

# Development and Validity of a 2-Item Screen to Identify Families at Risk for Food Insecurity



**WHAT'S KNOWN ON THIS SUBJECT:** Food insecurity (FI) in the United States is a public health problem. FI among young children is often invisible, because although young children who experience FI may experience negative health and developmental outcomes, their growth is often unaffected.



**WHAT THIS STUDY ADDS:** Providers need efficient methods for identifying young children in food-insecure households to ensure that families have access to nutrition-related services that provide healthy food and alleviate caregiver stress. We present here a brief, sensitive, specific, and valid FI screen.

## abstract

**OBJECTIVES:** To develop a brief screen to identify families at risk for food insecurity (FI) and to evaluate the sensitivity, specificity, and convergent validity of the screen.

**PATIENTS AND METHODS:** Caregivers of children (age: birth through 3 years) from 7 urban medical centers completed the US Department of Agriculture 18-item Household Food Security Survey (HFSS), reports of child health, hospitalizations in their lifetime, and developmental risk. Children were weighed and measured. An FI screen was developed on the basis of affirmative HFSS responses among food-insecure families. Sensitivity and specificity were evaluated. Convergent validity (the correspondence between the FI screen and theoretically related variables) was assessed with logistic regression, adjusted for covariates including study site; the caregivers' race/ethnicity, US-born versus immigrant status, marital status, education, and employment; history of breastfeeding; child's gender; and the child's low birth weight status.

**RESULTS:** The sample included 30 098 families, 23% of which were food insecure. HFSS questions 1 and 2 were most frequently endorsed among food-insecure families (92.5% and 81.9%, respectively). An affirmative response to either question 1 or 2 had a sensitivity of 97% and specificity of 83% and was associated with increased risk of reported poor/fair child health (adjusted odds ratio [aOR]: 1.56;  $P < .001$ ), hospitalizations in their lifetime (aOR: 1.17;  $P < .001$ ), and developmental risk (aOR: 1.60;  $P < .001$ ).

**CONCLUSIONS:** A 2-item FI screen was sensitive, specific, and valid among low-income families with young children. The FI screen rapidly identifies households at risk for FI, enabling providers to target services that ameliorate the health and developmental consequences associated with FI. *Pediatrics* 2010;126:e26–e32

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### KEY WORDS

food insecurity, screening tools, nutrition, child development, hunger

### ABBREVIATIONS

FI—food insecurity  
HFSS—Household Food Security Survey  
PEDS—Parents' Evaluations of Developmental Status  
aOR—adjusted odds ratio  
CI—confidence interval

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The US Department of Agriculture has reported that 14.6% of US households in 2008 were food insecure, meaning that at some time during the year they were unable to obtain adequate food because of constrained resources.<sup>1</sup> “Adequate” refers to the quantity or quality of food for all household members to maintain an active lifestyle at all times. Among households with children, 21% were food insecure.<sup>1</sup> Black or Hispanic households with single parents, young children, and incomes below the federal poverty line are at increased risk for food insecurity (FI).<sup>2,3</sup>

Household FI is a serious public health concern, particularly for young children. Children in food-insecure households experience adverse health and development attributable to the inadequate quality and quantity of foods and to overall family stress.<sup>4</sup> Our research group (Children’s HealthWatch) found that children younger than 3 years who live in food-insecure households have 90% greater adjusted odds of being in fair/poor health (versus good/excellent), 31% greater adjusted odds of being hospitalized since birth,<sup>5</sup> and 76% greater adjusted odds of being at increased developmental risk compared with food-secure families.<sup>6</sup> Caregivers with positive depression-screen results have 2.69 times the odds of reporting FI compared with caregivers with negative depression-screen results.<sup>7</sup>

