

# Development and Validation of an Abbreviated Child and Adult Food Security Scale for Use in Clinical and Research Settings in the United States



Ana Poblacion, PhD, MSc; Stephanie Ettinger de Cuba, PhD, MPH; Deborah A. Frank, MD; Georgiana Esteves, MPH; Lindsey J. Rateau, MPH; Timothy C. Heeren, PhD; Sharon Coleman, MSPT, MPH; Maureen M. Black, PhD; Diana B. Cutts, MD; Félice Lê-Scherban, PhD, MPH; Eduardo R. Ochoa, Jr, MD, FAAP; Megan Sandel, MD, MPH; Richard Sheward, MPP; John Cook, PhD, MAEd

## ARTICLE INFORMATION

### Article history:

Submitted 29 August 2022  
Accepted 6 February 2023

### Keywords:

Food security  
Psychometric scale  
Hunger  
Health policy  
COVID-19

### Supplementary materials:

Figure 2 and Tables 1, 2, and 3 are available at [www.jandonline.org](http://www.jandonline.org)

2212-2672/© 2023 by the Academy of Nutrition and Dietetics. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).  
<https://doi.org/10.1016/j.jand.2023.02.004>

## ABSTRACT

**Background** Food insecurity (FI) prevalence was consistently >10% over the past 20 years, indicating chronic economic hardship. Recession periods exacerbate already high prevalence of FI, reflecting acute economic hardship. To monitor FI and respond quickly to changes in prevalence, an abbreviated food security scale measuring presence and severity of household FI in adults and children is needed.

**Objective** Our aim was to develop an abbreviated, sensitive, specific, and valid food security scale to identify severity levels of FI in households with children.

**Design** Cross-sectional and longitudinal survey data were analyzed for years 1998 to 2022.

**Participants/setting** Participants were racially diverse primary caregivers of 69,040 index children younger than 4 years accessing health care in 5 US cities.

**Statistical analyses performed** Sensitivity, specificity, positive and negative predictive values, accuracy, and area under the receiver operator curve were used to test combinations of questions for the most effective abbreviated scale to assess levels of severity of adult and child FI compared with the Household Food Security Survey Module. Adjusted logistic regression models assessed convergent validity between the Abbreviated Child and Adult Food Security Scale (ACAFSS) and health measures. McNemar tests examined the ACAFSS performance in times of acute economic hardship.

**Results** The ACAFSS exhibited 91.2% sensitivity; 99.6% specificity; 98.3% and 97.6% positive and negative predictive values, respectively; 97.7% accuracy; and a 99.6% area under the receiver operator curve, while showing high convergent validity.

**Conclusions** The ACAFSS is highly sensitive, specific, and valid for detecting severity levels of FI among racially diverse households with children. The ACAFSS is recommended as a stand-alone scale or a follow-up scale after households with children screen positive for FI risk. The ACAFSS is also recommended for planning interventions and evaluating their effects not only on the binary categories of food security and FI, but also on changes in levels of severity, especially when rapid decision making is crucial. *J Acad Nutr Diet.* 2023;123(10S):S89-S102.

FOOD INSECURITY (FI) IS A MAJOR PUBLIC HEALTH issue in the United States. FI, identified as a household-level social and economic condition involving lack of consistent access to enough healthful food for an active healthy life,<sup>1</sup> negatively impacts cognitive function and physical and behavioral health of adults and children.<sup>2-4</sup> FI aggravates almost any co-occurring adverse

health condition,<sup>5-8</sup> disproportionately burdening families with low socioeconomic status and families of color.

During the past 20 years, national household FI prevalence—encompassing both low and very low food security—has been consistently >10%, and very low food security alone persists at >3%.<sup>9</sup> This reveals a national state of chronic economic hardship, in which an inequitable economic system perpetuates high poverty and FI rates, in turn, harming child and adult health and well-being.<sup>10</sup>

In 2020, during the COVID-19 pandemic, national FI prevalence remained unchanged overall (10.5%) compared with

## Statement of Potential Conflict of Interest

See page S102.

the previous year. However, looking more closely, the 2020 prevalence was statistically significantly higher than the national average among households with children (14.8%), headed by single women (27.7%), with respondents who self-identified as non-Hispanic Black (21.7%) or Hispanic (17.2%), and with incomes <185% of the poverty threshold (28.6%).<sup>11</sup> This is consistent with a state of acute economic hardship, in which severe disturbances of the already fragile economic stability among marginalized communities exacerbate rates of poverty and FI. Moreover, recent evidence indicates high likelihood of worsening periods of FI attributable to continued escalation of acute disruptions by global climate-change patterns,<sup>12</sup> with greater frequency of extreme weather events, disruption of agricultural production, and zoonotic transmission of potential pandemic viruses.<sup>13,14</sup> All of these imply high likelihood of increasing economic stress with attendant social and political unrest, poverty, and FI.<sup>15-18</sup>

Historically, to monitor household FI prevalence, the US Census Bureau has collected annual survey data using the US Household Food Security Survey Module (HFSSM).<sup>11</sup> Although the combination of adult and child scales comprising the 18-item HFSSM is the best available food security measure under chronic economic hardship, a need exists for shorter measures that are more flexible and adaptable to rapidly changing circumstances in which time, financial constraints, and respondent burden preclude the use of all 18 HFSSM items.

Since the HFSSM's development in the 1990s, with its full format using 10- or 18-item scales, depending on presence of children in a household, shorter scales have been successfully validated. These include the adult-only 6-item short form of the HFSSM,<sup>19,20</sup> the Hunger Vital Sign, a 2-item binary household-level FI risk screening tool,<sup>21-23</sup> and the 9-item Self-Administered Food Security Survey Module for children 12 years and older.<sup>24</sup> Despite successfully identifying households with, without, or at risk of FI, these shorter measures do not identify levels of severity of FI in households with children.<sup>9</sup> To monitor FI and quickly respond to changes not only in prevalence but severity, an abbreviated scale that can measure the presence of household FI and its levels of severity in both adults and children during times of chronic or acute economic hardship is needed.

The purpose of this study was to develop a shorter, sensitive, specific, and valid food security scale, based on items from the established HFSSM, that can identify presence and levels of severity of FI in households with children among diverse families with young children living through times of chronic and acute economic hardships, and to test the novel abbreviated scale with theoretically and empirically related child and adult health variables.

## METHODS

This novel measure was named the "Abbreviated Child and Adult Food Security Scale" (ACAFSS). To validate this scale, the following 4 aims were accomplished in this study: validation of the ACAFSS using Children's HealthWatch Cross-Sectional Study (CHW-CSS) data; test the validity of the ACAFSS with theoretically and empirically related child and adult health variables using data from the same CHW-CSS sample; test the ACAFSS within groups varying by demographic characteristics using CHW-CSS sample data; and test the ability of the

## RESEARCH SNAPSHOT

**Research Question:** Does the Abbreviated Child and Adult Food Security Scale (ACAFSS) capture severity of child and adult food insecurity as effectively as the 18-item US Household Food Security Survey Module (HFSSM)?

**Key Findings:** Using Children's HealthWatch cross-sectional and longitudinal survey data from more than 69,000 households with at least 1 child younger than 4 years, the ACAFSS was successfully validated against the HFSSM. The ACAFSS exhibited 91.2% sensitivity; 99.6% specificity; 98.3% and 97.6% positive and negative predictive values, respectively; 97.7% accuracy; and a 99.6% area under the receiver operator curve relative to the HFSSM. The ACAFSS also showed high convergent validity for caregiver and child physical and mental health outcomes compared with the HFSSM.

ACAFSS to detect change in levels of severity of FI in times of acute economic hardship. To accomplish aim 4, this study used CHW-CSS data to form a longitudinal dataset using 2 CHW-CSS interviews within the same household before, during, and after the 2008 Great Recession. Eligibility criteria and sample selection are described below for each study (Figure 1). This article describes the validation process of the final version of the ACAFSS, and Figure 2 (available at [www.jandonline.org](http://www.jandonline.org)) and Tables 1, 2, and 3 (available at [www.jandonline.org](http://www.jandonline.org)) detail its preliminary steps. Analyses were conducted using SAS, version 9.4.<sup>25</sup>

### Aim 1. ACAFSS Validation in Times of Chronic Economic Hardship: Cross-Sectional Study

Twenty-two years of data (June 1998 to March 2020) were obtained from the main ongoing multiracial, repeat cross-sectional sentinel study (CHW-CSS) that monitors the health, well-being, and food security of young children and their families seeking care in medical centers in 5 cities across the United States (Baltimore, MD; Boston, MA; Little Rock, AR; Minneapolis, MN; and Philadelphia, PA). Caregivers of index children younger than 4 years were interviewed if fluent in English, Spanish, or Somali (Minneapolis only) and knowledgeable about the child's health and household situation. Caregivers of critically ill and/or injured children or those interviewed within the previous 6 months were not approached. Before data collection began, each site obtained Institutional Review Board approval, renewed annually. All respondents consented to participate in the study. A final sample of 69,040 surveys was used to validate the ACAFSS against the HFSSM during times of chronic economic hardship.

