Food Insecurity Works through Depression, Parenting, and Infant Feeding to Influence Overweight and Health in Toddlers[1,2]

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Abstract

We used the Early Childhood Longitudinal Study-Birth Cohort 9- and 24-mo surveys ($n = 8693$) and Structural Equation Modeling to examine direct and indirect associations between food insecurity and toddlers' overweight (weight for length), physical health, and length for age. There were significant effects of food insecurity on parental depression and parental depression in turn influenced physical health. There were also significant effects of food insecurity on parenting practices, which in turn were significantly associated with infant feeding and subsequently toddlers' overweight. There were no significant direct or indirect associations between food insecurity and toddlers' length for age. Our results show that food insecurity influences parenting, including both depression and parenting practices. Findings suggest parental depression is a stressor on parenting behavior that social policy should address to alleviate problematic child health outcomes. Findings underscore the importance of continuing and strengthening policy initiatives to ensure that families with infants and toddlers have sufficient, predictable, and reliable food supply.   J. Nutr. 137: 2160–2165, 2007.

Introduction

Food insecurity is defined as "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire food in socially acceptable ways" (1). Food insecurity is a multidimensional phenomenon that has successive stages as categorized by the USDA: high food security, marginal food security, low food security, and very low food security. As households become less food secure, there is a decrease in the frequency and quantity of adults' and children's food intake (2). Growing evidence indicates that children in households lacking access to sufficient food are more likely to be in poor health and to have poor nutritional outcomes than children from food-secure households (3–7). Having sufficient food is a necessary condition for children's normal growth and development and recent evidence suggests that deprivation of food can be a precursor to nutritional and health problems (4).

Some studies suggest that food insecurity is associated with a number of poor health outcomes for children (8), including vitamin deficiency (9), illnesses and chronic illness (10), poor health status, and infections (8). Some studies have also found that food insecure children are more likely to experience lower reported physical and psychological functioning (3,4). Although findings point to negative associations for health outcomes, findings are inconsistent regarding overweight outcomes. According to some studies, children from food insecure households are at an increased likelihood of being overweight and others find differences for some subgroups and others show no association (4,10–14). Several studies have found that food insecurity is not associated with length for age among children (15), whereas other studies have found a relationship between the 2 (16).

Most research on food insecurity and child outcomes, however, has not focused on infants and toddlers and has not used longitudinal data. Studies that have examined associations between food insecurity and child health and nutritional status have not uncovered how (i.e. the pathways through which) food insecurity might influence such outcomes. To fill these research gaps, we used data from the Early Childhood Longitudinal Survey-Birth Cohort (ECLS-B),[5] a longitudinal, nationally representative sample of children at ages 9 and 24 mo, to address the following key research question: Is there an association between food insecurity and child nutritional status and physical health outcomes, and do parental depression, parenting practices, and infant feeding practices mediate these associations? This study expands an existing body of work that finds a link between inadequate food and a variety of outcomes for children (4,5,17,18).

The pathways through which food insecurity influences child well-being

Just as important as understanding whether food insecurity influences physical health and nutrition outcomes in the early

[5] Abbreviations used: CES-D, Center for Epidemiological Studies of Depression Scale; CFI, comparative fit index; ECLS-B, Early Childhood Longitudinal Study-Birth Cohort; NCATS, Nursing Child Assessment Teaching Scale; RMSEA, mean square error of approximation; TLI, Tucker-Lewis Index; WRMR, weighted root mean square residual.

years is understanding how these associations operate. Several indirect pathways through which food insecurity may influence child outcomes have been suggested (4,5,17,18) but have only begun to be empirically tested (19).

Parental depression. Research indicates that adults in food insecure households are significantly more likely to exhibit symptoms of depression than other adults (19,20). A sizeable body of research has found that parental depression is associated with fewer positive health behaviors, with lower levels of positive parent-child interactions (21,22), and shorter breastfeeding (23,24). Some studies have also found that depressed mothers are more likely than nondepressed mothers to report that their children are in fair or poor health (25) and that infants of depressed mothers are at higher risk of being underweight and/or of having lower height for age (26).

