Parental Feeding Beliefs and Practices and Household Food Insecurity in Infancy

Colin J. Orr, MD, MPH; Maureen Ben-Davies, MD, MPH; Sophie N. Ravanbakht, BA; H. Shonna Yin, MD, MS; Lee M. Sanders, MD, MPH; Russell L. Rothman, MD, MPP; Alan M. Delamater, PhD; Charles T. Wood, MD, MPH; Eliana M. Perrin, MD, MPH

From the Department of Pediatrics (CJ Orr and M Ben-Davies), University of North Carolina School of Medicine, Chapel Hill, NC; Department of Pediatrics and Duke Center for Childhood Obesity Research (SN Ravanbakht, CT Wood, and EM Perrin), Duke University Medical Center, Durham, NC; Department of Pediatrics and Population Health (HS Yin), Bellevue Hospital Center, New York University School of Medicine, New York, NY; Department of Pediatrics (LM Sanders), Center for Health Policy, Stanford University, Stanford, Calif; Vanderbilt University Medical Center (RL Rothman), Nashville, Tenn; and Mailman Center for Child Development, University of Miami Miller School of Medicine (AM Delamater), Miami, Fla

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Address correspondence to Eliana M. Perrin, MD, MPH, Duke Center for Childhood Obesity Research, Department of Pediatrics, Duke University Medical Center 146 Civitan Building, 2213 Elba St, Durham, NC 27705 (e-mail: eliana.perrin@duke.edu).

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Abstract

Objective: Food insecurity is associated with childhood obesity possibly mediated through caregiver feeding practices and beliefs. We examined if caregiver feeding practices differed by household food security status in a diverse sample of infants. We hypothesized that feeding practices differ based on food security status.

Patients and methods: Included in the baseline cross-sectional analysis of data from a randomized controlled trial to prevent obesity were 842 caregivers of 2-month-old infants presenting for well-child care at 4 academic institutions. Food insecurity exposure was based on an affirmative answer to 1 of 2 items in a 2-item validated questionnaire. Chi-square tests examined the association between parent feeding practices and food security status. Logistic regression adjusted for covariates. Differences in caregiver feeding practices by food security status and race/ethnicity were explored with an interaction term (food security status x race/ethnicity).

Results: Forty-three percent of families screened as food insecure. In adjusted logistic regression, parents from food-insecure households were more likely to endorse that "the best way to make an infant stop crying is to feed him or her" (adjusted odds ratio [aOR], 1.72; 95% confidence interval [CI], 1.28−2.29) and "when my baby cries, I immediately feed him or her" (aOR, 1.40; 95% CI, 1.06−1.83). Food-insecure caregivers less frequently endorsed paying attention to their baby when he or she is full or hungry (OR, 0.57; 95% CI, 0.34−0.96). Racial/ethnic differences in beliefs and behaviors were observed by food security status.

Conclusions: During early infancy, feeding practices differed among caregivers by household food security status. Further research is needed to examine whether these practices are associated with increased risk of obesity and obesity-related morbidity.

Keywords: food insecurity; infants; obesity

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What's New

This study examines how caregivers living in households affected by food insecurity feed their infants. Several feeding practices, including the use of food to soothe, differ by food insecurity and, in some cases, by ethnicity.

Household food insecurity, defined as a household where "access to adequate food is limited by a lack of money or other resource," affects many families in the United States.[1] In 2015, 6.4 million households with children did not have reliable access to healthy foods, which affected approximately 13.1 million children, or more than 1 out of 6 children living in the United States.[2] Children raised in food-insecure households are more likely to suffer from iron-deficiency anemia,[3,4] poor school performance,[5,6] and developmental delay.[6−8] Although several studies have found that food insecurity is associated with childhood obesity,[9−11] other studies have not found this association.[12] One possible explanation for why food insecurity might contribute to obesity is that food insecurity may lead to increased consumption of poor-quality foods that tend to be less expensive yet higher in fat and sugar content.[13,14]

In addition to affecting diet quality during childhood, the influence of food insecurity on obesity may also be explained by parental feeding behaviors during childhood. For caregivers living in food-insecure households, feelings of worry and vulnerability surrounding their limited household food supply may affect not only *what* they feed their children but also *how* they feed their children. Feeding practices during childhood could play a role in

establishing feeding habits, cardiovascular health, and, potentially, weight later in adulthood.[15–17] In studies conducted among affluent, mostly white children, parental feeding practices were associated with weight for age later in adolescence and adulthood.[18–21]

Among mainly immigrant Hispanic mothers living in New York, food insecurity is associated with parental restrictive and controlling feeding behaviors of infants.[22] Food insecurity has also been associated with pressured and restrictive feeding behaviors of preschool children, as well as the use of high-energy supplements in preschool-age children.[23] In addition, despite evidence that exclusive breastfeeding is associated with decreased risk of childhood obesity,[24] few studies have compared breastfeeding practices among mothers differentially affected by food insecurity. However, further information derived from a diverse sample of caregivers is warranted to explore specific beliefs and practices surrounding infant feeding, including breastfeeding prevalence and solid food introduction,[25] among food-insecure caregivers.