The CHW-CSS collects data on food security using the 18-item HFSSM,<sup>11</sup> the established measure for all validation analyses in this research. The HFSSM is based on a set of questions that reflect conditions and behaviors related to lack of access to food due to financial constraints during the 12 months before the interview. In households with children, the HFSSM includes 3 questions about the household's food conditions overall, 7 questions about food conditions among adults in the household, and 8 questions about children's

**Process of Analysis – Abbreviated Child and Adult Food Security Scale (ACAFSS)**

<p><b>Established scale - HFSSM</b> 10-item household food security module &amp; 8-item child food security module</p>	<p><b>New Scale 9 items - ACAFSS_prelim</b> HFSSM 6-item household short form &amp; 3-item child food security module (Q.14, Q.16 and Q.17) Supplementary Figure and Tables</p>	<p><b>New Scale 8 items - ACAFSS</b> HFSSM 6-item household short form &amp; 2-item child food security module (Q.12, and Q.15)</p>
--	---	---

Aim 1	Aim 2	Aim 3	Aim 4
Validate the ACAFSS compared to HFSSM in times of chronic economic hardship	Test the ACAFSS with theoretically and empirically related child and adult health variables	Test the ACAFSS within groups varying by demographic characteristics	Test ACAFSS' ability to detect change in levels of severity of food insecurity in times of acute economic hardship
Dataset: CHW-CSS <sup>a</sup>	Dataset: CHW-CSS <sup>a</sup>	Dataset: CHW-CSS <sup>a</sup>	Datasets: CHW-COVID <sup>b</sup> and CHW-GtRecess <sup>c</sup>

**Validation during times of chronic economic hardships – Cross-Sectional Dataset**

<sup>a</sup> <b>Children's HealthWatch Cross-sectional Study (CHW-CSS)</b>		
<ul style="list-style-type: none"> <li>• June 1998 – March 2020</li> <li>• Sample: 69,040 surveys</li> </ul>		
<b>Aim 1</b>		
Validation: <ul style="list-style-type: none"> <li>• Sensitivity</li> <li>• Specificity</li> <li>• Positive Predictive Value</li> </ul>	<ul style="list-style-type: none"> <li>• Negative Predictive Value</li> <li>• Accuracy</li> <li>• Area Under de Receiver Operator Curve</li> </ul>	
<b>Aim 2</b>		
Child Variables: <ul style="list-style-type: none"> <li>• Child history of hospitalizations (ever, never)</li> <li>• Health Status (excellent/good, fair/poor)</li> <li>• Developmental Risk (no concerns, 1+ concerns)</li> </ul>	Caregiver Variables: <ul style="list-style-type: none"> <li>• Health Status (excellent/good, fair/poor)</li> <li>• Risk for Depressive Symptoms (yes, no)</li> </ul>	
Control Variables: Caregivers age, race/ethnicity, nativity, marital status, employment status, education level. Child's age, sex assigned at birth, health insurance status, birth weight, breastfeeding.		
<b>Aim 3</b>		
Race/Ethnicity: <ul style="list-style-type: none"> <li>• Hispanic</li> <li>• Black, non-Hispanic</li> <li>• White non-Hispanic</li> <li>• Other non-Hispanic</li> </ul>	Nativity: <ul style="list-style-type: none"> <li>• US-born</li> <li>• Immigrant</li> </ul>	Age Range of Index Child in Household: <ul style="list-style-type: none"> <li>• 0-12 months</li> <li>• 13-24 months</li> <li>• 25-36 months</li> <li>• 37-48 months</li> </ul>

**Validation during times of acute economic hardships – Two Longitudinal Datasets**

<b>Aim 4</b>		
<sup>b</sup> <b>Children's HealthWatch COVID-19 Follow-Up Study (CHW-COVID) - Appendix</b>		
<ul style="list-style-type: none"> <li>• Linked longitudinal dataset prospectively collected: <ul style="list-style-type: none"> <li>○ January 2018 - March 2020 (pre-COVID)</li> <li>○ September 2021 - March 2022 (during COVID)</li> </ul> </li> <li>• Sample: 597 surveys</li> </ul>		
<sup>c</sup> <b>Children's HealthWatch 2008 Great Recession (CHW-GtRecess)</b>		
<ul style="list-style-type: none"> <li>• Longitudinal subset of CHW-CCS revisited retrospectively: <ul style="list-style-type: none"> <li>○ January 2005 - December 2007 (pre-Recession)</li> <li>○ January 2008 - January 2016 (during/after Great Recession)</li> </ul> </li> <li>• Sample: 767 surveys</li> </ul>		

**Figure 1.** Analysis Process of the Abbreviated Child and Adult Food Security Scale (ACAFSS).

Questions Used To Assess the Food Security Status of Households with Children Using the Abbreviated Child and Adult Food Security Scale (ACAFSS)
1. "The food that we bought just didn't last, and we didn't have money to get more." Was that often, sometimes, or never true for you in the last 12 months?
"La comida que (compré / compramos) no rindió lo suficiente, y (no tenía / no teníamos) dinero para comprar más." (Para Ud. / En su hogar), ¿ésto ocurrió frecuentemente, a veces, o nunca en los últimos 12 meses?
2. "We couldn't afford to eat balanced meals." Was that often, sometimes, or never true for you in the last 12 months?
"(No tenía / No teníamos) recursos suficientes para comer comida variada y nutritiva." (Para Ud. / En su hogar), ¿ésto ocurrió frecuentemente, a veces, o nunca en los últimos 12 meses?
3. In the last 12 months, did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food? (Yes/No)
En los últimos 12 meses, ¿(Ud. / Ud. u otro adulto del hogar) redujo alguna vez la cantidad de sus comidas o dejó de desayunar, almorzar o cenar porque le faltaba dinero para alimentos? (Sí/No)
4. (If <u>yes</u> to question 3) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
(Si <u>sí</u> a la pregunta 3) ¿Con qué frecuencia sucedió esto? Casi todos los meses, algunos meses pero no todos, o solamente en 1 ó 2 meses?
5. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food? (Yes/No)
En los últimos 12 meses, ¿comió Ud. alguna vez menos de lo que pensaba que debía comer porque le faltaba dinero para alimentos? (Sí/No)
6. In the last 12 months, were you ever hungry, but didn't eat, because there wasn't enough money for food? (Yes/No)
En los últimos 12 meses, ¿Tuvo Ud. hambre alguna vez pero no comió porque le faltaba dinero para alimentos? (Sí/No)
(Questions 7 and 8 assess food security status of children in the household)
7. "We couldn't feed our children a balanced meal, because we couldn't afford that." Was that often, sometimes, or never true for you in the last 12 months?
"No (pude / pudimos) alimentar a los niños o jóvenes del hogar con comida variada y nutritiva porque nos faltaba dinero para alimentos." En su hogar, ¿ésto ocurrió frecuentemente, a veces, o nunca en los últimos 12 meses?
8. In the last 12 months, were the children ever hungry but you just couldn't afford more food? (Yes/No)
En los últimos 12 meses, ¿alguna vez algun niño o joven del hogar dejó de desayunar, almorzar o cenar por falta de dinero para alimentos? (Sí/No)
<b>ACAFSS Coding of Responses</b>
Questions 1, 2, and 7 are coded as affirmative (i.e., possibly indicating food insecurity) if the response is "often" or "sometimes." Question 4 is coded as affirmative if the response is "almost every month" or "some months but not every month." Questions 3, 5, 6, and 8 are coded as affirmative if the response is "yes."
<b>Assessing Food Security Status in Households with Children Aged 0–17 using the ACAFSS</b>
Households with children are classified as food insecure if two or more affirmative answers are given in response to the entire set of 8 questions. Households are classified as having very low food security if five or more affirmative answers are given in response to the entire set of 8 questions.
The food security status of children in the household is assessed by responses to the child-referenced items (questions 7 and 8). Households reporting one of these conditions are classified as having food insecurity among children. Households reporting two conditions are classified as having very low food security among children.