Infant feeding practices. For infants and toddlers, feeding patterns are important to growth and development (27). The duration of breastfeeding, timing of introduction of complementary foods, and adherence to infant feeding recommendations are crucial factors ensuring the introduction of developmentally appropriate, micronutrient-rich foods through the first year of life. When the maternal diet is inadequate, as is likely to be the case in food insecure situations, decisions regarding infant feeding may also be compromised. Researchers have documented broad variations in infant feeding practices (28,29) but have not examined if such practices are influenced by food insecurity.

Parenting processes. Food insecurity in the home may also translate into a source of family stress that affects parenting behaviors and parent-child interactions (30). Prior research indicates that economic hardship is linked to harsher and less responsive parent-child interactions, with adverse outcomes for children (31). The absence of food could be seen as either a stressful event or a source of chronic stress if the food problem is prolonged (4–6). Parents suffering from food deprivation are likely to have their physical and emotional states and parenting behaviors affected (32). Therefore, food insecurity may reflect a hardship associated with less competent parenting (33).

Based on the review of the literature, we test the hypothesis that food insecurity will be both directly and indirectly associated with physical health and nutritional status outcomes. Indirect associations between food insecurity and physical health and nutritional status will operate through depression, parenting behaviors, and infant feeding practices. These associations will be strongest for reported physical health and overweight but weaker and potentially insignificant for length for age.

Subjects and Methods

Data. These analyses use the 9- and 24-mo restricted use data from the ECLS-B, the first nationally representative longitudinal study of U.S children from infancy to the time they enter school. The ECLS-B oversamples Asians and American Indians, low- to moderately low-birth weight infants, and twins. Data collection is occurring in 5 waves: at ~9 mo after birth, 24 mo, 48 mo, entrance to kindergarten, and at first grade. The primary modes of data collection are in-person interviews, direct child assessments, and videotaping of mother-child interactions, all occurring during home visits. Information on children and parents was also drawn from birth certificates. The ECLS-B is a study that includes the Household Food Security Survey Module (1), which asks about food availability and hunger during the year prior to the survey. We use the food insecurity data from the first wave (9 mo), which in theory covers the first 9 mo of the child's life as well as 3 mo prenatal. We

also drew our measures on the proposed pathways (parental depression, parenting practices, and infant feeding practices) from the first wave (9 mo). We drew our outcome data from the second wave (24 mo).

Subjects. At 9 mo, 10,688 parent interviews and 10,221 child assessments were completed (34). We excluded 1995 cases because they did not have parent assessments, child assessments from both the 9-mo and 24-mo interviews, and outcome data from the 24-mo interview, yielding a final sample of 8693. All analyses were conducted using sample weights.

Outcome variables. We created a dichotomous measure of physical health at 24 mo to examine children's overall health status as rated by caregivers. If the mother reported the child to be in "excellent," "very good," or "good" health, physical health status was coded as 0. If the mother reported that the child was in "fair" or "poor" health, physical health status was coded as 1.

At 24 mo, using CDC-defined percentiles for child weight and length, we identified overweight children as those with a weight for length ≥95th percentile (35,36). Those who met these criteria were coded as 1 and considered overweight and those who did not were coded as 0.

At 24 mo, using CDC-defined percentiles for length for age, we identified short or stunted children as those with a length <5th percentile. Those who met these criteria were coded as 1 and those who did not were coded as 0.

Primary predictor. Food security was measured at 9 mo using the USDA Household Food Security Survey Module (1). Using the standard guidelines for use (1), a categorical variable was created based on parent responses to 18 questions regarding a variety of hunger and food security issues (e.g. experiencing hunger, skipping meals, and running out of food) over the past 12 mo. This variable was coded to identify the child's household as having: *1*) high or marginal food security (households that affirm ≤2 responses); *2*) low food security (those affirming ≥3 or ≤7 responses); or *3*) very low food security (households that affirm ≥8 responses). Some prior research suggests that reporting any affirmative responses on the food insecurity survey module signifies increased food insecurity and may be associated with child development (37). In light of these findings, we also conducted analyses with our outcomes identifying households reporting ≥1 responses on the USDA food security module, but our results did not differ from those using the standard guidelines. All successive analyses presented measure food insecurity using the standard guidelines (1).