Providers need efficient methods for identifying young children in food-insecure households to ensure that families have access to nutrition-related services that provide healthy food and alleviate caregiver stress. Several questionnaires are available to identify food-insecure households. The 18-item US Household Food Security Scale (HFSS) is used by the Current Population Survey to monitor national food-security status annually.<sup>2,8,9</sup> Al-

though the HFSS is widely used, it is time-consuming to administer and has a complex scoring algorithm, which limits its use as a clinical tool. Several shortened questionnaires have been published, including the HFSS Short Form (a 6-item version with excellent sensitivity and good specificity)<sup>9,10</sup> and a recently developed single-item screen for hunger.<sup>11</sup> Although the hunger question has acceptable sensitivity and specificity for identifying families at risk for hunger (ie, the sensation caused by involuntary lack of food),<sup>11</sup> the exclusive focus on hunger may miss food-insecure families that experience stress related to uncertain access to enough food but not the physiologic sensation of hunger. Data from the Community Childhood Hunger Identification Project<sup>12,13</sup> and Children’s HealthWatch<sup>5,6</sup> suggest that negative effects of FI (“at risk for hunger”) on child health and behavior are present before reaching the threshold for hunger.<sup>14</sup>

Data collected by Children’s HealthWatch provide a unique opportunity to develop an FI screen, to test the sensitivity and specificity of the screen against the HFSS, and to test the convergent validity against negative health outcomes for caregivers and children known to be associated with FI. The purpose of this study was to develop a brief screen to identify families at risk for FI and to examine the sensitivity, specificity, and convergent validity of the screen in a multisite sample of low-income families with young children.

## PATIENTS AND METHODS

### Participants

Data were obtained from 30 098 caregivers interviewed in hospital-based settings between 1998 and 2005 as part of Children’s HealthWatch (formerly the Children’s Sentinel Nutrition Assessment Program [C-SNAP]) in

Baltimore, Maryland; Boston, Massachusetts; Little Rock, Arkansas; Los Angeles, California; Minneapolis, Minnesota; Philadelphia, Pennsylvania; and Washington, DC. Institutional review board approval was obtained from each site.

Trained interviewers surveyed caregivers who accompanied children younger than 36 months in acute/primary care clinics and hospital emergency departments during peak patient flow times. Caregivers of critically ill or injured children were not approached. Potential respondents were excluded if they did not speak English, Spanish, or (in Minneapolis only) Somali, were not knowledgeable about the child’s household, lived out of state, or did not provide informed consent. To ensure that families had low income, analyses were limited to families who were uninsured or receiving public insurance.

### Measures

All measures are part of the Children’s HealthWatch survey instrument.

### Demographics

Caregivers reported their age, race/ethnicity, country of origin, marital and employment status, level of education, and the child’s age and gender.

### Food Insecurity

The 18-item US HFSS,<sup>2,8,9</sup> which serves as the gold standard in the assessment of household food security, was used in this study. According to established procedures from the US Department of Agriculture, households are classified as food insecure if they endorse  $\geq 3$  affirmative responses to 18 total questions.<sup>2,9</sup>

### Child Health Outcomes

Caregivers reported their child’s birth weight, breastfeeding history, and number of lifetime hospitalizations (excluding birth). Caregivers rated the

child's health as excellent, good, fair, or poor, which yielded a binary variable (excellent/good versus fair/poor).<sup>15</sup> Developmental risk was measured by using the Parents' Evaluations of Developmental Status (PEDS), a 10-item screen of parents' concerns about their children's development that meets standards set by the American Academy of Pediatrics for developmental screening.<sup>16–20</sup> "Developmental risk" was defined by using published guidelines<sup>21</sup> as caregiver report of 1 or more developmentally appropriate concerns. The PEDS sample was restricted to children older than 4 months, because the sensitivity and specificity of the PEDS are better for children than for infants younger than 4 months of age.<sup>22</sup> The PEDS instrument was incorporated into the Children's HealthWatch survey instrument in 2004.

### *Child Anthropometric Measurements*

At the time of the interview, the child's weight and length were measured and recorded by using equipment and protocols standardized across Children's HealthWatch sites.<sup>6</sup> Weight-for-length and weight-for-age z scores were calculated by using the 2000 US Centers for Disease Control and Prevention age- and gender-specific reference values.<sup>23</sup> "At risk for underweight" was defined as weight for age at <5th percentile or weight for length at <10th percentile. "Overweight" was defined as weight for length at ≥95th percentile for children younger than 24 months and BMI for age at ≥85th percentile for children 24 months of age or older.