**Figure 3.** Abbreviated Child and Adult Food Security Scale (ACAFSS) questions used to assess food security status of households with children. English and Spanish versions.

**Table 4.** Psychometric analyses to validate the ACAFSS<sup>a</sup> relative to the Household Food Security Survey Module: Cross-sectional data from 1998 to 2020 (n<sup>b</sup> = 69,040)

Variable	FI <sup>c</sup> ACAFSS (8-item scale)	VLFS <sup>d</sup> ACAFSS (8-item scale)	Child FI <sup>e</sup> ACAFSS (2-item child subscale)
	← estimate (95% CI) →		
Sensitivity	91.2 (90.7-91.6)	93.2 (92.4-93.9)	94.9 (94.4-95.4)
Specificity	99.6 (99.5-99.6)	98.5 (98.4-98.6)	99.1 (99.0-99.2)
Positive predictive value	98.3 (98.1-98.5)	81.4 (80.3-82.4)	92.9 (92.3-93.5)
Negative predictive value	97.6 (97.5-97.7)	99.5 (99.5-99.6)	99.4 (99.3-99.4)
Accuracy	97.7 (97.6-97.9)	98.2 (98.0-98.3)	98.7 (98.6-98.7)
Area under the receiver operator curve	99.6 (99.6-99.6)	99.6 (99.6-99.6)	97.1 (96.8-97.3)

<sup>a</sup>ACAFSS = Abbreviated Child and Adult Food Security Scale.

<sup>b</sup>n = number of households.

<sup>c</sup>FI = food insecurity.

<sup>d</sup>VLFS = very low food security.

<sup>e</sup>Child FI = food insecurity among children.

food conditions, totaling 18 questions. The HFSSM was completed by the child's primary caregiver. The number of affirmative responses to the HFSSM determines the food security status of a household. Following standard methods for coding responses,<sup>26</sup> households were classified as food secure if caregivers reported 0, 1, or 2 food insecure conditions. Households were classified as food insecure if caregivers reported 3 or more food insecure conditions. Food insecure households were further classified as having low food security if caregivers affirmed between 3 and 7 conditions; or very low food security if they reported 8 or more food insecure conditions.

In addition, based on the 8 child-referenced questions, households were classified as having FI among children or food insecure children if caregivers reported 2 or more food insecure conditions among the children. Households were further classified as having low food security among children if caregivers reported 2 to 4 conditions or having very low food security among children if 5 or more food insecure conditions among the children were affirmed.

To compose the ACAFSS, the widely used 6-Item Adult Short Form of the HFSSM<sup>20</sup> was combined with 2 questions from the child module of the HFSSM: Question 12: "We couldn't feed our children a balanced meal, because we couldn't afford that.

Was that often, sometimes, or never true for you in the last 12 months?" Question 15: "In the last 12 months, were the children ever hungry but you just couldn't afford more food? (yes/no)"—yielding the 8-item ACAFSS measure.

The ACAFSS followed the same standard methodology as the HFSSM coding of responses, that is, responses of "often," "sometimes," "yes," "almost every month," and "some months but not every month" were coded as affirmative (yes). Food security status was determined by the sum of affirmative responses to the ACAFSS in the past 12 months. Households were classified as food secure if caregivers reported 0 or 1 food insecure conditions among the ACAFSS full set of 8 questions. Households were classified as food insecure if caregivers reported 2 or more conditions. Food insecure households were further classified as having either low food security (2 to 4 conditions) or very low food security (5 or more conditions). In addition, food security status of children in the household was assessed by responses to the 2 child-referenced questions. Households were classified as having FI among children or a child FI if caregivers reported 1 or both food insecure conditions among the children. Households were further classified as having low food security among children (1 condition) or very low food security among children (2 conditions).

**Table 5.** Contingency table of the HFSSM<sup>a</sup> cross-tabulated with the revised version of the ACAFSS<sup>b</sup>: Cross-sectional data from 1998 to 2020 (n<sup>c</sup> = 69,040)

ACAFSS	HFSSM		
	Identified by the HFSSM	Not identified by the HFSSM	Total
	← n (%) →		
Identified by the ACAFSS	13,670 (91.2)	233 (0.4)	13,903 (20.1)
Not identified by the ACAFSS	1,319 (8.8)	53,818 (99.6)	55,137 (79.9)
Total	14,989 (21.7)	54,051 (78.3)	69,040 (100.0)

<sup>a</sup>HFSSM = Household Food Security Survey Module.

<sup>b</sup>ACAFSS = Abbreviated Child and Adult Food Security Scale.

<sup>c</sup>n = number of households.

**Table 6.** Description of demographic and biological characteristics by food security status in households with children using the HFSSM<sup>a</sup> and the revised version of the ACAFSS<sup>b</sup>: Cross-sectional data from 1998 to 2020 (n<sup>c</sup> = 69,040)

Variable	Total	HFSSM			P value	ACAFSS			P value
		Food secure	Low food security	Very low food security		Food secure	Low food security	Very low food security	
<b>Total</b>		← n (%) →				← n (%) →			
	69,040 (100)	54,051 (78.3)	10,471 (15.2)	4,518 (6.5)		55,137 (79.9)	8,730 (12.6)	5,173 (7.5)	
		← mean ± SD →				← mean ± SD →			
<b>Caregiver</b>									
Age, y	27 ± 6	27 ± 6	28 ± 6	28 ± 6	<.001	27 ± 6	28 ± 6	28 ± 6	<.001
		← n (%) →				← n (%) →			
Race/ethnicity					<.001				<.001
Hispanic	18,840 (27.5)	13,156 (24.6)	4,287 (41.2)	1,397 (31.2)		13,477 (24.7)	3,767 (43.5)	1,596 (31.1)	
Black non-Hispanic	34,446 (50.3)	27,798 (51.9)	4,496 (43.2)	2,152 (48.1)		28,395 (52.0)	3,621 (41.8)	2,430 (47.4)	
White non-Hispanic	12,582 (18.4)	10,583 (19.8)	1,280 (12.3)	719 (16.1)		10,693 (19.6)	1,012 (11.7)	877 (17.1)	
Other non-Hispanic	2,580 (3.8)	2,041 (3.8)	333 (3.2)	206 (4.6)		2,088 (3.8)	266 (3.1)	226 (4.4)	
Nativity					<.001				<.001
US-born	51,727 (75.2)	42,352 (78.6)	6,255 (59.9)	3,120 (69.1)		43,162 (78.6)	4,981 (57.2)	3,584 (69.3)	
Immigrant	17,092 (24.8)	11,506 (21.4)	4,192 (40.1)	1,394 (30.9)		11,776 (21.4)	3,732 (42.8)	1,584 (30.7)	
Health status					<.001				<.001
Excellent/good	50,255 (79.0)	40,967 (82.6)	6,809 (69.5)	2,479 (58.2)		41,640 (82.3)	5,726 (70.0)	2,889 (59.1)	
Fair/poor	13,386 (21.0)	8,612 (17.4)	2,992 (30.5)	1,782 (41.8)		8,935 (17.7)	2,451 (30.0)	2,000 (40.9)	
Depressive symptoms					<.001				<.001
Negative screen	48,380 (77.6)	39,928 (82.3)	6,469 (67.2)	1,983 (47.3)		40,555 (82.0)	5,426 (67.7)	2,399 (49.9)	
Positive screen	13,941 (22.4)	8,576 (17.7)	3,156 (32.8)	2,209 (52.7)		8,929 (18.0)	2,599 (32.4)	2,413 (50.1)	
Marital status					<.001				<.001
Single	34,861 (50.6)	27,574 (51.2)	4,871 (46.6)	2,416 (53.6)		28,199 (51.3)	4,012 (46.1)	2,650 (51.4)	
Partnered	26,800 (38.9)	21,058 (39.1)	4,200 (40.2)	1,542 (34.2)		21,405 (38.9)	3,538 (40.6)	1,857 (36.0)	
Without a partner	7,199 (10.5)	5,276 (9.8)	1,376 (13.2)	547 (12.1)		5,386 (9.8)	1,160 (13.3)	653 (12.7)	
Employment status					<.001				<.001
Employed	32,374 (47.0)	26,524 (49.2)	4,221 (40.4)	1,629 (36.1)		27,019 (49.1)	3,438 (39.5)	1,917 (37.1)	
Not employed	36,514 (53.0)	27,413 (50.8)	5,220 (59.6)	2,881 (63.9)		28,000 (50.9)	5,267 (60.5)	3,247 (62.9)	