Pathway variables (mediators). Infant feeding practices were measured using a latent variable: a continuous measure of the duration of breastfeeding in months (based on mothers' reports) and a dichotomous measure of when children began eating solid foods, such as Cheerios or baby food from jars. Children who began eating solid foods early (at or before 3 mo of age) were coded as 0 and those who began eating solid foods after 3 mo were coded as 1.

Maternal depression was measured at 9 mo using the 12-item abbreviated version of the Center for Epidemiological Studies of Depression Scale (CES-D) (39). The CES-D was designed to measure the frequency of depressive symptoms in the clinical literature on depression and is well known for its strong psychometric properties (38). Total scores ranged from 0 to 36. A cut point on this scale of 5 or higher was used to identify mothers who experienced mild depression and other more severe forms of depression and were coded as 1; all others were coded as 0 (39).

Parenting practices were measured at 9 mo using the Nursing Child Assessment Teaching Scale (NCATS) (40). The NCATS rates caregiver and child interactions using 4 subscales (sensitivity to the infant's cues, response to distress, social-emotional growth fostering behavior, and cognitive growth fostering behavior) and has been shown to have good reliability and validity (41). The NCATS was a direct assessment administered and videotaped during the 9-mo interview and was coded and later scored by specially trained observers. Total scores ranged from 0 to 43, with higher scores indicating more positive parenting practices.

Control variables. A range of control variables from the 9-mo survey were included in the analyses to properly specify relationships between food insecurity and child well-being. We included covariates that are

predictive of both food insecurity and child outcomes that could (at least in part) be driving any associations found between these variables. Parental education was measured using a categorical variable indicating the highest level of education attained by either resident parent, coded as: less than high school, high school degree/equivalent, vocational school/ some college, and bachelor's degree or higher. Maternal employment was measured using a categorical variable indicating whether the mother had full-time employment ($\geq$35 h/wk), had part-time employment, was looking for work, or was not in the labor force. Mother's age at birth was measured in years and ranged from 15 to 50 y. Family structure was measured using categorical variables that identified single parent households, 2-parent households, and extended family or other types of households. We included categorical measures for receipt of food stamps by anyone in the household at any point since the child's birth and for Special Supplemental Nutrition Program for Women, Infants, and Children receipt by either the mother or child within the past 12 mo. The child's exposure to cigarette smoke was measured dichotomously based on the mother's report of whether any members of the household smoked inside the house at the time of the survey. A dichotomous variable was created to measure receipt of the appropriate number of well-baby visits, determined using the recommendations of the American Academy of Pediatrics (42) according to the age of the child. We also included a measure of the household poverty index ratio: <1.00; 1.00–1.85; 1.86– 2.99; or $\geq$3.00. Child gender was measured using a dichotomous variable. Child's age was measured continuously in months to account for variation in the timing of survey administration (6–22 mo for the 9-mo wave and 16–38 mo for the 24-mo wave).

Statistical analysis. For multivariate analysis, we used structural equation modeling, allowing us to test direct and indirect effects of food insecurity on child nutritional and physical health outcomes (43). Structural equation modeling allowed us to test the hypothesis that the associations between food insecurity and child health and nutrition may be direct as well as mediated by maternal depression, parenting practices, and infant feeding practices. Analyses were conducted using Mplus (44). We assessed the acceptability of model fit using the mean square error of approximation (RMSEA), the comparative fit index (CFI), the weighted root mean square residual (WRMR), and the Tucker Lewis Index (TLI). These goodness-of-fit indexes determine whether there is a relatively good fit between the hypothesized model and the observed data and calculate the rejection rates for misspecified models [i.e. models with misspecified factor covariance(s) and models with misspecified factor loading(s)] (45). Cut-offs of 0.06 for the RMSEA, 0.95 for the CFI, 0.90 for the WRMR, and 0.95 for the TLI were used (45). We also calculated weighted descriptive statistics for all variables in the analysis (**Table 1**).

Results

Physical health. The significant indirect association between food insecurity and fair or poor health operated through depression, net of controls for parent characteristics, household characteristics, and child characteristics (**Table 2; Fig. 1**). Food insecure homes had higher levels of depression ($\beta = 0.243$; $P < 0.001$), which were in turn associated with fair or poor physical health for young children ($\beta = 0.058$; $P = 0.03$). This model had a reasonable fit (RMSEA = 0.008, CFI = 0.986, TLI = 0.960, WRMR = 0.457).