### *Caregiver Health Outcomes*

Caregivers rated their physical health as excellent, good, fair, or poor, which yielded a binary variable (excellent/good versus fair/poor).<sup>15</sup> Caregivers completed a 3-item depression screen that has a sensitivity of 100%, specific-

ity of 88%, and positive predictive value of 66% compared with the 8-item Rand screening instrument.<sup>24</sup> Respondents with 2 or more positive responses were coded as having a positive depression-screen result.<sup>24</sup>

### **FI-Screen Development**

Screen development includes consideration of sensitivity (the screen's ability to correctly identify food-insecure households), specificity (the screen's ability to correctly identify food-secure households), and convergent validity (correspondence between the screen and theoretically related variables).<sup>25–27</sup> We sought to develop an FI screen from the HFSS with 5 specific characteristics: (1) applicable to families with young children; (2) brief; (3) highly sensitive (>90%); (4) specific (>80%); and (5) valid (convergent validity). The prevalence of affirmative responses for each item on the HFSS was calculated for the total sample and for food-insecure families. Prevalence data were used to generate sensitivity and specificity tables for combinations of 1 or 2 questions with the highest prevalence of affirmative responses among food-insecure families. Convergent validity was examined by using demographic and health information on a sample of low-income families across 7 diverse US cities.

### **Statistical Analyses**

Analyses were conducted by using SAS 9.1 (SAS Institute Inc, Cary, NC).

### *Demographics and Health Outcomes*

Data were examined by using frequencies of demographic and health-related variables for children and caregivers according to FI status based on the 18-item HFSS.  $\chi^2$  analyses were conducted to determine differences in demographics and health outcomes according to FI status.

### *Sensitivity and Specificity*

A 2 × 2 table of FI status based on HFSS criteria and the FI screen was generated. Sensitivity was calculated as the number of food-insecure families correctly identified by the FI screen divided by the number of food-insecure families identified with HFSS criteria. Specificity was calculated as the number of families correctly identified by the FI screen as food secure divided by the number of food-secure families identified with HFSS criteria.

### *Convergent Validity*

Convergent validity was tested by using 2 sets of logistic regressions to examine patterns of negative health outcomes by comparing the FI screen with the HFSS. The independent variable in each set of models was FI status (measured by the FI screen or the HFSS). The dependent variables were child's health, number of hospitalizations in the child's life, child being at risk for underweight or overweight, child being at developmental risk, caregiver's health, and caregiver's positive depression-screen result. All models were adjusted for Children's HealthWatch site, caregivers' race/ethnicity, US-born versus immigrant status, marital status, education, employment, history of breastfeeding, child's gender, and low birth weight. Covariates were chosen on the basis of theoretical and bivariate associations with both FI and the outcomes.

## **RESULTS**

### **Sample**

Of 41 669 caregivers approached for recruitment, 37 805 (90.7%) were eligible to participate. Of them, 34 049 (90.1%) completed the interview. Eligibility criteria for this analysis included complete data for questions 1 and 2 of the HFSS; 88% of the completed interviews collected between June 1998

and December 2008 were included in the final analyses ( $n = 30\,098$ ).

Table 1 lists the sample according to FI status based on the HFSS; 23% were food insecure. Of the 7 Children's HealthWatch sites, Minneapolis had the highest overall prevalence of FI, followed by the Boston site. Nearly 60% of the data were collected from caregivers of a child younger than 12 months, and there was no difference in prevalence of FI status according to child's age or gender. Compared with food-secure households, a higher proportion of children in food-insecure households were breastfed. A lower proportion of caregivers in food-insecure households were younger than 21 years, born in the United States, employed, and had a high school diploma or college degree compared with caregivers in food-secure households. The majority of caregivers interviewed were black or Hispanic. A higher proportion of Hispanic caregivers compared with other ethnic groups were food insecure.

Compared with caregivers in food-secure households, caregivers in food-insecure households were more likely to report their own health as fair or poor, to have a positive depression-screen result, and to rate their child's health as fair or poor (see Table 1). In addition, children in food-insecure households were more likely to be at developmental risk and to have been hospitalized at least once since birth. Compared with children in food-secure households, fewer children in food-insecure households were at risk for underweight. No differences were found with respect to child overweight or low birth weight according to FI status.