(continued on next page)

**Table 6.** Description of demographic and biological characteristics by food security status in households with children using the HFSSM<sup>a</sup> and the revised version of the ACAFSS<sup>b</sup>: Cross-sectional data from 1998 to 2020 (n<sup>c</sup> = 69,040) (continued)

Variable	Total	HFSSM			P value	ACAFSS			P value
		Food secure	Low food security	Very low food security		Food secure	Low food security	Very low food security	
Educational level					<.001				<.001
≤ Some high school	17,408 (25.3)	12,561 (23.3)	3,443 (33.0)	1,404 (31.2)		12,888 (23.5)	2,945 (33.9)	1,575 (30.6)	
High school graduate	26,603 (38.7)	21,058 (39.1)	3,950 (37.9)	1,595 (35.5)		21,478 (39.1)	3,318 (38.2)	1,807 (35.1)	
≥ Tech school/college	24,766 (36.0)	20,245 (37.6)	3,027 (29.0)	1,494 (33.3)		20,577 (37.5)	2,426 (27.9)	1,763 (34.3)	
<b>Index child</b>									
		← mean ± SD →				← mean ± SD →			
Age, mo	17.2 ± 12.4	16.9 ± 12.3	18.0 ± 12.7	18.3 ± 12.8	<.001	17.2 ± 12.3	16.9 ± 12.8	18.0 ± 12.8	<.001
		← n (%) →				← n (%) →			
Sex assigned at birth					.177				.182
Female	32,178 (46.6)	25,261 (46.7)	4,870 (46.5)	2,047 (45.3)		25,795 (46.8)	4,011 (45.9)	2,372 (45.9)	
Male	36,862 (53.4)	28,790 (53.3)	5,601 (53.5)	2,471 (54.7)		29,342 (53.2)	4,719 (54.1)	2,801 (54.1)	
Health Insurance status					<.001				<.001
Public	58,420 (85.0)	44,856 (83.3)	9,456 (90.6)	4,108 (91.4)		45,825 (83.5)	7,901 (90.8)	4,694 (91.1)	
Private	2,850 (4.1)	2,098 (3.9)	529 (5.1)	223 (5.0)		2,151 (3.9)	438 (5.0)	261 (5.1)	
None	7,478 (10.9)	6,864 (12.8)	450 (4.3)	164 (3.6)		6,921 (12.6)	362 (4.2)	195 (3.8)	
		← mean ± SD →				← mean ± SD →			
Birth weight, g	3,115 ± 679	3,112 ± 674	3,130 ± 692	3,108 ± 704	.023	3,112 ± 675	3,134 ± 692	3,111 ± 699	.010
		← n (%) →				← n (%) →			
Ever breastfed					<.001				<.001
Yes	41,285 (60.0)	31,233 (58.0)	7,073 (67.8)	2,979 (66.1)		31,884 (58.1)	5,952 (68.4)	3,449 (66.9)	
No	27,428 (40.0)	22,591 (42.0)	3,366 (32.2)	1,525 (33.9)		23,021 (41.9)	2,751 (31.6)	1,710 (33.1)	
Ever hospitalized					<.001				<.001
Yes	18,435 (27.1)	141,77 (26.6)	2,895 (28.0)	1,363 (30.6)		14,486 (26.6)	2,396 (27.8)	1,553 (30.4)	
No	49,656 (72.9)	39,123 (73.4)	7,437 (72.0)	3,096 (69.4)		39,882 (73.4)	6,214 (72.2)	3,560 (69.6)	
Health status					<.001				<.001
Excellent/good	61,514 (89.3)	48,779 (90.5)	9,010 (86.3)	3,725 (82.6)		49,700 (90.4)	7,510 (86.3)	4,304 (83.3)	
Fair/poor	7,361 (10.7)	5,146 (9.5)	1,430 (13.7)	785 (17.4)		5,308 (9.6)	1,193 (13.7)	860 (16.7)	

(continued on next page)

**Table 6.** Description of demographic and biological characteristics by food security status in households with children using the HFSSM<sup>a</sup> and the revised version of the ACAFSS<sup>b</sup>. Cross-sectional data from 1998 to 2020 (n<sup>c</sup> = 69,040) (continued)

Variable	Total	HFSSM			ACAFSS			P value
		Food secure	Low food security	Very low food security	Food secure	Low food security	Very low food security	
Developmental risk								<.001
No concern	37,056 (80.0)	29,171 (81.6)	5,756 (77.6)	2,129 (67.8)	29,767 (81.5)	4,780 (78.0)	2,509 (68.9)	<.001
1 or more concerns	9,262 (20.0)	6,592 (18.4)	1,658 (22.4)	1,012 (32.2)	6,775 (18.5)	1,352 (22.0)	1,135 (31.1)	<.001
Site								<.001
Baltimore	11,609 (16.8)	9,708 (18.0)	1,223 (11.7)	678 (15.0)	9,887 (17.9)	956 (11.0)	766 (14.8)	
Boston	15,940 (23.1)	12,022 (22.2)	2,510 (24.0)	1,408 (31.2)	12,330 (22.4)	2,081 (23.8)	1,529 (29.6)	
Little Rock	16,655 (24.1)	13,698 (25.3)	2,011 (19.2)	946 (20.9)	13,877 (25.2)	1,583 (18.1)	1,195 (23.1)	
Minneapolis	12,594 (18.2)	8,532 (15.8)	3,202 (30.6)	860 (19.0)	8,759 (15.9)	2,850 (32.6)	985 (19.0)	
Philadelphia	12,242 (17.7)	10,091 (18.7)	1,525 (14.6)	626 (13.9)	10,284 (18.7)	1,260 (14.4)	698 (13.5)	

<sup>a</sup>HFSSM = Household Food Security Survey Module.  
<sup>b</sup>ACAFSS = Abbreviated Child and Adult Food Security Scale.  
<sup>c</sup>n = number of households.

**Statistical Analysis.** Psychometric analyses were performed with the ACAFSS. To achieve a successful version of the ACAFSS, 7 steps were involved in the validation of the ACAFSS: analysis of sensitivity, specificity, positive and negative predictive values, accuracy, and the area under the receiver operator curve (AUC). Sensitivity identifies the scale's ability to correctly identify food insecure households (minimizing false negatives), whereas specificity describes the scale's ability to correctly identify food secure households (minimizing false positives). Positive predictive value shows the percent of those identified by the scale as food insecure that are actually food insecure, negative predictive value shows the percent of those not identified by the scale as food insecure that are actually food secure. The AUC illustrates the scale's ability to distinguish households with FI from households without FI, and accuracy shows the degree to which the scale correctly describes FI.

Three sets of contingency tables were used to test psychometric attributes of the ACAFSS in relation to the HFSSM: 1) the full form of both scales (HFSSM and ACAFSS) with household food security status dichotomized as food secure or food insecure (low and very low food security combined); 2) the full form of both scales (HFSSM and ACAFSS) with food security status dichotomized as not very low food secure (food security and low food security combined) or very low food secure; 3) using the child subscale of both scales (HFSSM and ACAFSS) dichotomized as food secure or food insecure (low and very low food security among children combined). The HFSSM served as the standard measure in all validation analyses.

**Aim 2. ACAFSS Tests with Theoretically and Empirically Child and Adult Health Variables**

Once the validation steps were completed, it was tested with theoretically and empirically related child and adult health variables (convergent validity).

**Covariables and Dependent Variables. Sociodemographic measures.** Caregivers self-reported their age, race and ethnicity (ie, Hispanic, Black non-Hispanic, White non-Hispanic, Other non-Hispanic), country of origin (henceforth, nativity: US-born or immigrant), marital status (single; partnered [married or cohabiting]; without a partner [separated, divorced or widowed]), employment status (employed; not employed), education level (< some high school; high school graduate; ≥ technical school/college); and children's health insurance status (public; private; none). Child's age (months) and sex assigned at birth (female; male) were obtained from medical records.