Overweight (weight for length). Net of controls for parent characteristics, household characteristics, and child characteristics, food insecurity did not directly affect overweight; instead, food insecurity worked indirectly through parenting practices and infant feeding to influence overweight. Food insecurity was negatively associated with positive parenting practices ($\beta = -0.077$; $P = 0.04$). Positive parenting practices influenced good infant feeding practices ($\beta = 0.067$; $P = 0.002$), and good infant feeding practices were negatively associated with overweight ($\beta = 0.361$; $P < 0.001$). This model also had a reasonable fit

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TABLE 1 Descriptive statistics for variables used in the analysis of the effects of household food insecurity on toddlers' health and nutritional outcomes at 24 mo[1]

Food security, %	
Very low food security	2.5
Low food security	10.1
High or marginal food security	87.4
Diet/infant feeding practices	
Duration of exclusive breastfeeding, *mo*	3.2 ± 3.5
Solid foods introduced before 3 mo, %	20.1
Parenting processes	
Parent/child interactions (NCATS)	26.7 ± 5.8
Depression (maternal), %	
Severe depressive symptoms on the CES-D scale	37.2
Gender of child, %	
Male	51.1
Female	48.9
Age of child, *mo*	10.5 ± 1.9
Family structure, %	
Two biological parents	77.6
Single parent	11.3
Other family structure	12.1
Resident parent education, %	
Less than high school	18.6
High school diploma/equivalent	20.3
Some college/vocational school	27.3
Bachelor's degree or more	33.9
Mother's age at birth, *y*	27.5 ± 6.4
Receipt of recommended number of well-baby visits, %	
Yes	22.3
No	77.8
Smoking in household, %	
Yes	11.3
No	88.8
Mother's employment status, %	
Full time	32.5
Part time	17.7
Looking for work	8.4
Not in labor force	41.4
Receipt of food stamps since child's birth, %	
Yes	21.6
No	78.4
Receipt of Special Supplemental Nutrition Program for Women, Infants, and Children in past year, %	
Yes	53.9
No	46.1
Poverty index ratio, %	
<1:00	25.8
1:00–1:85	24.5
1.86–2.99	18.4
>3:00	31.3
Physical health, %	
General health rating[2]	14.1
Nutritional status, %	
Overweight (weight for length)[3]	17.8
Length for age[4]	9.0

[1] Data are means ± SD or percent; n = 8693.
[2] Defined as percentage of parents who reported toddlers to be in fair or poor health.
[3] Defined as percentage of children with a weight for length ≥95th percentile.
[4] Defined as percentage of children with a length for age <5th percentile.

TABLE 2 Standardized path coefficients for the structural equation models (Figs. 1 and 2) describing relationships among household food insecurity and toddlers' health and nutritional outcomes at 24 mo ($n = 8693$)[1]

	Physical health		Overweight (weight for length)		Length for age	
Effects of food insecurity on mediators	β	P-value[2]	β	P-value[2]	β	P-value[2]
Food insecurity → parenting	−0.077	0.04	−0.077	0.04	−0.077	0.04
Food insecurity → infant feeding practices	0.073	0.08	0.076	0.07	0.073	0.08
Food insecurity → depression	0.243	<0.001	0.243	<0.001	0.243	<0.001
Effects of mediators on mediators						
Depression → parenting	−0.017	0.30	−0.017	0.30	−0.017	0.29
Depression → infant feeding practices	−0.034	0.09	−0.035	0.08	−0.034	0.09
Parenting → infant feeding practices	0.065	0.002	0.067	0.002	0.065	0.002
Effects of mediators on outcome						
Food insecurity → outcome	0.072	0.09	0.065	0.17	−0.021	0.72
Parenting → outcome	−0.014	0.06	0.036	0.18	−0.025	0.41
Infant feeding practices → outcome	−0.042	0.31	−0.361	<0.001	−0.005	0.92
Depression → outcome	0.058	0.03	−0.025	0.29	0.053	0.14
RMSEA[3]	0.008		0.010		0.009	
CFI[4]	0.986		0.979		0.981	
TLI[5]	0.960		0.934		0.943	
WRMR[6]	0.457		0.508		0.488	

[1] Adjusted for parent characteristics, household characteristics, and child characteristics.
[2] *P < 0.05, ***P < 0.001. NS, Not significant, P > 0.05.
[3] Acceptable values <0.06.
[4] Acceptable values >0.95.
[5] Acceptable values >0.95.
[6] Acceptable values >0.90.