### FI Screen

Most respondents who lived in food-insecure households answered affirmatively (often true or sometimes true

**TABLE 1** Sample Description According to FI Status (Determined by the 18-Item HFSS) ( $N = 30\,098^a$ )

	Food Secure ( $N = 23\,256$ ), %	Food Insecure ( $N = 6842$ ), %	<i>P</i>
Site of data collection			<.001
Baltimore	14.7	8.0	
Boston	27.3	24.5	
Little Rock	18.7	11.7	
Minneapolis	21.9	40.6	
Philadelphia	9.4	6.4	
Los Angeles	5.9	5.3	
Washington, DC	2.0	3.6	
Child predictor variables			
Age			.08
<4 mo	26.3	26.7	
4–12 mo	32.6	33.8	
13–24 mo	25.9	25.3	
25–36 mo	15.2	14.2	
Gender			.81
Female	46.7	46.8	
Male	53.4	53.2	
Low birth weight (<2500 g)	14.2	13.8	.41
Breastfed	50.9	66.1	<.001
Child outcome variables			
At risk for underweight <sup>b</sup>	15.3	14.0	.01
Overweight <sup>c</sup>	13.7	13.8	.80
Child health (fair/poor)	10.7	16.8	<.001
Number of lifetime hospitalizations	22.6	24.4	.002
Developmental risk <sup>d</sup>	12.4	18.0	<.001
Caregiver predictor variables			
Birth mother <21 y of age	21.7	14.5	<.001
Race/ethnicity			<.001
Asian	1.5	0.9	
Black	56.6	43.5	
Hispanic	26.0	45.4	
White	14.9	9.3	
Native American	1.0	0.9	
Born in the United States	72.2	47.6	<.001
Married/partnered	37.7	44.3	<.001
Employed	41.8	32.9	<.001
Education			<.001
Some high school	33.6	43.6	
High school graduate	41.0	36.2	
College graduate	25.4	20.2	
Caregiver outcome variables			
Caregiver health (fair/poor)	17.2	32.4	<.001
Caregiver positive depression-screen result	20.4	39.7	<.001

<sup>a</sup> Limited to families who were uninsured or receiving public insurance.

<sup>b</sup> At risk for underweight was defined as weight for age at <5th percentile or weight for height at <10th percentile.

<sup>c</sup> Overweight was defined as weight-for-length at  $\geq 95$ th percentile for children younger than 24 months and BMI for age at  $\geq 85$ th percentile for children aged 24 months or older. If length data were not available, weight for age at  $\geq 95$ th percentile was used as a proxy.

<sup>d</sup> Developmental risk was determined by the PEDS ( $\geq 1$  concern) only for children older than 4 months, and data collection began in 2004 ( $n = 10\,874$ ).

versus never true) to questions 1 and 2 of the HFSS: 92.5% and 81.9%, respectively. These questions asked (1) "Within the past 12 months we worried whether our food would run out before we got money to buy more" and (2) "Within the past 12 months the food we

bought just didn't last and we didn't have money to get more."

### Sensitivity and Specificity

Cross-tabulation tables were generated for combinations of the first 2 questions of the HFSS to examine sen-

sitivity and specificity. Four combinations were explored. An affirmative response to question 1 only or question 2 only of the HFSS provided a sensitivity of 93% or 82% and a specificity of 85% or 95%, respectively. An affirmative response to both questions 1 and 2 provided a sensitivity of 78% and specificity of 96%. An affirmative response to question 1 and/or question 2 of the HFSS provided a sensitivity of 97% and specificity of 83% (Table 2); therefore, these are the criteria that comprise the FI screen.

### Risk for Negative Health Outcomes

Adjusted logistic regression models were conducted by using both the HFSS and the FI screen (separately) to examine how FI status is related to child and caregiver health outcomes while controlling for covariates (Table 3). Compared with caregivers in food-secure households, those in food-insecure households (as measured by the FI screen) were 1.56 times more likely to report their child's health as

fair or poor (adjusted odds ratio [aOR]: 1.56 [95% confidence interval (CI): 1.44–1.68];  $P < .001$ ), 1.99 times more likely to report their own health as fair or poor (aOR: 1.99 [95% CI: 1.86–2.13];  $P < .001$ ), and 2.76 times more likely to have a positive depression-screen result (aOR: 2.76 [95% CI: 2.59–2.94];  $P < .001$ ). Compared with those in food-secure households, children from food-insecure households (as measured by the FI screen) were 1.17 times more likely to have had hospitalizations in their lifetime (aOR: 1.17 [95% CI: 1.10–1.24];  $P < .001$ ) and 1.6 times more likely to be at developmental risk (aOR: 1.60 [95% CI: 1.42–1.80];  $P < .001$ ) (see Table 3). These associations are similar to, although slightly weaker than, the corresponding associations with the 18-item HFSS,<sup>5–7</sup> which demonstrates convergent validity of the FI screen as a measure of FI. Differences in child anthropometric indices (at risk for underweight or overweight) as detected by the 18-item

HFSS or the FI screen were small and not statistically significant.