**Index child measures.** Caregivers reported their child's birth weight (in grams), whether the child was ever breastfed (yes/no), or ever hospitalized (excluding birth), and rated the child's health status using the National Health and Nutrition Examination Survey question,<sup>27</sup> dichotomized as excellent/good vs fair/poor. Developmental risk was assessed by the Parents' Evaluation of Developmental Status,<sup>28-30</sup> a 10-item screen of parents' concerns about their children's development that meets the standards set by the American Academy of Pediatrics for developmental



**Table 7.** Association of child and adult biological variables with household-level food insecurity as indicated by the HFSSM<sup>a</sup> and the revised version of the ACAFSS<sup>b</sup> in crude and adjusted logistic regression models: Cross-sectional data from 1998 to 2020 (n<sup>c</sup> = 69,040)

Variable	HFSSM		ACAFSS	
	cOR <sup>d</sup> (95% CI)	aOR <sup>e</sup> (95%CI) <sup>f</sup>	cOR (95% CI)	aOR (95% CI) <sup>f</sup>
<b>Caregiver</b>				
Health status (fair/poor)	2.45 (2.34-2.55)	2.28 (2.18-2.39)	2.41 (2.31-2.51)	2.25 (2.15-2.36)
Positive risk for depressive symptoms	2.96 (2.84-3.08)	3.33 (3.18-3.48)	2.91 (2.79-3.03)	3.30 (3.15-3.46)
<b>Index child</b>				
Health status (fair/poor)	1.12 (1.07-1.16)	1.13 (1.09-1.19)	1.11 (1.07-1.16)	1.14 (1.09-1.19)
Developmental risk (1+ concerns)	1.50 (1.42-1.58)	1.55 (1.46-1.64)	1.50 (1.42-1.58)	1.56 (1.47-1.65)
Lifetime hospitalizations	1.65 (1.56-1.74)	1.69 (1.60-1.80)	1.63 (1.54-1.72)	1.68 (1.58-1.78)

<sup>a</sup>HFSSM = Household Food Security Survey Module.

<sup>b</sup>ACAFSS = Abbreviated Child and Adult Food Security Survey.

<sup>c</sup>n = number of households.

<sup>d</sup>cOR = crude odds ratio.

<sup>e</sup>aOR = adjusted odds ratio.

<sup>f</sup>Model adjusted for caregiver age, race/ethnicity, nativity, marital status, employment status, education, child age, sex, health insurance, birth weight, breastfeeding history, site, and year of the survey.

screening tests for young children. Only children 4 months or older were assessed with the Parents' Evaluation of Developmental Status, as sensitivity and specificity values for children younger than 4 months are low.<sup>29</sup> Caregivers' report of 1 or more Parents' Evaluation of Developmental Status concerns are considered at moderate risk for developmental delays and in need of additional screening, monitoring, and intervention.<sup>31</sup> Child age and sex at birth were obtained from medical records.

**Caregiver measure.** Caregivers rated their own physical health, also using the National Health and Nutrition Examination Survey health status question.<sup>27,32</sup> Caregivers were screened for depressive symptoms using the Kemper scale, a tool with 3 questions validated for female respondents.<sup>33</sup> Female caregivers with 2 or more affirmative responses were considered to screen positive for depressive symptoms.

**Statistical Analysis.** To illustrate the overall sample, descriptive statistics for demographic and biological variables were generated by 3-category food security status assessed separately with the HFSSM and the ACAFSS. Subsequently, 2 separate series of logistic regression analyses were conducted to examine patterns of caregiver and child negative health outcomes and their association with FI using the HFSSM, then the ACAFSS, with food security status dichotomized as food secure or food insecure (low and very low food security). All analyses used FI status as the independent/predictor variable, with the food secure category used as the reference group in crude and adjusted analyses. Dependent variables included child and caregiver physical and mental health measures, as described below. Variables with  $P < .20$  in bivariate analyses of association with the food security predictor or the health outcome variable were considered eligible for inclusion as potential confounding factors in the multivariate analyses. The final model contained only those variables with strongest association, with 2-tailed  $P < .05$ , using a backward stepwise

forward elimination technique. Crude and adjusted odds ratios are reported with corresponding 95% CIs.

### Aim 3. ACAFSS Test within Groups with Diverse Demographic Characteristics

ACAFSS validation was also performed separately by each self-reported caregiver's race and ethnicity category, nativity, and by age ranges of the index child in each respondent household (0–12 months, 13–24 months, 25–36 months, and 37–48 months) using the revised version of the ACAFSS and the 18-item HFSSM.

**Statistical Analysis.** Similarly, psychometric analyses were performed using sensitivity, specificity, positive and negative predictive values, accuracy, and the AUC.

### Aim 4. Validation of the ACAFSS in a Period of Acute Economic Hardship: Longitudinal Study

From the CHW-CSS, a sample collected pre-2008 Great Recession between January 2005 and December 2007 that had a complete interview containing the 18-item HFSSM was examined retrospectively to obtain a longitudinal analytic sample (CHW-GtRecess). From the prerecession sample, households with a second complete interview containing the 18-item HFSSM collected during and after the 2008 Great Recession between January 2008 and 2016 were selected to form the longitudinal dataset, yielding 767 surveys.

**Statistical Analysis.** For the longitudinal analyses, cross-tabulations with McNemar tests were run to examine differences in prevalence of food security/FI between before and during and after the 2008 Great Recession using the CHW-GtRecess longitudinal sample. Significant differences in proportions of household or child FI were defined as those with 2-tailed  $P < .05$ .

**Table 8.** Validity of the revised version of the ACAFSS<sup>a</sup> relative to the HFSSM<sup>b</sup> by race and ethnicity, nativity, and age of index child in the household: Cross-sectional data from 1998 to 2020 (n<sup>c</sup> = 69,040)

Variable	Race and Ethnicity				Nativity				Age of Index Child in Household							
	Black		White		US-born		Immigrant		0-12 mo		13-24 mo		25-36 mo		37-48 mo	
	non-Hispanics	Hispanics	non-Hispanics	Hispanics	non-Hispanic	Others	non-Hispanic	Others	US-born	Immigrant	0-12 mo	13-24 mo	25-36 mo	37-48 mo		
Sensitivity	89.4 (88.7-90.2)	92.7 (91.6-93.8)	89.2 (86.6-91.9)	89.9 (89.3-90.5)	93.5 (92.9-94.1)	91.7 (91.0-92.4)	90.3 (89.4-91.2)	90.7 (89.7-91.7)	92.7 (91.3-94.1)							
Specificity	99.6 (99.5-99.7)	99.6 (99.5-99.8)	99.5 (99.1-99.8)	99.7 (99.6-99.7)	99.2 (99.0-99.4)	99.5 (99.4-99.6)	99.7 (99.6-99.8)	99.5 (99.3-99.6)	99.5 (99.3-99.8)							
Positive predictive value	98.5 (98.2-98.8)	98.3 (97.9-98.6)	98.1 (97.5-98.7)	98.4 (98.1-98.6)	98.2 (97.9-98.6)	98.0 (97.6-98.3)	98.9 (98.6-99.2)	98.1 (99.5-98.6)	98.7 (98.1-99.3)							
Negative predictive value	97.0 (96.7-97.3)	97.5 (97.3-97.7)	98.6 (98.4-98.8)	97.8 (97.6-97.9)	96.9 (96.6-97.2)	97.9 (97.7-98.1)	97.4 (97.1-97.6)	97.4 (97.1-97.7)	97.4 (96.9-97.9)							
Accuracy	97.4 (97.2-97.6)	97.6 (97.5-97.8)	98.5 (98.3-98.7)	97.9 (97.8-98.0)	97.3 (97.1-97.6)	97.9 (97.7-98.1)	97.7 (97.4-97.9)	97.5 (97.3-97.8)	97.7 (97.3-98.1)							
Area under the receiver operator curve	99.6 (99.5-99.6)	99.8 (99.8-99.8)	99.4 (99.2-99.7)	99.6 (99.5-99.6)	99.5 (99.5-99.6)	99.6 (99.6-99.7)	99.6 (99.6-99.7)	99.5 (99.4-99.6)	99.6 (99.5-99.7)							

<sup>a</sup>ACAFSS = Abbreviated Child and Adult Food Security Scale.

<sup>b</sup>HFSSM = Household Food Security Survey Module.

<sup>c</sup>n = number of households.

estimate (95% CI)

Preliminary validation iterations for aims 1 and 4 are available in Figure 2 and Tables 1 to 3 (available at [www.jandonline.org](http://www.jandonline.org)).