Greenlight, a multisite randomized trial designed to prevent childhood obesity, has been described earlier.[26] This study surveyed parents of 2-month-old infants residing in 4 low-income communities across the United States to develop a detailed assessment of feeding behaviors at age 2 months.[27] Greenlight provided an umbrella study for the research described here which had the following aims: 1) assess the association between household food security status and caregiver feeding practices and beliefs, and 2) examine the association between household food security status and infant exposure to exclusive breastfeeding status and solid food introduction.

METHODS

STUDY POPULATION AND DATA COLLECTION

The sample included caregivers enrolled in a multisite randomized cluster trial of a previously described[26] obesity prevention intervention for infants from 2 to 24 months of age, recruited from pediatric continuity clinics based in academic teaching hospitals in 4 US cities: Nashville, Tenn; New York, NY; Miami, Fla; and Chapel Hill, NC. Interviews of caregivers were conducted in person at the clinic visit when possible or by telephone using a standardized questionnaire. For the purposes of the primary study, eligible participants were enrolled if caregivers spoke fluent English or Spanish, the child was 6 to 16 weeks of age, and the child was presenting for a 2-month well-child visit with plans to return for all well-child visits until age 2 years. Children older than 2 months were eligible for inclusion in the study as long as they were presenting for a 2-month well-child visit.

Caregivers were excluded if they were less than 18 years old or if they had significant mental or neurological illness or poor visual acuity that would limit their ability to participate in some portions of the study questionnaire. Potential subjects were also excluded if the infant was born at less than 34 weeks gestational age, if the infant had a birth weight of less than 1.5 kg, if the infant was a multiple birth, if there were provider concerns about their current weight (less than third percentile at 2-month visit), or if there were any known medical problems that might interfere with healthy weight gain. All study documents were translated into Spanish and reviewed by an advisory committee of native speakers from 4 countries in Latin America to ensure that the materials were culturally competent.[26] Informed consent was obtained from caregivers prior to the collection of information. This study was approved by the institutional review boards at all of the respective institutions.

STUDY MEASURES

EXPOSURE VARIABLE: HOUSEHOLD FOOD SECURITY

Household food insecurity was assessed using a validated 2-item screening questionnaire.[28] The items pertained to whether, over the previous 12 months, 1) caregivers worried that their food would run out before they got money to buy more, or 2) the food that they bought did not last and they had no money to get more. Caregivers were asked to report if the statements were "often true," "sometimes true," or "never true." As done in prior studies, a family was classified as food insecure if they had an affirmative response ("sometimes true" or "often true") to at least 1 of the 2 questions.[1,22,28]

OUTCOME VARIABLES: INFANT FEEDING BELIEFS AND PRACTICES

Caregivers reported on infant nutrition, specifically with regard to any breastfeeding, volume of formula fed to bottle-fed infants at each meal, and solid food introduction, by responding to the following questions: "How much formula do you usually give [your child] at each feeding?" (open-ended) and "Is [your child] eating solid foods yet or do you put any solid foods in the bottle?" (yes or no).

Caregiver feeding beliefs and practices were assessed using 15 items selected from the Infant Feeding Style Questionnaire (IFSQ), an instrument validated among a sample of low-income, black caregivers and their infants ranging in age from 3 to 20 months.[29] The IFSQ has 83 individual questions loading onto 5 feeding style model constructs: laissez-faire, pressuring/overfeeding, restrictive, indulgent, and responsive.[29] The use of individual IFSQ items has been reported previously in children under 3 months of age.[27] The items selected for the study were chosen during study design because they represent caregiver feeding behaviors and beliefs that were hypothesized to be modifiable by the planned intervention within the aims of the randomized trial.[26] This approach has been used in previously published studies.[27,30] Of the 15 items selected, 2 loaded onto the restrictive domain; 4, responsive; 6, pressuring; and 3, laissez-faire. Caregivers responded to these derived statements on a 5-point Likert scale ranging from "always" to "never" for feeding practices or "agree" to "disagree" for feeding beliefs of individual items.

COVARIATES

Caregivers also were asked to provide sociodemographic information, such as their annual household income and participation in federal food assistance programs, including the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Anthropometric data on each infant were also gathered at the clinic well-child visit by practice nurses or nursing assistants.

DATA ANALYSIS

Characteristics of the study population and features of infant nutrition and feeding practices and beliefs were described by food insecurity status using means and standard deviations for continuous variables and frequencies and proportions for categorical variables. These variables were compared using the chi-square test or the Wilcoxon rank-sum test as appropriate. The cohort included in the analyses was restricted to subjects with the food insecurity variable available.

To assess for the independent association of food insecurity status with feeding practices and beliefs we performed multivariable analysis using proportional odds logistic regression models. Separate proportional odds ordinal logistic regression models were conducted, with each feeding practice and belief being treated as an ordered response-dependent variable, to estimate the adjusted odds ratios and 95% confidence intervals of the exposure of food insecurity versus food secure (referent). We included the following list of covariates, chosen a priori, for adjustment: infant gender, number of children in the home, caregiver race/ethnicity, income, caregiver education, study site, and WIC enrollment status.

Finally, we tested for interaction between race/ethnicity and food security status and association with feeding practices and beliefs. A cross-product term between race/ethnicity and food security status (race/ethnicity x food security status) was created. The interaction was explored based on prior research that showed differences in feeding behaviors and beliefs by race and ethnicity.[27] The interaction term allows for exploration of differences in caregiver feeding behaviors by race/ethnicity and food security status; for example, do food-secure Hispanic caregivers feed their infant the same as food-insecure Hispanic caregivers? For those dependent variables that had statistically significant interaction with ethnicity, the caregiver mean score of affirmation of these statements is presented.