(RMSEA = 0.010, CFI = 0.979, TLI = 0.934, WRMR = 0.508; Table 2; **Fig. 2**).

Length for age. Food insecurity was not directly or indirectly associated with length for age, net of controls for parent characteristics, household characteristics, and child characteristics.

Discussion

The primary objective of this study was to explore whether there were associations between food insecurity and child nutritional status and physical health outcomes and if so, whether parental depression, parenting practices, and infant feeding practices mediated these associations. Our analyses supported some of the proposed hypotheses.

Overweight (weight for length). We found that the significant indirect association between food insecurity and overweight operated through parenting and infant feeding practices. Food insecurity was negatively associated with good parenting practices, which influenced infant feeding practices and consequently overweight. Prior research on overweight suggests that hunger and overweight can coexist (46). Our study illuminated the pathways through which this association exists. One pathway is through parenting practices. Prior research suggests that the coping strategies that food insecure households use to stave off hunger are likely to affect parenting practices. Our findings support recent research that indicates that adults in food insecure households are significantly more likely to exhibit less positive parenting than other adults (5,7,11). Food insecurity may be a stressor that results in inconsistent parenting. Less positive
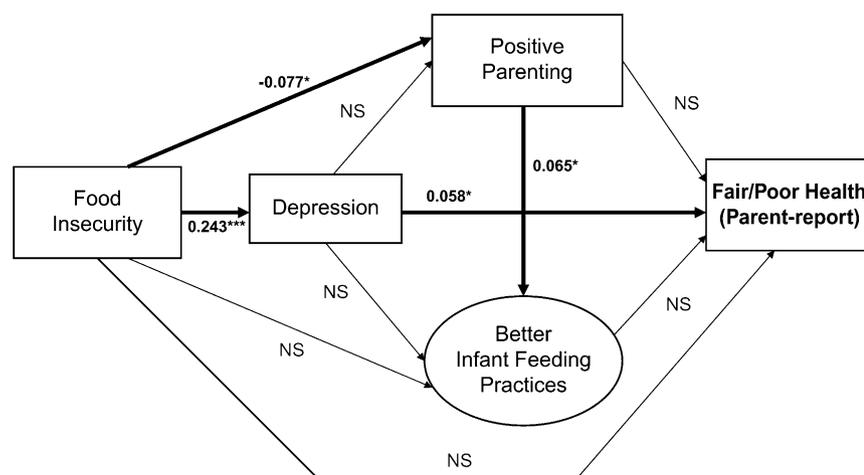
FIGURE 1 Final model with standardized path coefficients showing relationships between household food insecurity, mediators, and toddlers' physical health at 24 mo ($n = 8693$). Controlling for child gender, child age at assessment, family structure, household poverty, parent education level, maternal employment, mother's age at birth, welfare receipt, smoking in the child's home, and receipt of well-baby visits. CFI = 0.986; TLI = 0.960; WRMR = 0.457; RMSEA = 0.008. NS, Not significant, P > 0.05. *P < 0.05 ***P < 0.001.