**RESULTS**

**Aim 1. ACAFSS Validation in Times of Chronic Economic Hardship**

The ACAFSS consists of 8-items comprising the HFSSM 6-item Adult Short Form plus 2 questions from the HFSSM child module (Figure 3). After applying psychometric analyses to examine the validity of the ACAFSS relative to the HFSSM, first with household food security status dichotomized as "food secure versus food insecure," then separately as "not very low food security versus very low food security," both sets of results showed high accuracy of the ACAFSS (Table 4). Similarly, when the child subscale was examined separately, it also exhibited exceptional psychometric properties. With low false positives (0.4%) and false negatives (8.8%), the 8-item ACAFSS correctly identified food insecure households with children similarly to the established 18-item HFSSM measure (Table 5). Thus, the ACAFSS is a sensitive, specific, and accurate scale that identifies presence and levels of severity of FI in households with children.

**Aim 2. ACAFSS Test with Theoretically and Empirically Related Child and Adult Health Variables**

Of the total sample of 69,040 households, almost 80% were food secure, classified either by the HFSSM or the ACAFSS. Low food secure households were identified in 15.2% of the HFSSM sample and 12.6% of the ACAFSS. Very low food secure households were found in 6.5% and 7.5% of the HFSSM and ACAFSS samples, respectively. Caregiver characteristics showed that the majority were born in the United States, with one-half self-identified as Black, non-Hispanic, single, and unemployed. Approximately one-quarter of caregivers reported fair or poor health and a positive screen for depressive symptoms. Child characteristics revealed the majority had public health insurance, healthy birth weights, good or excellent health, no developmental delays, no hospitalizations, and had been breastfed. Overall results showed a similar distribution of FI by demographic and biological variables with the HFSSM and the ACAFSS, indicating that the ACAFSS cutoffs were able to identify households with similar characteristics (Table 6).

Crude and adjusted logistic regression models were estimated separately with the HFSSM and the ACAFSS to examine the relationship between food security status in the household and child and caregiver health outcomes using the CHW-CSS data. After controlling for selected covariates, the ACAFSS showed caregivers in food insecure households had odds 2.25 (95% CI 2.15 to 2.36) times as great of reporting their own health as fair or poor, and 3.30 (95% CI 3.15 to 3.46) times as great of having a positive depression screen result compared with caregivers in food secure households. Similarly, children living in food insecure households had odds 1.14 (95% CI 1.09 to 1.19) times as great of having their health status reported as fair or poor, had odds 1.56 (95% CI 1.47 to 1.65) times as great of being at developmental risk and 1.68 (95% CI 1.58 to 1.78)

**Table 9.** Comparison of household food security prevalence between pre–Great Recession and during and after the Great Recession within the same household using the ACAFSS<sup>a</sup>: Longitudinal 2008 Great Recession sample from 2005 to 2016 (n<sup>b</sup> = 767)<sup>c</sup>

Household food security	ACAFSS Pre–Great Recession			
	Very low food security	Low food security	Food security	Total
	← n (%) →			
<b>ACAFSS during/after Great Recession</b>				
Very low food security	4 (10.2)	15 (12.0)	18 (3.0)	37 (4.8)
Low food security	12 (30.8)	56 (44.8)	85 (14.1)	153 (20.0)
Food security	23 (59.0)	54 (43.2)	500 (82.9)	577 (75.2)
Total	39 (5.1)	125 (16.3)	603 (78.6)	767 (100.0)

<sup>a</sup>ACAFSS = Abbreviated Child and Adult Food Security Survey.

<sup>b</sup>n = number of households.

<sup>c</sup>McNemar  $\chi^2$  statistic: 7.857; corresponding *P* value: .049.

times as great of having been hospitalized since birth, compared with those in food secure households. Based on the overlapping CIs for the adjusted odds ratios, there are no differences in associations between FI and any of the child or caregiver physical or mental health outcomes, whether measured by the ACAFSS or the HFSSM. This demonstrates strong convergent validity of the ACAFSS as a measure of FI (Table 7).

### Aim 3. ACAFSS Test within Groups with Diverse Demographic Characteristics

Furthermore, the ACAFSS was tested by caregivers' self-reported race and ethnicity, nativity, and by age ranges of index child using the CHW-CSS data. Results showed high psychometric properties of the ACAFSS within caregiver race and ethnicity, nativity, and child age (Table 8).

### Aim 4. Validation of the ACAFSS in a Period of Acute Economic Hardship

McNemar test was used to examine the ACAFSS performance in times of acute economic hardship in a recession period. Employing the CHW-GtRecess sample, the analysis

examined changes in proportions of FI during the 2008 Great Recession (before vs during and after the recession) using the ACAFSS (Tables 9 and 10). Results showed that the ACAFSS was able to capture changes in proportions of household FI during and after the 2008 Great Recession (*P* = .049).

## DISCUSSION

An abbreviated, sensitive, specific, and valid food security scale was developed and validated to identify presence and levels of severity of FI in both adults and children in households among diverse families with young children. After several iterations of validation analyses, the ACAFSS exhibited high sensitivity, specificity, positive and negative predictive values, accuracy, and AUC. The ACAFSS also presented high convergent validity for caregiver and child's physical and mental health variables compared with the HFSSM.

Changes in the US economy over the past 4 decades resulting from globalization, financialization, and other factors have led to a steady shift of employment from manufacturing into service-producing industries,<sup>34</sup> known for being heterogeneous in terms of wages, earnings, benefits, and other work

**Table 10.** Comparison of household food security among children prevalence between pre–Great Recession and during and after the Great Recession within the same household using the ACAFSS<sup>a</sup>: Longitudinal 2008 Great Recession sample from 2005 to 2016 (n<sup>b</sup> = 767)<sup>c</sup>

Food security among children	ACAFSS Pre–Great Recession			
	Very low food security	Low food security	Food security	Total
	← n (%) →			
<b>ACAFSS during/after Great Recession</b>				
Very low food security	0 (0.0)	1 (0.9)	4 (0.6)	5 (0.6)
Low food security	1 (33.3)	42 (38.2)	68 (10.4)	111 (14.5)
Food security	2 (66.7)	67 (60.9)	582 (89.0)	651 (84.9)
Total	3 (0.4)	110 (14.3)	654 (85.3)	767 (100.0)

<sup>a</sup>ACAFSS = Abbreviated Child and Adult Food Security Survey.

<sup>b</sup>n = number of households.

<sup>c</sup>McNemar  $\chi^2$  statistic: 0.674; corresponding *P* value: .879.

conditions.<sup>35</sup> These changes contributed to stagnation in inflation-adjusted earnings<sup>36</sup> and emergence of persistent under- and unemployment,<sup>37</sup> poverty,<sup>38</sup> FI,<sup>39</sup> housing instability and homelessness,<sup>40</sup> and consequent high prevalence of chronic poor health in the United States, especially among people identifying as non-Hispanic Black and Hispanic. Families with young children experienced particular vulnerability to the changed labor market and economic circumstances because, generally, parents of younger children are themselves younger, have shorter work histories, lower earnings and assets, and are more susceptible to economic hardships than parents of older children.<sup>41</sup> In addition, young children within a sensitive period of brain and body growth are physiologically more vulnerable than older children to adverse impacts exerted by chronic economic hardship both directly on their developmental trajectories and indirectly via their parents' health and well-being. Consequently, they may experience developmental, health, and behavioral setbacks that can persist into school age and beyond.<sup>42,43</sup> These conditions, all exacerbated by a long history of inequities in wages and earnings, effectively created a state of chronic economic hardship among a large proportion of US families, giving rise to the need for development of food security measures suited to those conditions.

Although the 18-item HFSSM provides the best available measure to identify FI in households with children, a scale that is more flexible and adaptable to rapidly changing circumstances is also needed. Thus, the 8-item ACAFSS was validated to identify food insecurity presence and its levels of severity. The ACAFSS allows for monitoring and quickly responding to food insecurity prevalence changes in households with children.

### Gaps Filled by the ACAFSS

Since the beginning of the COVID-19 pandemic, efforts to assess changes in FI have given rise to several adaptations, such as use of the US Department of Agriculture Food Sufficiency question in the US Census Bureau's PULSE survey with a response period of 7 days,<sup>44</sup> the validated 2-item Hunger Vital Sign screen with a recall period of 30 days in the COVID Impact Survey,<sup>45</sup> 2 questions from the HFSSM, with a timeframe of "since the beginning of the pandemic" for a collaboration between the Hamilton Project and the Middle Class Initiative Survey of Mothers with Young Children,<sup>46</sup> and the University of Southern California Center for Economic and Social Research's Understanding Coronavirus in America tracking survey, which includes some questions from the HFSSM in modified form with a 7-day recall period.<sup>47</sup> Each of these adaptations has merit, and their uses under the circumstances are laudable. However, they all have limitations as well. Those limitations include only partial coverage of the established domains of food security and variation in time reference period and combinations of questions that have not been validated against the full HFSSM or externally against health and developmental or behavioral outcomes, resulting in lack of comparability with prepandemic measures of food security.<sup>48</sup> Furthermore, none of these adaptations attempted to measure severity levels of child FI as measured by the child subscale of the 18-item HFSSM. This gap in knowledge has been filled with the validation of the ACAFSS.