Statistical analyses were performed using Stata/IC 14.2 for Windows (http://www.stata.com). Two-sided P values $\leq .05$ were considered statistically significant.

RESULTS

A total of 842 parent-child dyads were included. Sociodemographic characteristics of the caregiver sample are summarized in Table 1. The majority of caregivers (96%) were mothers of the enrolled infants. The sample was racially and ethnically diverse: 28% black (non-Hispanic), 18% white, 50% Hispanic, and 4% as other. The average age of the enrolled infant was 2.3 months. A large majority of the sample (85%) was enrolled in WIC, and 32% reported a very low annual household income of less than $10,000. Overall, 377 (45%) of caregivers lived in households that met the definition of food insecurity.

In bivariate analysis, food insecurity was strongly associated with financial resources; those with a household income less than $10,000 per year had the highest prevalence of food insecurity, with 43% of such families identifying as food insecure ($P < .001$). The prevalence of food insecurity was also higher among those of Hispanic ethnicity (60%), compared to those who self-identified as black, white, or other race (25%, 12%, and 3%, respectively; $P < .001$). More food-insecure caregivers had not completed high school (37%) compared to those who were food secure (17%) (for food insecurity by education, overall $P < .001$).

Unadjusted associations between food security status and individual items from the infant feeding questionnaire are shown in Table 2. Fewer food-insecure caregivers reported exclusive breastfeeding at the time of discharge from the hospital (43% vs 35%) as shown in Table 3; however, this difference was not statistically significant. No difference was noted in volume of formula fed to infants between food-secure and food-insecure caregivers. No difference between the two groups was observed in the percent of caregivers who reported feeding their child any breast milk (54% for food secure vs 56% for food insecure).

The results of the multivariate analysis between feeding beliefs and behaviors and food insecurity are shown in Table 4. Food-insecure households had increased odds of agreeing with immediately feeding a baby when he or she cries (odds ratio [OR], 1.40; 95% confidence interval [CI], 1.06−1.83). Food-insecure households also had increased odds of believing that the best way to stop an infant from crying is by feeding (OR, 1.72; 95% CI, 1.28−2.29). Food-insecure caregivers less frequently endorsed paying attention when their baby seems to be telling them she or he is full or hungry (OR, 0.57; 95% CI, 0.34−0.96).

Finally, differential associations were found in the relationships between infant feeding practices and food insecurity by race/ethnicity (Figs. 1 and 2). Responses to the statement, "My child lets me know he or she is full," varied by race/ethnicity and food insecurity status (Fig. 1) (global P interaction = .03). The difference observed between responses given by food-secure non-Hispanic black caregivers (4.6) and food-insecure non-Hispanic black caregivers (4.4) was statistically significant ($P = .04$). The differences observed among Hispanic, non-Hispanic whites, and those who identified as "other" were not statistically significant. Responses to the statement, "The best way to make an infant stop crying is to feed him or her," varied by race/ethnicity and food security status (Fig. 2) (P for interaction = .01). The difference observed among

Table 1. Descriptive Statistics of Greenlight Cohort by Food Insecurity Status

Characteristics	Overall (N = 842)	Food Secure (n = 465)	Food Insecure (n = 377)	*P* Value
Infant age (mo), mean (SD)	2.3 (0.4)	2.33 (0.4)	2.3 (0.5)	.78*
Infant sex				.37†
Female	430 (51%)	231 (50%)	199 (53%)	
Child insurance				< .001†
Medicaid	726 (86%)	371 (79%)	355 (94%)	
Private insurance	90 (11%)	82 (17%)	8 (2%)	
None	26 (3%)	12 (3%)	14 (4%)	
Number of adults (> 18 y) in household				.02†
1	85 (10%)	39 (8%)	46 (12%)	
2	480 (57%)	284 (61%)	196 (51%)	
3 or more	277 (33%)	142 (31%)	135 (36%)	
Number of children (≤ 18 y) in household				.08†
1	335 (40%)	194 (42%)	141 (37%)	
2	254 (30%)	146 (31%)	108 (29%)	
3 or more	253 (30%)	125 (27%)	128 (34%)	
Caregiver relationship to child				.77†
Mother	806 (96%)	447 (96%)	359 (96%)	
Father	34 (4%)	18 (4%)	16 (4%)	
Caregiver ethnicity				< .001†
Hispanic	417 (50%)	194 (42%)	223 (60%)	
White, non-Hispanic	152 (18%)	106 (23%)	46 (12%)	
Black, non-Hispanic	236 (28%)	140 (30%)	96 (25%)	
Other	37 (4%)	25 (5%)	12 (3%)	
Caregiver education				< .001†
Less than high school	218 (26%)	80 (17%)	138 (37%)	
High school graduate	277 (33%)	145 (31%)	132 (35%)	
Partial college	196 (23%)	130 (28%)	66 (18%)	
College or higher	151 (18%)	110 (24%)	41 (11%)	
Household income (N = 812)				< .001†
Less than $10,000	259 (32%)	104 (23%)	155 (43%)	
$10,000–$19,999	223 (27%)	118 (26%)	105 (29%)	
$20,000–$39,999	200 (25%)	117 (26%)	83 (23%)	
$40,000 or more	130 (16%)	109 (24%)	21 (6%)	
WIC enrollment	714 (85%)	361 (78%)	353 (94%)	< .001†
Study site				.004†
Miami, Fla	141 (17%)	68 (15%)	73 (16%)	
Chapel Hill, NC	250 (30%)	161 (35%)	89 (24%)	
Nashville, Tenn	224 (27%)	113 (26%)	111 (28%)	
New York, NY	227 (27%)	123 (24%)	104 (29%)	

WIC indicates Special Supplemental Nutrition Program for Women, Infants, and Children.
*Student's *t*-test.
†Pearson's chi-square test.