To assess whether the households identified as food insecure by the FI screen experienced risk despite classification as food secure by the 18-item HFSS, analyses were repeated among those who were classified as food secure on the basis of the 18-item HFSS ( $N = 23\,256$ ). The FI-screen results show attenuated, but statistically significant, associations with poor child and caregiver health outcomes. Caregivers classified as food insecure by the FI screen but not the 18-item HFSS were 1.26 times more likely to report their child's health as fair or poor (aOR: 1.26 [95% CI: 1.12–1.40];  $P < .001$ ), 1.41 times more likely to report their own health as fair or poor (aOR: 1.41 [95% CI: 1.28–1.56];  $P < .001$ ), and 1.88 times more likely to have a positive depression-screen result (aOR: 1.88 [95% CI: 1.72–2.06];  $P < .001$ ) compared with caregivers classified as food secure by the FI screen. Children in these households were 1.11 times more likely to have had hospitalizations in their lifetime (aOR: 1.11 [95% CI: 1.02–1.21];  $P < .001$ ) and 1.36 times more likely to be at developmental risk (aOR: 1.36 [95% CI: 1.15–1.61];  $P < .001$ ) than children identified as food secure by the FI screen in this subsample of food-secure households (see Table 4).

**TABLE 2** Cross-tabulation of Overlap Between the 18-Item HFSS and the FI Screen in Identifying Food-Insecure Households

	Identified by the HFSS, n (%)	Not Identified by the HFSS, n (%)	Total, n (%)
Identified by the FI screen	6614 (97)	3977 (17)	10 591 (35)
Not identified by the FI screen	228 (3)	19 279 (83)	19 507 (65)
Total	6842 (23)	23 256 (77)	30 098 (100)

**TABLE 3** Relation Between FI Status on the HFSS and on the 2-Item FI Screen With Child and Caregiver Health Outcomes ( $N = 30\,098$ )

	HFSS			FI Screen		
	Food Secure	Food Insecure	$P$	Food Secure	Food Insecure	$P$
		aOR (95% CI)			aOR (95% CI)	
Reported child health (fair/poor)	1.0	1.73 (1.59–1.88)	<.001	1.0	1.56 (1.44–1.68)	<.001
Number of lifetime hospitalizations	1.0	1.19 (1.11–1.28)	<.001	1.0	1.17 (1.10–1.24)	<.001
At risk for underweight	1.0	0.96 (0.88–1.05)	.36	1.0	0.94 (0.87–1.01)	.09
Overweight	1.0	1.03 (0.94–1.12)	.56	1.0	0.98 (0.91–1.06)	.59
Developmental risk <sup>a</sup>	1.0	1.72 (1.51–1.97)	<.001	1.0	1.60 (1.42–1.80)	<.001
Caregiver health (fair/poor)	1.0	2.29 (2.12–2.46)	<.001	1.0	1.99 (1.86–2.13)	<.001
Caregiver positive depression screen	1.0	3.13 (2.91–3.37)	<.001	1.0	2.76 (2.59–2.94)	<.001

Data were adjusted for site, race/ethnicity, US-born mother versus immigrant, marital status, education, child gender, caregiver employment, breastfeeding, low birth weight, and maternal age. The sample was limited to families that were uninsured or receiving public insurance.

<sup>a</sup> Developmental risk was determined by the PEDS ( $\geq 1$  concern) only for children older than 4 months, and data collection began in 2004 ( $n = 10\,874$ ).