A second gap filled by the ACAFSS is determination of changes in levels of severity of household FI. This feature allows results from interventions to be assessed beyond a binary measure of food security or FI, using changes in levels of severity to evaluate their success in a more nuanced manner, for example, from very low to low food security.<sup>49</sup>

A third gap is related to the feedback loop between screening and intervening. Once households with children are identified to be at risk for FI using a screening tool, it is desirable to confirm the presence of FI and classify its level of severity at the household and child levels. This need arises because screening tools are not tailored to yield definitive diagnoses or determination of presence of any adverse health condition or disease without further diagnostic process. Thus, after an initial food security screening with a validated tool like the American Academy of Pediatrics' recommended Hunger Vital Sign, the ACAFSS can be used in households with children to confirm screen results.<sup>50</sup> In addition, interventions should be planned and implemented for different levels of severity of FI, including referral to national food assistance programs, such as the Supplemental Nutrition Assistance Program, and providing the family with immediate food relief. And finally, intervention success should be measured by a decrease in level of severity of FI beyond the binary result of food security or FI. Thus, the ACAFSS can be used in clinical, research, school, and other settings, when time, financial constraints, and respondent burden preclude use of all HFSSM items.

This study has some limitations. First, the authors acknowledge that the methods used for identifying the child-referenced items to be included in the ACAFSS child subscale met established standards for validation; however, they may not have been as conservative as item-response theory methods. Second, despite the inclusion criterion of households with children younger than 4 years, the Children's Health-Watch dataset is composed of households with 1 to 9 children 17 years and younger (mean 2.3 children per household). Still, it would be important to test the ACAFSS in households with a representative sample of children and adolescents. Third, the ACAFSS has not been validated among families with children from rural areas. Nonetheless, we consider the ACAFSS validation an important step forward allowing further replication among these and other households in future research using national representative datasets.

### CONCLUSIONS

A sensitive, specific, and valid abbreviated food security scale that balances respondent burden, time and/or financial constraints with the precision of measuring severity of FI—low and very low food security—in both adults and children in the same household was developed and validated using data from racially diverse families with young children. Based on the scale's ability to detect presence and levels of FI, the revised version of the ACAFSS is recommended for widespread adoption as either a stand-alone scale, or as a follow-up scale after households with children screen positive for FI risk. In addition, the revised version of the ACAFSS is recommended for planning timely interventions and evaluating them beyond the binary level of food security or insecurity, especially when rapid decision making is crucial, such as during the COVID-19 pandemic.

## References

- Core indicators of nutritional state for difficult-to-sample populations. *J Nutr*. 1990;120(suppl 11):1557-1600.
- Drennen CR, Coleman SM, Ettinger de Cuba S, et al. Food insecurity, health, and development in children under age four years. *Pediatrics*. 2019;144(4):e20190824.
- 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(2):135-150.
- Cook JT, Black M, Chilton M, et al. Are food insecurity's health impacts underestimated in the U.S. population? Marginal food security also predicts adverse health outcomes in young U.S. children and mothers. *Adv Nutr*. 2013;4(1):51-61.
- Cook JT. Clinical implications of household food security: Definitions, monitoring, and policy. *Nutr Clin Care*. 2002;5(4):152-167.
- Ettinger de Cuba S, Casey P, Cutts D, et al. Household food insecurity positively associated with increased hospital charges for infants. *J Appl Res Child*. 2018;9(1):Article 8.
- Cook JT, Frank DA. Food security, poverty, and human development in the United States. *Ann N Y Acad Sci*. 2008;1136:193-209.
- Cook JT, Frank DA, Berkowitz C, et al. Food insecurity is associated with adverse health outcomes among human infants and toddlers. *J Nutr*. 2004;134(6):1432-1438.
- Key statistics & graphics. US Department of Agriculture, Economic Research Service. Accessed February 15, 2022. <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/key-statistics-graphics/>
- Sparke M. Austerity and the embodiment of neoliberalism as ill-health: Toward a theory of biological sub-citizenship. *Soc Sci Med*. 2017;187:287-295.
- Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A; Household Food Insecurity in the United States in 2019. US Department of Agriculture, Economic Research Service. Published September 2020. Accessed January 5, 2021. <https://www.ers.usda.gov/webdocs/publications/99282/err-275.pdf?v=6169.9>
- IPCC, 2018. In: Masson-Delmotte V, Zhai P, Pörtner HO, et al., eds. *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. Cambridge University Press; 2018:3-24. Accessed January 11, 2021. [https://www.ipcc.ch/site/assets/uploads/sites/2/2022/06/SPM\\_version\\_report\\_LR.pdf](https://www.ipcc.ch/site/assets/uploads/sites/2/2022/06/SPM_version_report_LR.pdf)
- Munir K, Ashraf S, Munir I, et al. Zoonotic and reverse zoonotic events of SARS-CoV-2 and their impact on global health. *Emerg Microbes Infect*. 2020;9(1):2222-2235.
- Letko M, Seifert SN, Olival KJ, Raina K, Plowright RK, Munster VJ. Bat-borne virus diversity, spillover and emergence. *Nat Rev Microbiol*. 2020;18(8):461-471.
- Bradshaw CJA, Ehrlich PR, Beattie A, et al. Underestimating the challenges of avoiding a ghastly future. *Front Conserv Sci*. 2021;1:615419.
- Dietz S, Stern N. Endogenous growth, convexity of damages and climate risk: How Nordhaus' framework supports deep cuts in carbon emissions. *Econ J*. 2015;125(583):574-620.
- Kulp SA, Strauss BH. New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nat Commun*. 2019;10(1):4844.
- Mekonnen MM, Hoekstra AY. Four billion people facing severe water scarcity. *Sci Adv*. 2016;2(2):e1500323.
- Blumberg SJ, Bialostosky K, Briefel RR, Hamilton WL. The effectiveness of a short form of the household food security scale. *Am J Public Health*. 1999;89(8):1231-1234.
- U.S. Household Food Security Survey Module: Six-Item Short Form. US Department of Agriculture, Economic Research Service. Accessed January 8, 2021. <https://www.ers.usda.gov/media/8282/short2012.pdf>
- 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(1):e26-e32.
- Baer TE, Scherer EA, Flegler WE, Hassan A. Food insecurity and the burden of health-related social problems in an urban youth population. *J Adolesc Health*. 2015;57:601-607.
- Gundersen C, Engelhard EE, Crumbaugh AS, Seligman HK. Brief assessment of food insecurity accurately identifies high-risk US adults. *Public Health Nutr*. 2017;20(8):1367-1371.
- US Department of Agriculture. Economic Research Service. *Self-Administered Food Security Survey Module for Children Ages 12 Years and Older*. September 2006. Accessed January 8, 2021. <https://www.ers.usda.gov/media/8283/youth2006.pdf>
- SAS [computer program]. Version 9.4. SAS Institute; 2013.
- Bickel G, Nord M, Price C, Hamilton WL, Cook JT. *Guide to Measuring Household Food Security*. US Department of Agriculture, Food and Nutrition Service; 2000.
- US Department of Health and Human Services. *National Health and Nutrition Examination Survey III Data Collection Forms*. US Department of Health and Human Services; 1991.
- Glascie FP. Scoring, administration and interpretation guidelines. In: Glascie FP, ed. *Collaborating with Parents: Using Parents' Evaluation of Developmental Status to Detect and Address Developmental and Behavioral Problems*. Ellsworth & Vandermeer Press; 1998:9-30.
- Glascie FP. *Collaborating with Parents: Using Parents' Evaluation of Developmental Status to Detect and Address Developmental and Behavioral Problems*. Ellsworth & Vandermeer Press; 1998.
- Glascie FP. Evidence-based approach to developmental and behavioral surveillance using parents' concerns. *Child Care Health Dev*. 2000;26(2):137-149.
- Voigt RG, Johnson SK, Mellon MW, et al. Relationship between parenting stress and concerns identified by developmental screening and their effects on parental medical care-seeking behavior. *Clin Pediatr (Phila)*. 2009;48(4):362-368.
- Dowd JB, Zajacova A. Reliability of self-rated health in U.S. adults. *Am J Epidemiol*. 2011;174(8):977-983.
- Kemper KJ, Babonis TR. Screening for maternal depression in pediatric clinics. *Am J Dis Child*. 1992;146:876-878.
- Harris K. Forty years of falling manufacturing employment. Beyond the Numbers: Employment and Unemployment Program. 2020;9(16). US Bureau of Labor Statistics. Accessed February 15, 2023. <https://www.bls.gov/opub/btn/volume-9/forty-years-of-falling-manufacturing-employment.htm>
- Data Retrieval: Employment, Hours, and Earnings (CES). US Bureau of Labor Statistics. Accessed January 22, 2021. <https://www.bls.gov/webapps/legacy/cesbtb1.htm>
- US Bureau of Labor Statistics. Average Weekly Earnings of Non-supervisory Production Workers, in 1982-84 Dollars (Adjusted for Inflation with Base 1982-84), 1975-2018. Accessed January 22, 2021. <https://data.bls.gov/timeseries/CES0500000031>
- US Bureau of Labor Statistics. Labor Force Statistics from the Current Population Survey; Original Data Value. Series ID LNS 14000000, Seasonally Adjusted Unemployment Rate by Month, 16 years and over, 1979-2020. <https://www.bls.gov/cps/>. Accessed January 22, 2021.
- Current Population Survey, 1960 to 2020. Annual Social and Economic Supplements (CPS ASEC). Work Experience and Poverty Status for People 16 Years Old and Over: 1987 to 2019. US Census Bureau, <https://www.bls.gov/opub/reports/working-poor/2020/home.htm>
- Household Food Security in the United States, Annual Reports, 1995-2019. US Department of Agriculture, Economic Research Service. <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/history-background/#annual>
- Henry M, Watt R, Mahathay A, Ouellette J, Sitler A. The 2019 Annual Homeless Assessment Report (AHAR) to Congress. Part 1: Point-in-Time Estimates of Homelessness. Published January 2020. Accessed February 15, 2023. <https://www.huduser.gov/portal/sites/default/files/pdf/2019-AHAR-Part-1.pdf>
- American Community Survey 2015-2019 5-Year Estimates. US Census Bureau. Published December 10, 2020. Accessed February 15, 2023. <https://www.census.gov/newsroom/press-kits/2020/acs-5-year.html>
- Hamad R, Rehkopf DH. Poverty and child development: A longitudinal study of the impact of the earned income tax credit. *Am J Epidemiol*. 2016;183(9):775-784.
- Duncan GJ, Magnuson K, Votruba-Drzal. Boosting family income to promote child development. *Future Child*. 2014;24(1):99-120.
- Household Pulse Survey: Measuring Social and Economic Impacts during the Coronavirus Pandemic. US Census Bureau. Accessed March 5, 2022. <https://www.census.gov/programs-surveys/household-pulse-survey.html>