Hispanic caregivers by food security status was statistically significant ($P < .001$).

There were no statistically significant differences in weight-for-length *z*-score at 2 months for the children enrolled by food insecurity status.

DISCUSSION

Our study found differences in feeding practices and beliefs between food-secure and food-insecure households. Families from food-insecure homes had increased odds of immediately feeding their child when he or she cried. Food-insecure caregivers also had increased odds of believing that the best way to stop an infant from crying is to immediately feed him or her. Food-insecure households had decreased odds of endorsing paying attention when the child seems to be telling the caregiver that he or she is hungry. No differences between food-insecure and food-secure households were observed in the odds of encouraging their child to finish their milk or formula or believing that it is important that a child finish all the milk or formula. Differences between feeding beliefs and practices based on race/ethnicity were found, in that food-insecure non-Hispanic black caregivers reported less agreement with their child letting the caregiver know when he or she is full compared to food-secure non-Hispanic black caregivers. Food-insecure Hispanic families were more likely to agree that the best way to stop an infant from crying is to feed him or her compared to food-secure Hispanic caregivers. Additionally, food-insecure Hispanic families were more likely to endorse immediately feeding their child when he or she cries relative to food-insecure non-Hispanic households.

During early infancy, children living in food-insecure homes may be exposed to infant-feeding practices that compound the negative effects of a nutritionally deprived environment, such as diluting formula.[31] Caregivers who are concerned about their family's food

Table 2. Infant Feeding Practices and Beliefs by Household Food Insecurity

Characteristics	Overall (N = 842)	Food Secure (n = 465)	Food Insecure (n = 377)	*P* Value
Restrictive				
Amount				
Behaviors				
I carefully control how much my child eats.				.09*
Never	121 (14%)	78 (17%)	43 (11%)	
Seldom or infrequently	52 (6%)	33 (7%)	19 (5%)	
Half of the time	57 (7%)	32 (7%)	25 (7%)	
Most of the time	159 (19%)	88 (19%)	71 (19%)	
Always	453 (54%)	234 (50%)	219 (58%)	
I am very careful not to feed my child too much.				0.27*
Never	101 (12%)	64 (14%)	37 (10%)	
Seldom or infrequently	50 (6%)	29 (6%)	21 (6%)	
Half of the time	43 (5%)	19 (4%)	24 (6%)	
Most of the time	142 (17%)	78 (17%)	64 (17%)	
Always	506 (60%)	275 (59%)	231 (61%)	
Responsive				
Satiety				
Behavior				
My child lets me know when he or she is full.				0.61*
Never	19 (2%)	13 (3%)	6 (2%)	
Seldom or infrequently	23 (3%)	12 (3%)	11 (3%)	
Half of the time	35 (4%)	17 (4%)	18 (5%)	
Most of the time	125 (15%)	65 (14%)	60 (16%)	
Always	640 (76%)	358 (77%)	282 (75%)	
My child lets me know when he or she is hungry.				0.54*
Never	6 (1%)	2 (0%)	4 (1%)	
Seldom or infrequently	10 (1%)	5 (1%)	5 (1%)	
Half of the time	16 (2%)	10 (2%)	6 (2%)	
Most of the time	112 (13%)	56 (12%)	56 (14%)	
Always	698 (83%)	392 (84%)	306 (81%)	
I let my child decide how much to eat.				0.74*
Never	181 (22%)	107 (23%)	74 (20%)	
Seldom or infrequently	61 (7%)	32 (7%)	29 (8%)	
Half of the time	69 (8%)	35 (8%)	34 (9%)	
Most of the time	136 (16%)	73 (16%)	63 (17%)	
Always	395 (47%)	218 (47%)	177 (47%)	
I pay attention when my baby seems to be telling me he or she is full or hungry.				0.30*
Never	2 (0%)	1 (0%)	1 (0%)	
Seldom or infrequently	2 (0%)	0 (0%)	2 (1%)	
Half of the time	13 (2%)	5 (1%)	8 (2%)	
Most of the time	64 (8%)	32 (7%)	32 (8%)	
Always	761 (90%)	427 (92%)	334 (89%)	
Pressuring				
Finishing				
Behavior				
I try to get my child to finish his or her breast milk or formula.				0.05*
Never	209 (25%)	130 (28%)	79 (21%)	
Seldom or infrequently	102 (12%)	62 (13%)	40 (11%)	
Half of the time	73 (9%)	41 (9%)	32 (8%)	
Most of the time	140 (17%)	69 (15%)	71 (19%)	
Always	318 (38%)	163 (35%)	155 (41%)	
Beliefs				
It is important for an infant to finish all of the milk in his or her bottle.				0.05
Disagree	300 (36%)	184 (40%)	116 (31%)	
Slightly disagree	99 (12%)	55 (12%)	44 (12%)	
Neutral	121 (14%)	67 (15%	54 (14%)	
Slightly agree	127 (15%)	65 (14%)	62 (17%)	
Agree	188 (23%)	90 (20%)	98 (26%)	
Soothing				
Behavior				
When my baby cries, I immediately feed him or her.				0.003*
Never	203 (24%)	131 (28%)	72 (19%)	
Seldom or infrequently	169 (20%)	96 (21%)	73 (19%)	
Half of the time	181 (22%)	103 (22%)	78 (21%)	
Most of the time	116 (14%)	58 (12%)	58 (15%)	
Always	172 (20%)	77 (17%)	95 (25%)	

