 14 | 1.00 (0.77–1.32) | | 0.83 (0.59–1.18) | |
| Employment status | | | | | |
| Employed | 12 | 1.00 | .02 | 1.00 | .010 |
| Not employed | 16 | 1.37 (1.06–1.77) | | 1.48 (1.10–1.98) | |
| Education | | | | | |
| Some high school | 14 | 1.03 (0.75–1.41) | .76 | 1.07 (0.76–1.53) | .867 |
| High school graduate | 13 | 1.00 | | 1.00 | |
| College graduate | 15 | 1.12 (0.83–1.51) | | 1.09 (0.77–1.53) | |
| Maternal depressive symptoms | | | | | |
| Yes | 19 | 1.93 (1.50–2.50) | <.0001 | 1.70 (1.27–2.28) | .0004 |
| No | 11 | 1.00 | | 1.00 | |

NA indicates not applicable; CI, confidence interval.

respect to FI group, 18% of children in food-insecure households, compared with 13% of children in food-secure households, were reported to be at developmental risk ($P = .007$).

The results of multivariate logistic analyses revealed that children from food-insecure households, compared with those from food-secure households, were two thirds more likely to experience developmental risk (adjusted odds ratio: 1.76; 95% confidence interval: 1.26–2.46; $P = .001$). In multivariate analyses unadjusted and adjusted for other covariates, children were more likely to have developmental risk if they were older, were male, had a low birth weight, were underweight, and had a history of hospital admissions. Children who were underweight, compared with normal weight, were almost 3 times more likely to experience developmental risk. In addition, caregivers who were unemployed or reported depressive symptoms were more likely to report that their children were at developmental risk. There were also geographic site differences in the proportions of children with developmental risk. Caregivers' age and education were not significantly related to developmental risk. The one association that changed with adjustments for covariates was the association between foreign-born caregivers and PEDS results; the unadjusted analysis indicated significance, whereas the relationship of foreign-born caregivers with developmental risk was no longer present after adjustment. When the analysis was repeated after removal of the families that reported FI with hunger, the negative relationship between FI and increased developmental risk was maintained (adjusted odds ratio: 1.77; 95% confidence interval: 1.23–2.56; $P = .002$).

## DISCUSSION

This study identified an association between FI and developmental risk among children <36 months of age from low-income (poor and near-poor) households. Although the detrimental effects of poverty on child development are well documented,[28] our study found that the additional association between FI and developmental risk in young children from poor and near-poor households was present even after controlling for theoretically chosen and statistically identified confounding variables. These control variables included child factors, such as previous hospitalizations, low birth weight, and current weight-for-age $z$ score, that usually would be identified by clinicians as markers of physiologic risk.[13,29] The nearly identical relationship between developmental risk and FI that was observed when households that reported FI with hunger were removed from the analysis suggests that the threshold for effects on young children's developmental risk occurs even in households at the less-severe end of the FI continuum. Our findings of greater incidence of developmental risk for very young children from low-income households with limited or uncertain food supplies are consistent with previous findings for school-aged children.[3,4,13,30]

There are at least 2 possible pathways that may explain the association between FI and developmental risk. In a nutritive pathway, FI may compel families to limit the quality of food given to their children, leading to micronutrient deficiencies. There is some evidence of an association between FI and iron deficiency,[31] which has been linked to developmental problems[32–34] and may contribute to the increased rate of developmental risks among children in households with FI. There also may be nonnutritive pathways linking FI and developmental risk. In one possible pathway, families with FI are confronted with the stress and anxiety of not having a steady reliable source of food[35] and are at risk for depressive symptoms.[9,36] Caregiver depression has a negative influence on child development,[37] particularly in the presence of poverty.[38] In the present study, almost one half of the caregivers in food-insecure households reported symptoms of depression, possibly because caregivers in households with FI thought that they could not provide a secure source of food. However, as with other cross-sectional studies that reported associations between FI and maternal depressive symptoms,[9,36] it is not clear whether depression preceded or followed FI.