FIGURE 2 Final model with standardized path coefficients showing relationships between household food insecurity, mediators, and toddlers' overweight status (weight for length) at 24 mo (n = 8693). Controlling for child gender, child age at assessment, family structure, household poverty, parent education level, maternal employment, mother's age at birth, welfare receipt, smoking in the child's home, and receipt of well-baby visits. CFI = 0.979; TLI = 0.934; WRMR = 0.508; RMSEA = 0.010. NS, Not significant, $P >$ 0.05. *$P < 0.05$ ***$P < 0.001$.
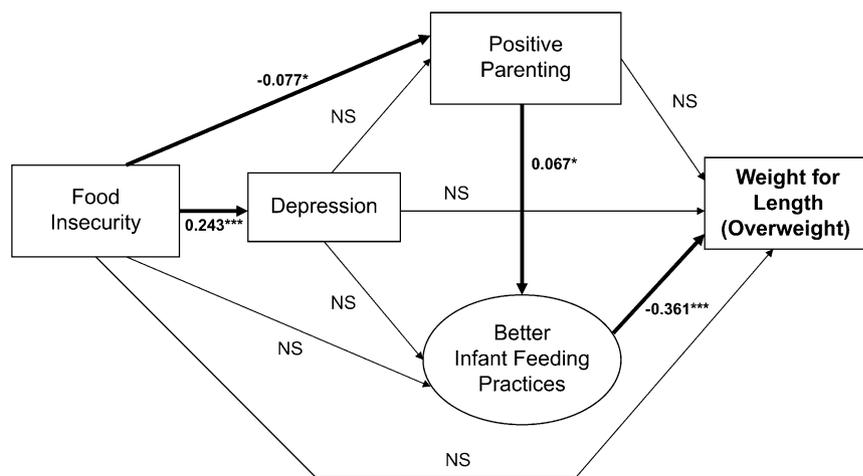
parenting is also associated with poorer infant feeding practices, in this case, the nonadherence to infant feeding recommendations involving breastfeeding and the timing of introduction of solid foods during infancy (28,29). The evidence provided here suggests that when the sufficiency and certainty of the availability and access to food is compromised, as is likely to be the case in food insecure situations, parenting practices and decisions regarding infant feeding may also be compromised. This is an association that has been commonly found in the literature, with some studies suggesting that food insufficiency and the accompanying anxiety may lead to less optimal parenting around food choices and less desirable feeding habits (15). In short, the link between food insecurity and overweight is not direct. Rather, food insecurity influences aspects of parenting and infant feeding, which ultimately influence children's overweight.

Physical health. We found that, net of controls, food insecurity did not have a direct association with poorer health. The significant indirect association between food insecurity and fair or poor health operated through depression. Food insecure homes had higher levels of parental depression, which in turn were associated with more frequent reports of fair or poor physical health among children. Our findings support recent research that indicates that adults in food insecure homes are more likely to exhibit symptoms of depression than other adults (19,20). Our findings linking food insecurity to caregiver reports of fair or poor child health were consistent with previous research that has linked food insecurity to depression and depression to poor health in very young children (47). In earlier studies, mothers who reported depressive symptoms were less likely to report that their infants were in very good or excellent health (19,48) and more likely to report fair or poor health (49). Research also supports an association between maternal depressive symptoms and infant emergency room visits and hospitalizations (49), which may indicate either poorer health among these infants or that depressed parents fail to take preventative health steps with their infants or cannot adequately perceive and respond to their children's health needs (48).

Length for age. Consistent with other research, we found that food insecurity had no associations with length for age (15,16). This may reflect that length for age is not a specific measure of the outcomes of these nonnutritional pathways and so strong effects were not found.

Limitations. Some limitations of this study should be noted. Some of the measures were not sensitive to food insecurity. The

ECLS-B lacks detailed dietary data or a household inventory of food supplies. Although our analyses used a wide variety of covariates to help eliminate alternative causal explanations, there is always the possibility that unmeasured characteristics account for these relationships. Although our pathways are derived based on suggestions from prior research, there is no guarantee that these are the primary pathways through which food insecurity influences child outcomes and there may be additional pathways. Finally, physical health status was not physician-reported and may be biased because of parent reports, especially among depressed mothers.

Future research. Future work can benefit from further examination of the presence and influence of food insecurity early in the child's life on family processes and children's development over further periods of development. The field would also benefit from research on families at high risk for food insecurity such as families with inconsistent employment.

Policy implications. Our findings show that already by age 2 y, food insecurity interferes with parent-child interactions and affects central aspects of development such as overall health and overweight. These findings underscore the importance of continuing and strengthening policy initiatives to ensure that families with infants and toddlers have sufficient, predictable, and reliable food. In particular, our research highlights the central role of parental depression, which is influenced by food insecurity and should be treated or ameliorated if compromised child outcomes are to be avoided. Such efforts can contribute to positive parenting and to children's development during the very important early years.

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