(*continued*)

Table 2 (*Continued*)

Characteristics	Overall (N = 842)	Food Secure (n = 465)	Food Insecure (n = 377)	*P* Value
Belief				
The best way to make an infant stop crying is to feed him or her.				< 0.001
Disagree	447 (53%)	276 (59%)	171 (45%)	
Slightly disagree	109 (13%)	61 (13%)	48 (13%)	
Neutral	90 (11%)	46 (10%	44 (12%)	
Slightly agree	110 (13%)	50 (11%)	60 (16%)	
Agree	86 (10%)	32 (7%)	54 (14%)	
Cereal				
Behavior				
I give my baby cereal in the bottle. (N = 826)				0.92*
Never	734 (89%)	408 (89%)	326 (89%)	
Seldom or infrequently	53 (6%)	31 (7%)	22 (6%)	
Half of the time	15 (2%)	7 (2%)	8 (2%)	
Most of the time	6 (1%)	3 (1%)	3 (1%)	
Always	18 (2%)	9 (2%)	9 (2%)	
Belief				
Cereal in the bottle helps infants sleep through the night. (N = 840)				0.61*
Disagree	390 (46%)	214 (46%)	176 (47%)	
Slightly disagree	47 (6%)	26 (6%)	21 (6%)	
Neutral	212 (25%)	112 (24%)	100 (27%)	
Slightly agree	72 (9%)	46 (10%)	26 (7%)	
Agree	119 (14%)	66 (14%)	53 (14%)	
Laissez-Faire				
Attention				
Behaviors				
I watch TV while feeding.				0.51*
Never	208 (25%)	115 (25%)	93 (25%)	
Seldom or infrequently	248 (29%)	134 (29%)	114 (30%)	
Half of the time	217 (26%)	129 (28%)	88 (23%)	
Most of the time	100 (12%)	54 (12%)	46 (12%)	
Always	69 (8%)	33 (7%)	36 (10%)	
When my child has a bottle, I prop it up. (N = 817)				0.09*
Never	626 (77%)	351 (78%)	275 (76%)	
Seldom or infrequently	101 (12%)	55 (12%)	46 (13%)	
Half of the time	37 (5%)	18 (4%)	19 (5%)	
Most of the time	24 (3%)	18 (4%)	6 (2%)	
Always	29 (4%)	11 (2%)	18 (5%)	
Beliefs				
I think it is OK to prop an infant's bottle to hold it in place. (N = 840)				0.26*
Disagree	616 (73%)	349 (75%)	267 (71%)	
Slight disagree	50 (6%)	29 (6%)	21 (6%)	
Neutral	49 (6%)	27 (6%)	22 (6%)	
Slightly agree	62 (7%)	26 (6%)	36 (10%)	
Agree	63 (8%)	33 (7%)	30 (8%)	

*Pearson's chi-square test.

supply appear more likely to employ infant-feeding practices that are unique to their stressed environment. This study adds to a growing body of evidence that describes the relationship between food insecurity and feeding practices in caregivers of very young infants.[22] In one study, Hispanic mothers who were food insecure were found to have more controlling feeding styles and, thus, were more likely to pressure their infants to eat when they were not hungry.[22] Because of the geographic and ethnic diversity of our sample, our study adds to these

Table 3. Infant Feeding Behaviors at Discharge and 2 Months of Age by Household Food Security Status

Characteristics	Combined (N = 842)	Food Secure (n = 465)	Food Insecure (n = 377)	*P* Value
Infant feeding at time of hospital discharge				.05*
Breast milk only	40%	43%	35%	
Formula only	22%	22%	23%	
Both breast milk and formula	38%	35%	42%	
Infant feeding at 2 mo (% any breast milk)	55%	54%	56%	.60*
Volume of formula fed each feeding at 2 mo (oz), (SD)	4 (1.3)	4 (1.3)	3.9 (1.3)	.18†
Early solid food introduction (% yes)	6.7%	7.5%	5.8%	.33*

SD indicates standard deviation.
*Pearson's chi-square test.
†Student's *t*-test.