In another possible nonnutritive pathway, a caregiver report of FI could be a marker for extreme poverty. Caregivers who reported FI had fewer years of formal education, were less likely to be employed, and had children who were more likely to be enrolled in public health insurance programs than did caregivers who reported food security. Although these factors associated with poverty were controlled for in the current analysis, we did not measure whether these extremely low-income households had more-limited access to resources besides food, including toys, books, and other learning materials, and experiences known to be important for promoting child development.[39,40]

Our findings must be interpreted in light of several important methodologic issues. First, the study was a sentinel study (conducted in English, Spanish, and Somali) of caregivers and their children 4 to 36 months of age who were waiting for care at 1 of 5 emergency departments and/or clinics that serve large numbers of families from low-income backgrounds. Although the sentinel sample included poor and near-poor caregivers and their children, who were at high baseline risk for negative health and developmental outcomes, the caregivers of the most severely ill and injured children were not included because of their need for immediate medical care. Second, the cross-sectional design can neither establish a causal relationship nor unequivocally ascertain the direction of effect between FI and developmental risk. However, our study results are consistent with recent developmental findings from a longitudinal evaluation of children from kindergarten through third grade.[3] Third, although we controlled statistically for important covariate and confounding factors, other unmeasured confounders might have influenced the findings. A less-stimulating home environment related to poverty is probably the most important unmeasured confounder in the relationship between FI and developmental risk. Although we sampled caregivers from poor and near-poor families and adjusted for variables related to poverty, such as type of health insurance and caregiver education and employment, we did not have a

measure of family income or the quality of the home environment.

Finally, shared-method variance (ie, the same caregivers reported food security and developmental concerns) could have influenced the results. That is, it is possible that caregivers who were concerned about food access tended to report concerns about child development because they were generally concerned about the overall family situation. However, this threat was minimized because families who expressed concerns but not endorsement of the food security items were not classified as having FI, in keeping with the US Department of Agriculture guidelines.

As expected, cognitive, language, and behavioral concerns are more likely to be identified as the infant develops into toddlerhood, when there are greater expectations of the child and more-complex and more-frequent interactions with the outside world than during the early months. Therefore, although we controlled for the age of the children at the time of examination, caregivers of toddlers were more likely to report that the children were at developmental risk than were caregivers of younger infants. In addition, birth weight, health, and gender are factors that were found in many other studies to influence development, particularly for children living in poverty, depending on the developmental outcome measured.[39–41] Consistent with the work of others, children in this sample who had low birth weights, had been previously hospitalized, and were male were more likely to be at developmental risk than were children who had normal birth weights, had not been hospitalized, and were female. Caregivers who were not born in the United States and caregivers who were employed were less likely to report that their children were at developmental risk than were caregivers in the contrasting groups.

The clinical and public policy implications of this study are striking. Infants who have experienced multiple negative environmental factors are at risk for long-term developmental consequences.[42] Therefore, the multiple factors for children living in poor and near-poor households who experience household FI and developmental risk could have long-term implications into school age. In contrast, focused interventions in young children have been shown to improve school readiness and long-term outcomes.[30,43–47] Therefore, early identification and remediation of FI, as well as developmental delay, are prudent.

This study of FI and child development highlights the importance of early identification of at-risk children in a model of preventative medicine. The American Academy of Pediatrics recommends that an algorithm be implemented at each well-child visit and states, "early identification of developmental problems should lead to further developmental and medical evaluation, diagnosis, and treatment, including early developmental intervention."[48] Evidence suggests that household FI (with or without the report of family hunger), even in the presence of appropriate weight-for-age values, is an important risk factor for the health, development, and behavior of children <3 years of age and, in the future, should be included in algorithms for developmental surveillance.[7,49]

Interventions for FI and developmental risk are available and overall have been successful.[44–46,50] Linking families to the Food Stamp Program and/or the Supplemental Nutrition Program for Women, Infants, and Children participation, as well as Early Intervention, Early Head Start, Head Start, and mental health services, is an important intervention that should be recommended if indicated by the risk surveillance or developmental screening. Participation in the Supplemental Nutrition Program for Women, Infants, and Children has been associated with positive infant growth and health.[51] Frongillo et al[52] reported that starting participation in the Food Stamp Program during the kindergarten to third-grade years was associated with academic (reading and math) improvement, compared with stopping participation in the Food Stamp Program during that same period.

## CONCLUSIONS

This study has shown that there is a statistically robust association between household FI and developmental risk during the first 3 years of life, when brain growth is rapid. Given the prevalence of FI in US households with young children, large numbers of children may be at risk of potentially preventable developmental deficits, even if they are not underweight for age. In a time of limited resources, providing nutritional and developmental interventions to young children and their families is a proactive step that might decrease the need for later, more-extensive interventions for developmentally or behaviorally impaired children of school age.[53] Future studies should evaluate the longitudinal relationship of FI and infant and toddler development. Those studies should consider direct evaluation of the caregiving environment and child development, as well as other important factors (such as health status, public assistance programs, and caregiver mental health) that may alter the relationship between FI and child development.