## DISCUSSION

We used a 2-item screen to identify families of young children at risk for FI. The FI screen is brief, with high sensitivity, good specificity, and convergent validity. A sensitivity of 97% indicates that only 3% of families who experienced FI were likely to be misclassified. With this highly sensitive screen, providers can identify nearly all children who lived in food-insecure families. A specificity of 83% indicates that 17% of families who were food secure according to the HFSS were classified

**TABLE 4** Relation Between FI Status on the 2-Item FI Screen and Child and Caregiver Health Outcomes Among the Subset of Food-Secure Households on the HFSS (*N* = 23 256)

	FI Screen		
	Food Secure	Food Insecure	
		aOR (95% CI)	<i>P</i>
Reported child health (fair/poor)	1.0	1.26 (1.12–1.40)	<.001
Number of lifetime hospitalizations	1.0	1.11 (1.02–1.21)	.01
At risk for underweight	1.0	0.90 (0.81–1.00)	.05
Overweight	1.0	0.95 (0.85–1.05)	.31
Developmental risk <sup>a</sup>	1.0	1.36 (1.15–1.61)	<.001
Caregiver health (fair/poor)	1.0	1.41 (1.28–1.56)	<.001
Caregiver positive depression screen	1.0	1.88 (1.72–2.06)	<.001

Data were adjusted for site, race/ethnicity, US-born mother versus immigrant, marital status, education, child gender, caregiver employment, breastfeeding, low birth weight, and maternal age. The sample was limited to families that were uninsured or receiving public insurance.

<sup>a</sup> Developmental risk was determined by the PEDS ( $\geq 1$  concern) only for children older than 4 months, and data collection began in 2004 (*n* = 8497).

as being at risk for FI by the screener. Results of 2 analyses demonstrate that households identified as at risk for FI were at increased risk for adverse child and caregiver health outcomes compared with households identified as food secure by the FI screen. Regardless of whether analyses were conducted across the entire sample or restricted to food-secure households based on the HFSS, households identified as at risk for FI by the FI screen were at increased risk for negative child and caregiver health outcomes, which suggests that intervention, such as referral to services, is warranted.

In this sample, FI was not associated with children's anthropometry, which suggests that FI is often invisible among young children because they may not appear undernourished (or overweight) yet still experience negative health and developmental outcomes. The FI screen can be easily administered in pediatric offices, by clinicians or practitioners working with young families (ie, Department of Social Services, school systems, Supplemental Nutrition Program for Women, Infants, and Children [WIC], child care programs, etc), or by community groups to assess individual and community needs. The FI screen has important clinical implications for all practitioners who work with very

young children and families. By identifying interventions designed for families identified as at risk for FI, practitioners can help families identify resources. For example, in Baltimore, the City Health Commissioner advocated for widespread use of the FI screen and developed a Web site ([www.hungryinbaltimore.org](http://www.hungryinbaltimore.org)) that identifies resources including food banks, food pantries, social services, and federally funded nutrition programs such as the Special Nutrition Assessment Program (SNAP), formerly the Food Stamp Program, and WIC. In addition, the Minnesota Department of Health Family Home Visiting Program has incorporated the FI screen into their protocol along with referrals to financial and food resources.

The FI screen is an efficient and valid way to identify families at risk for FI. For a more comprehensive assessment of FI, the 18-item HFSS should be administered.

There were limitations to this study. First, although the method used for identifying items to be included in the FI screen was systematic and met the set criteria of this study, it was not as precise as methods used in traditional item-response theory, a scientific approach often used to create shortened versions of large questionnaires. Sec-

ond, the data used in these analyses included a large, multisite, clinical sample of exclusively urban, low-income families of very young children. Although there is a strong link between poverty and FI, the validity of the FI screen has not been tested in a population of varying socioeconomic status, in rural populations, or in families without young children. Further investigations of the FI screen should be conducted in these populations. Third, participants responded to these questions as part of a larger questionnaire delivered by an interviewer with the assurance that their responses would be confidential and not influence their medical care. It is not known to what extent responses might have differed if the questions were administered in the context of a clinical interview by a health care practitioner. Additional testing of the screen in clinical settings is warranted. Finally, as with any self-report measure, families could have intentionally misrepresented themselves and incorrectly reported FI. However, the sensitivity, specificity, and convergent validity demonstrated suggest increased vulnerability among children at risk for FI. To guard against misrepresentation, providers should incorporate the FI screen into other clinical assessments.

## CONCLUSIONS

A 2-item FI screen for identifying families at risk for FI was developed and demonstrated sensitivity, specificity, and convergent validity. The FI screen quickly identifies households with young children at risk for FI, which enables providers to target services to ameliorate the health and developmental consequences associated with FI.

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