Table 4. Unadjusted and Adjusted Proportional Odds Ordinal Logistic Regression Odds Ratios and 95% Confidence Intervals of Infant Feeding Practices and Beliefs by Household Food Security Status

Parental Feeding Behaviors and/or Belief	Unadjusted Odds Ratio (95% Confidence Interval)*	Adjusted Odds Ratio (95% Confidence Interval)*,†
Restrictive Behaviors		
Amount		
Behaviors		
I carefully control how much my child eats.	1.41 (1.10–1.84)	1.15 (0.86–1.54)
I am very careful not to feed my child too much.	1.14 (0.87–1.49)	0.87 (0.65–1.17)
Responsive		
Satiety		
Behaviors		
My child lets me know when he or she is full.	0.90 (0.65–1.24)	0.81 (0.58–1.16)
My child lets me know when he or she is hungry.	0.81 (0.56–1.15)	0.73 (0.49–1.09)
I let my child decide how much to eat.	1.06 (0.82–1.36)	1.15 (0.87–1.52)
I pay attention when my baby seems to be telling me he or she is full or hungry.	0.68 (0.43–1.08)	0.57 (0.34–0.96)
Pressuring		
Finishing		
Behavior		
I try to get my child to finish his or her breast milk or formula.	1.4 (1.10–1.80)	1.01 (0.77–1.33)
Belief		
It is important for an infant to finish all of the milk in his or her bottle.	1.47 (1.14–1.87)	1.04 (0.80–1.38)
Soothing		
Behavior		
When my baby cries, I immediately feed him or her.	1.62 (1.27–2.07)	1.40 (1.06–1.83)
Belief		
The best way to make an infant stop crying is to feed him or her.	1.86 (1.43–2.40)	1.72 (1.28–2.29)
Cereal		
Behavior		
I give my baby cereal in the bottle.	1.06 (0.69–1.64)	1.26 (0.77–2.1)
Belief		
Cereal in the bottle helps infants sleep through the night.	0.95 (0.73–1.21)	0.97 (0.73–1.28)
Laissez-Faire		
Attention		
Belief		
I think it is OK to prop an infant's bottle to hold it in place.	1.26 (0.91–1.70)	1.4 (1.0–1.97)
Behaviors		
I watch TV while feeding.	1.02 (0.81–1.31)	1.14 (0.87–1.49)
When my child has a bottle, I prop it up.	1.12 (0.81–1.55)	1.06 (0.74–1.52

*Proportional odds ordinal logistic regression.

†Adjusted for patient sex; Special Supplemental Nutrition Program for Women, Infants, and Children status; number of children in home; caregiver race/ethnicity; caregiver education; household income; and study site.

findings an appreciation for differential expression of infant-feeding behaviors in Hispanic and non-Hispanic families, as well as an understanding of the influence of family health beliefs.

In this study, we found that food-insecure caregivers had increased odds of strongly affirming the belief that feeding is the best way to make an infant stop crying. This result suggests that caregivers affected by food insecurity may place a higher value on the ability of food to relieve any perceived discomfort regardless of hunger cues from the infant. Within the context of limited financial means to maintain a reliable source of food, these specific beliefs make intuitive sense. Another hypothesis is that the lack of a sense of control, inherent to having an unreliable source of food, may prompt caregivers to use pressuring behaviors during infant feeding. The research into using food to soothe is sparse but suggests that this behavior is related to maternal self-efficacy and maternal rating of their child's negative temperament.[19]

Although early solid food introduction is known to be associated with increased odds of obesity in childhood,[32] we did not find any evidence of a relationship between food insecurity and early solid food introduction in our study sample. Likewise, we did not find any differences in the amount of formula fed to infants who are bottle fed. These findings are notable, particularly when considering that food-insecure caregivers in this sample showed increased odds of using food to soothe.

The coping mechanisms that caregivers employ to manage the stress of food insecurity may be predicated by their sociocultural contexts. Our findings are consistent with other work that has demonstrated differences in feeding practices by race/ethnicity of infants,[27] as well as preschool-age children.[33] This study highlights the importance of understanding how a family's culture influences feeding strategies during times of food insecurity and its impact on health.

There are limitations to this study. Due to its cross-sectional design, this study cannot make any inference on the

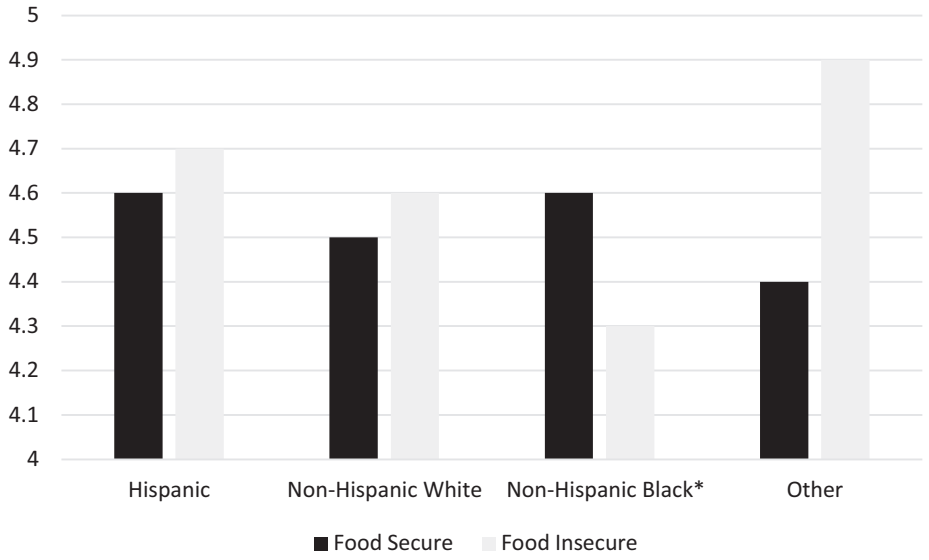

Figure 1. *Agreement with "my child lets me know when he or she is full" by race/ethnicity and food security status. *P value < 0.05.*

direct influence of these caregiver behaviors during child infancy on the incidence of heavier weight status in toddlerhood. Further, although surveys were completed under conditions of privacy, food-insecure caregivers may have been influenced by social desirability to under-report food insecurity or over-report behaviors they may perceive as positive, thus limiting the quality of data gathered. Our analysis of early food introduction is also limited because we only analyzed 2-month data. Our study does not explore the differences in caregiver feeding behaviors and beliefs by acculturation and food security; however, this would be an interesting future study. Prior work from the Greenlight study explored the association between feeding behaviors and acculturation among a Latino population.[34]