## ACKNOWLEDGMENTS

This research was supported by grants from the W.K. Kellogg Foundation, MAZON: A Jewish Response to Hunger, the Gold Foundation, the Minneapolis Foundation, Project Bread: The Walk for Hunger, the Sandpiper Foundation, the Anthony Spinazzola Foundation, the Daniel Pitino Foundation, the Candle Foundation, the Wilson Foundation, the Abell Foundation, the Claneil Foundation, the Beatrice Fox Auerbach donor-advised fund of the Hartford Foundation (on the advice of Jean Schiro Zavela and Vance Zavela), Susan Schiro and Peter Manus, the Eos Foundation, the Endurance Fund, the Gryphon Fund, the Shoffer Foundation, and anonymous donors.

We are very grateful to the families that participated in this study. We also thank Zhaoyan Yang for excellent management of surveillance and interview data and SAS programming. Special thanks go to Nicole Neault, MPH, Stephanie Ettinger De Cuba, MPH, Joni Geppert, MPH,

Tu Quan, Susan Goolsby, Anna Quigg, MA, Jodi Marani, MEd, and Jennifer Breaux, MPH, for excellence in training, scheduling, and supervising interview staff members and for diligence in coding, cleaning, and preparing questionnaires for data entry. We would also like to thank Frances P. Glascoe, PhD, author of the Parents' Evaluations of Developmental Status, for her consultation on the use of the PEDS in our study.

## REFERENCES


1. Nord M, Andrews M, Carlson S. *Measuring Food Security in the United States: Household Food Security in the United States, 2005*. USDA Economic Research Service, Economic Research Report Number 29, Washington, DC, November 2006. Available at: www.ers.usda.gov/Publications/ERR29/ERR29.pdf. Accessed November 11, 2006
2. Casey PH, Szeto KL, Robbins JM, et al. Child health-related quality of life and household food security. *Arch Pediatr Adolesc Med.* 2005;159:51–56
3. Jyoti D, Frongillo E, Jones S. Food insecurity affects children's academic performance, weight gain, and social skills. *J Nutr.* 2005;135:2831–2839
4. Alaimo K, Olson CM, Frongillo EA. Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. *Pediatrics.* 2001;108:44–53
5. Olson CM. Nutrition and health outcomes associated with food insecurity and hunger. *J Nutr.* 1999;129(suppl):521S–524S
6. Casey PH, Szeto K, Lensing S, Bogle M, Weber J. Children in food-insufficient, low-income families: prevalence, health, and nutrition status. *Arch Pediatr Adolesc Med.* 2001;155:508–514
7. Cook JT, Frank DA, Berkowitz C, et al. Food insecurity is associated with adverse health outcomes among human infants and toddlers. *J Nutr.* 2004;134:1432–1438
8. Cook JT, Frank DA, Levenson SM, et al. Child food insecurity increases risks posed by household food insecurity to young children's health. *J Nutr.* 2005;136:1073–1076
9. Whitaker RC, Phillips SM, Orzol SM. Food insecurity and the risks of depression and anxiety in mothers and behavior problems in their preschool-aged children. *Pediatrics.* 2006;118(3). Available at: www.pediatrics.org/cgi/content/full/118/3/e859
10. Shonkoff JP, Phillips DA, eds. *From Neurons to Neighborhoods: The Science of Early Childhood Development*. Washington, DC: National Academy Press; 2000
11. Dobbing J. The later growth of the brain and its vulnerability. *Pediatrics.* 1974;53:2–6
12. Dobbing J, Sands J. Vulnerability of developing brain, part IX: the effect of nutritional growth retardation on the timing of the brain growth-spurt. *Biol Neonate.* 1971;19:363–378
13. Frongillo EA Jr. Validation of measures of food insecurity and hunger. *J Nutr.* 1999;129(suppl):506S–509S
14. Weinreb L, Wehler C, Perloff J, et al. Hunger: its impact on children's health and mental health. *Pediatrics.* 2002;110(4). Available at: www.pediatrics.org/cgi/content/full/110/4/e41
15. Hamilton W. *Household Food Security in the United States in 1995: Technical Report of the Food Security Measurement Project*. Alexandria, VA: Department of Agriculture, Food and Nutrition Service; 1997
16. Nord M, Andrews M, Carlson S. *Measuring Food Security in the United States: Household Food Security in the United States, 2004*. USDA Economic Research Service, Economic Research Report Number 11, Washington, DC, October 2005. Available at www.ers.usda.gov/publications/err11/err11.pdf. Accessed August 8, 2006
17. Bickel G, Nord M, Price C, Hamilton W, Cook J. *Measuring Food Security in the United States: Guide to Measuring Household Food Security, Revised 2000*. Department of Agriculture, Food and Nutrition Service, Alexandria, VA, March 2000
18. Kemper KJ, Babonis TR. Screening for maternal depression in pediatric clinics. *Am J Dis Child.* 1992;146:876–878
19. Glascoe FP. *Collaborating With Parents: Using Parents' Evaluation of Developmental Status to Detect and Address Developmental and Behavioral Problems*. Nashville, TN: Ellsworth and Vandermeer Press; 1998
20. Yip R, Binkin NJ, Fleshood L, Trowbridge FL. Declining prevalence of anemia among low-income children in the United States. *JAMA.* 1987;258:1619–1623
21. Glascoe FP. Evidence-based approach to developmental and behavioral surveillance using parents' concerns. *Child Care Health Dev.* 2000;26:137–149
22. American Academy of Pediatrics, Committee on Children With Disabilities. Developmental surveillance and screening of infants and young children. *Pediatrics.* 2001;108:192–196
23. Halfon N, Regalado M, Sareen H, et al. Assessing development in the pediatric office. *Pediatrics.* 2004;113(suppl):1926–1933
24. Woodruff BA, Duffield A. *Assessment of Nutritional Status in Emergency-Affected Populations: Adults*. Geneva, Switzerland: United Nations, Administrative Committee on Coordination, Subcommittee on Nutrition; 2000
25. Kielman A, McCord C. Weight-for-age as an index of risk of death in children. *Lancet.* 1978;1:1247–1250
26. Centers for Disease Control and Prevention, National Center for Health Statistics. CDC growth charts: United States. Available at: www.cdc.gov/nchs/about/major/nhanes/growthcharts/clinical_charts.htm. Accessed October 11, 2006
27. Svedberg P, World Institute for Development Economics Research. *Poverty and Undernutrition: Theory, Measurement, and Policy*. New York, NY: Oxford University Press; 2000
28. National Institute of Child Health and Human Development Early Child Care Research Network. Duration and developmental timing of poverty and children's cognitive and social development from birth through third grade. *Child Dev.* 2005;76:795–810
29. Kleinman R. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2004
30. Noble KG, Tottenham N, Casey BJ. Neuroscience perspectives on disparities in school readiness and cognitive achievement. *Future Child.* 2005;15:71–89
31. Skalicky A, Meyers AF, Adams WG, Yang Z, Cook JT, Frank DA. Child food insecurity and iron deficiency anemia in low-income infants and toddlers in the United States. *Matern Child Health J.* 2006;10:177–185
32. Grantham-McGregor S, Ani C. A review of studies on the effect of iron deficiency on cognitive development in children. *J Nutr.* 2001;131(suppl 2):649S–666S
33. Black MM. Micronutrient deficiencies and cognitive functioning. *J Nutr.* 2003;133(suppl 2):3927S–3931S
34. Lozoff B, Jimenez E, Hagen J, Mollen E, Wolf AW. Poorer behavioral and developmental outcome more than 10 years after treatment for iron deficiency in infancy. *Pediatrics.* 2000;105(4). Available at: www.pediatrics.org/cgi/content/full/105/4/e51
35. Alaimo K, Olson CM, Frongillo EA. Family food insufficiency, but not low family income, is positively associated with dysthymia and suicide symptoms in adolescents. *J Nutr.* 2002;132:719–725
36. Casey P, Goolsby S, Berkowitz C, et al. Maternal depression, changing public assistance, food security, and child health status. *Pediatrics.* 2004;113:298–304
37. Dawson G, Ashman SB, Panagiotides H, et al. Preschool outcomes of children of depressed mothers: role of maternal behavior, contextual risk, and children's brain activity. *Child Dev.* 2003;74:1158–1175