Our analytical approach carries the risk of spurious associations due to multiple testing. The questions included in this analysis were selected from a validated tool (IFSQ) based on clinical relevance and importance to the main outcome of the umbrella study; however, we did not use the entire scale or even complete subscales for specific feeding styles due to concern of respondent burden from the overall study measures. An additional study limitation is use of the IFSQ in children younger than 3 months. The use of individual IFSQ questions and in samples younger than 3 months age has been previously reported.[27]

We did not analyze caregiver perception of child temperament within the context of food insecurity for this study, so this influence requires further evaluation.

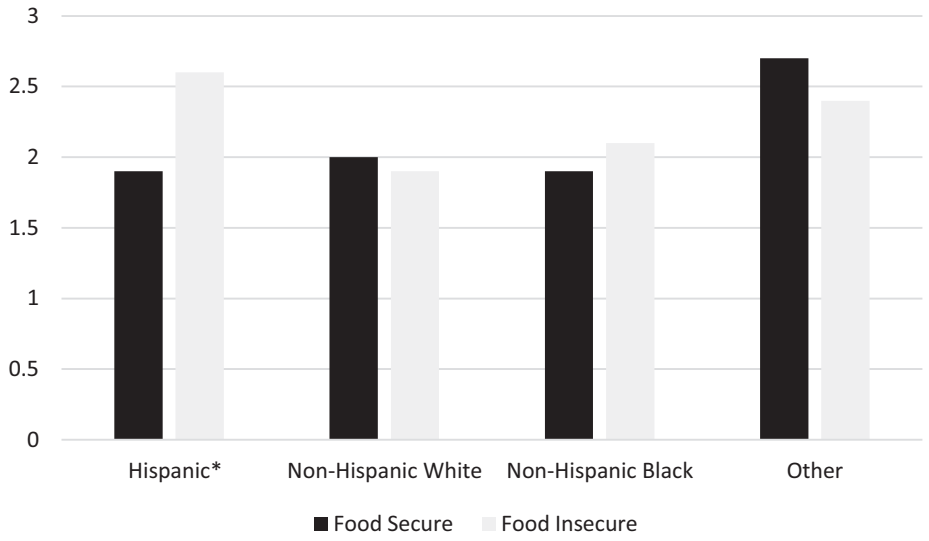

Figure 2. *Agreement with belief that the best way to stop an infant from crying is to feed him or her by race/ethnicity and food security status. *P value < 0.001.*

Finally, caregivers may have been prone to under- or over-report the exact amounts of formula consumed by their infants, instead reporting approximate amounts based on the quantity of milk that was prepared.

Although the prevalence of food insecurity has decreased since the 2008 recession, a large number of children are still affected by food insecurity.[2] More pediatricians are becoming aware of childhood food insecurity,[35] and the American Academy of Pediatrics recently issued a policy statement advocating for the promotion of food security as a modifiable social determinant of life-course health.[1] Some physicians have advocated screening for food insecurity among vulnerable populations.[28] Our findings have established a better context for providing culturally sensitive, anticipatory guidance about feeding practices to the families of infants and young children. For child advocates and public health leaders—including regional and national directors of the agencies that administer WIC and the Supplemental Nutrition Assistance Program—this understanding can help frame community-based solutions to the twin public-health problems of food insecurity and obesity.

Conclusions

During early infancy, feeding practices and beliefs differ among caregivers by household food security status. Further research is needed to examine whether these practices are associated with increased risk of obesity and obesity-related morbidity in food-insecure households. Future studies should also focus on how the impact of food insecurity on health differs by a child's race/ethnicity.