38. Petterson SM, Albers AB. Effects of poverty and maternal depression on early child development. *Child Dev.* 2001;72:1794–1813
39. Bradley RH, Corwyn RF. Socioeconomic status and child development. *Annu Rev Psychol.* 2002;53:371–399
40. Watson JE, Kirby RS, Kelleher KJ, Bradley RH. Effects of poverty on home environment: an analysis of three-year outcome data for low birth weight premature infants. *J Pediatr Psychol.* 1996;21:419–431
41. Aber JL, Jones SJ, Cohen J. The impact of poverty on the mental health and development of very young children. In: Zeanah CH, ed. *Handbook of Infant Mental Health*. New York, NY: Guilford Press; 2000:113–128
42. Sameroff AJ. Environmental risk factors in infancy. *Pediatrics.* 1998;102(suppl E):1287–1292
43. Rouse C, Brooks-Gunn J, McLanahan S. Introducing the issue. *Future Child.* 2005;15:5–14
44. Walker SP, Chang SM, Powell CA, Grantham-McGregor SM. Effects of early childhood psychosocial stimulation and nutritional supplementation on cognition and education in growth-stunted Jamaican children: prospective cohort study. *Lancet.* 2005;366:1804–1807
45. Devaney BL, Ellwood MR, Love JM. Programs that mitigate the effects of poverty on children. *Future Child.* 1997;7:88–112
46. Barnett WS. Long-term effects of early childhood programs on cognitive and school outcomes. *Future Child.* 1995;5:25–50
47. Black MM, Dubowitz H, Krishnakumar A, Starr RH Jr. Early intervention and recovery among children with failure to thrive: follow-up at age 8. *Pediatrics.* 2007;120:59–69
48. American Pediatric Association, Council on Children With Disabilities, Section on Developmental Behavioral Pediatrics, Bright Futures Steering Committee and Medical Home Initiatives for Children with Special Needs Project Advisory Committee. Identifying infants and young children with developmental disorders in the medical home: an algorithm for developmental surveillance and screening. *Pediatrics.* 2006;118:405–420
49. Rose-Jacobs R, Cabral H, Cook JT, Martin B, Frank DA. Household food insufficiency and Bayley Scales of Infant Development scores between 6 and 36 months. In: *14th Biennial International Conference on Infant Studies*. Chicago, IL: International Society of Infant Studies; 2004
50. Love JM, Kisker EE, Ross C, et al. The effectiveness of Early Head Start for 3-year-old children and their parents: lessons for policy and programs. *Dev Psychol.* 2005;41:885–901
51. Black MM, Cutts DB, Frank DA, et al. Special Supplemental Nutrition Program for Women, Infants, and Children participation and infants' growth and health: a multisite surveillance study. *Pediatrics.* 2004;114:169–176
52. Frongillo EA, Jyoti DF, Jones SJ. Food Stamp Program participation is associated with better academic learning among school children. *J Nutr.* 2006;136:1077–1080
53. Shonkoff JP, Meisels SJ. *Handbook of Early Childhood Intervention*. 2nd ed. New York, NY: Cambridge University Press; 2000

## ADULT SUPERVISION

"At Mascoutah Middle School in Illinois, 13-year-old Megan Coulter was recently given detention for hugging two friends goodbye before the weekend—a violation of the school's ban on 'public displays of affection.' One California school district worried about 'bullying, violence, self-esteem and lawsuits' also banned tag, cops and robbers, touch football and every other activity that involved 'bodily contact.' In some schools, free play has been replaced by organized relay races and adult-supervised activities, in order to protect children from spontaneous outbreaks of creativity. This makes sense to the sort of person who thinks children must at all costs be protected from the scrapes of life and insulated from the prospect of having to deal with social interactions or disappointment. We're already paying the price for the epidemic of overprotectiveness. Congress has appropriated more than $600 million to encourage kids to walk or bike to school. An entire generation of kids now rides in minivans to schools where they aren't allowed to chase one another, swing on swings or play dodgeball. And we wonder why we have an obesity problem."

**Sykes C. *Wall Street Journal*. November 18, 2007**

**Editor's note**: Mr. Sykes is the author, most recently, of *50 Rules Kids Won't Learn in School.* St. Martins, 2007

Noted by JFL, MD

# Household Food Insecurity: Associations With At-Risk Infant and Toddler Development

Ruth Rose-Jacobs, Maureen M. Black, Patrick H. Casey, John T. Cook, Diana B. Cutts, Mariana Chilton, Timothy Heeren, Suzette M. Levenson, Alan F. Meyers and Deborah A. Frank

*Pediatrics* 2008;121;65-72
DOI: 10.1542/peds.2006-3717