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References

1. Council on Community Pediatrics, Committee on Nutrition.. Promoting food security for all children. *Pediatrics*. 2015;136:e1431–e1438.
2. Alisha Coleman-Jensen MPR, Gregory, CA, Singh, A. Household food security in the United States in 2015. Available at: https://www.ers.usda.gov/publications/pub-details/?pubid=79760 Accessed October 1, 2018.
3. Eicher-Miller HA, Mason AC, Weaver CM, et al. Food insecurity is associated with iron deficiency anemia in US adolescents. *Am J Clin Nutr*. 2009;90:1358–1371.
4. Park K, Kersey M, Geppert J, et al. Household food insecurity is a risk factor for iron-deficiency anaemia in a multi-ethnic, low-income sample of infants and toddlers. *Public Health Nutr*. 2009;12:2120–2128.
5. Alaimo K, Olson CM, Frongillo Jr. EA. Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. *Pediatrics*. 2001;108:44–53.
6. Jyoti DF, Frongillo EA, Jones SJ. Food insecurity affects school children's academic performance, weight gain, and social skills. *J Nutr*. 2005;135:2831–2839.
7. Shankar P, Chung R, Frank DA. Association of food insecurity with children's behavioral, emotional, and academic outcomes: a systematic review. *J Dev Behav Pediatr*. 2017;38:135–150.
8. Rose-Jacobs R, Black MM, Casey PH, et al. Household food insecurity: associations with at-risk infant and toddler development. *Pediatrics*. 2008;121:65–72.
9. Casey PH, Simpson PM, Gossett JM, et al. The association of child and household food insecurity with childhood overweight status. *Pediatrics*. 2006;118:e1406–e1413.
10. Larson NI, Story MT. Food insecurity and weight status among U.S. children and families: a review of the literature. *Am J Prev Med*. 2011;40:166–173.
11. Metallinos-Katsaras E, Must A, Gorman K. A longitudinal study of food insecurity on obesity in preschool children. *J Acad Nutr Diet*. 2012;112:1949–1958.
12. Trapp CM, Burke G, Gorin AA, et al. The relationship between dietary patterns, body mass index percentile, and household food security in young urban children. *Child Obes*. 2015;11:148–155.
13. Bruening M, MacLehose R, Loth K, et al. Feeding a family in a recession: food insecurity among Minnesota parents. *Am J Public Health*. 2012;102:520–526.
14. Dietz WH. Does hunger cause obesity? *Pediatrics*. 1995;95:766–767.
15. Spruijt-Metz D, Li C, Cohen E, et al. Longitudinal influence of mother's child-feeding practices on adiposity in children. *J Pediatr*. 2006;148:314–320.
16. Saiz Jr. AM, Aul AM, Malecki KM, et al. Food insecurity and cardiovascular health: findings from a statewide population health survey in Wisconsin. *Prev Med*. 2016;93:1–6.
17. Faith MS, Heshka S, Keller KL, et al. Maternal-child feeding patterns and child body weight: findings from a population-based sample. *Arch Pediatr Adolesc Med*. 2003;157:926–932.
18. Faith MS, Scanlon KS, Birch LL, et al. Parent-child feeding strategies and their relationships to child eating and weight status. *Obes Res*. 2004;12:1711–1722.
19. Stifter CA, Anzman-Frasca S, Birch LL, et al. Parent use of food to soothe infant/toddler distress and child weight status. An exploratory study. *Appetite*. 2011;57:693–699.
20. Zhang L, McIntosh WA. Children's weight status and maternal and paternal feeding practices. *J Child Health Care*. 2011;15:389–400.
21. Murashima M, Hoerr SL, Hughes SO, et al. Maternal parenting behaviors during childhood relate to weight status and fruit and vegetable intake of college students. *J Nutr Educ Behav*. 2012;44:556–563.
22. Gross RS, Mendelsohn AL, Fierman AH, et al. Food insecurity and obesogenic maternal infant feeding styles and practices in low-income families. *Pediatrics*. 2012;130:254–261.
23. Feinberg E, Kavanagh PL, Young RL, et al. Food insecurity and compensatory feeding practices among urban black families. *Pediatrics*. 2008;122:e854–e860.
24. Wang L, Collins C, Ratliff M, et al. Breastfeeding reduces childhood obesity risks. *Child Obes*. 2017;13:197–204.
25. Sun C, Foskey RJ, Allen KJ, et al. The impact of timing of introduction of solids on infant body mass index. *J Pediatr*. 2016;179:104–110.e101.
26. Sanders LM, Perrin EM, Yin HS, et al. "Greenlight study": a controlled trial of low-literacy, early childhood obesity prevention. *Pediatrics*. 2014;133:e1724–e1737.
27. Perrin EM, Rothman RL, Sanders LM, et al. Racial and ethnic differences associated with feeding- and activity-related behaviors in infants. *Pediatrics*. 2014;133:e857–e867.
28. Hager ER, Quigg AM, Black MM, et al. Development and validity of a 2-item screen to identify families at risk for food insecurity. *Pediatrics*. 2010;126:e26–e32.
29. Thompson AL, Mendez MA, Borja JB, et al. Development and validation of the Infant Feeding Style Questionnaire. *Appetite*. 2009;53:210–221.
30. Taveras EM, Blackburn K, Gillman MW, et al. First steps for mommy and me: a pilot intervention to improve nutrition and physical activity behaviors of postpartum mothers and their infants. *Matern Child Health J*. 2011;15:1217–1227.

31. Burkhardt MC, Beck AF, Kahn RS, et al. Are our babies hungry? Food insecurity among infants in urban clinics. *Clin Pediatr (Phila)*. 2012;51:238–243.
32. Huh SY, Rifas-Shiman SL, Taveras EM, et al. Timing of solid food introduction and risk of obesity in preschool-aged children. *Pediatrics*. 2011;127:e544–e551.
33. Evans A, Seth JG, Smith S, et al. Parental feeding practices and concerns related to child underweight, picky eating, and using food to calm differ according to ethnicity/race, acculturation, and income. *Matern Child Health J*. 2011;15:899–909.
34. Dancel LD, Perrin E, Yin SH, et al. The relationship between acculturation and infant feeding styles in a Latino population. *Obesity (Silver Spring)*. 2015;23:840–846.
35. O'Malley JA, Peltier CB, Klein MD. Obese and hungry in the suburbs: the hidden faces of food insecurity. *Acad Pediatr*. 2012;12:163–165.