45. The COVID Impact Survey. Accessed March 5, 2022. <https://www.norc.org/Research/Projects/Pages/covid-impactsurvey.aspx>
46. Bauer L. The COVID-19 Crisis Has Already Left Too Many Children Hungry in America. The Hamilton Project. Published May 6, 2020. Accessed March 5, 2022. [https://www.hamiltonproject.org/blog/the\\_covid\\_19\\_crisis\\_has\\_already\\_left\\_too\\_many\\_children\\_hungry\\_in\\_america](https://www.hamiltonproject.org/blog/the_covid_19_crisis_has_already_left_too_many_children_hungry_in_america)
47. USC Center for Economic and Social Research's Understanding Coronavirus in America tracking survey, USC Dornsife Accessed March 6, 2022. <https://uasdata.usc.edu/index.php>.
48. Poblacion A, Ettinger de Cuba S, Cook JT. Comparing food security before and during the COVID-19 pandemic: Considerations when choosing measures. *J Acad Nutr Diet*. 2021;121(10):1945-1947.
49. Gundersen C. A consideration of the evaluation of demonstration projects to End Childhood Hunger (EDECH). *J Acad Nutr Diet*. 2021;121(1 suppl):S78-S80.
50. Council on Community Pediatrics and Committee on Nutrition. promoting food security for all children. *Pediatrics*. 2015;136(5):e1431-e1438.

## AUTHOR INFORMATION

A. Poblacion is a research scientist and director of multisite operations, Children's HealthWatch, Department of Pediatrics, Boston Medical Center, Boston, MA. S. Ettinger de Cuba is the executive director, Children's HealthWatch, Department of Pediatrics, Boston Medical Center, Boston, MA. D. A. Frank is a professor of child health and well-being, Department of Pediatrics, Boston University School of Medicine, Children's HealthWatch, Boston Medical Center, Boston, MA. G. Esteves is a postgraduate associate, Yale School of Public Health, New Haven, CT. L. J. Rateau is a statistical data analyst, Biostatistics and Epidemiology Data Analytics Center, Boston University School of Public Health, Boston, MA. T. C. Heeren is a professor, Department of Biostatistics, Boston University School of Public Health, Boston, MA. S. Coleman is a senior project manager, Biostatistics and Epidemiology Data Analytics Center, Boston University School of Public Health, Boston, MA. M. M. Black is a professor emeritus, Department of Pediatrics, Growth and Nutrition Division, University of Maryland School of Medicine, Baltimore, MD, and a distinguished fellow, Early Child Development, RTI International, Research Triangle Park, NC. D. B. Cutts is the chief of pediatrics, Department of Pediatrics, Hennepin County Medical Center, Minneapolis, MN. F. Lê-Scherban is an associate professor, Department of Epidemiology and Biostatistics, Drexel University Dornsife School of Public Health, Philadelphia, PA. E. R. Ochoa Jr is an associate professor and section chief of community pediatrics Department of Pediatrics, University of Arkansas for Medical Sciences, Little Rock, AR. M. Sandel is an associate professor, Department of Pediatrics, Boston University School of Medicine, Children's HealthWatch, Boston Medical Center, Boston, MA. R. Sheward is the director of innovative partnerships, Children's HealthWatch, Boston Medical Center, Boston, MA. J. Cook is an associate professor, Department of Pediatrics, Boston University School of Medicine, Children's HealthWatch, Boston Medical Center, Boston, MA.

Address correspondence to: Ana Poblacion, PhD, MSc, Children's HealthWatch, Boston Medical Center, 801 Albany St, 3rd Floor, W-11, Boston, MA 02119. E-mail: [ana.poblacion@bmc.org](mailto:ana.poblacion@bmc.org)

## STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

## FUNDING/SUPPORT

This work was supported by the U.S. Department of Agriculture's Economic Research Service (USDA-ERS) call for proposals administered by Tufts University as part of an award totaling \$100,000. The contents are those of the authors and do not necessarily represent the official views of, nor an endorsement, by USDA-ERS or Tufts University. This article is published as part of a supplement supported by the U.S. Department of Agriculture, Economic Research Service.

## ACKNOWLEDGEMENTS

The authors thank the families who shared their time and information with us for making this work possible.

## AUTHOR CONTRIBUTIONS

A. Poblacion, S. Ettinger de Cuba, and J. Cook conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript. L. J. Rateau and S. Coleman conducted the data analysis and reviewed and revised the manuscript for important intellectual content. T. C. Heeren oversaw the design and methods and reviewed and revised the manuscript for important intellectual content. D. A. Frank provided clinical expertise, and critically reviewed the manuscript for important intellectual content. R. Sheward provided policy expertise, and critically reviewed the manuscript for important intellectual content. D. B. Cutts, M. M. Black, E. R. Ochoa Jr, M. Sandel, F. Lê-Scherban supervised data collection and critically reviewed the manuscript for important intellectual content. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

<p>Four aims were involved in the validation process of the ACAFSS: 1) validation of the ACAFSS using Children’s HealthWatch Cross-Sectional Study (CHW-CSS) data; 2) test the ACAFSS with theoretically and empirically related child and adult health variables using the same CHW-CSS sample; 3) test the ACAFSS within groups varying by demographic characteristics using CHW-CSS sample; and 4) test the ability of the ACAFSS to detect change in levels of severity of food insecurity in times of acute economic hardship. To accomplish aim 4, this study used the CHW-CSS to form a longitudinal dataset: a) using 2 CHW-CSS interviews pre- and during and after the 2008 Great Recession and b) collecting follow-up data during the COVID-19 pandemic from a subset of CHW-CSS respondents. Because the validation process comprised several iterations of the ACAFSS, this figure details the ACAFSS validation preliminary steps within aims 1 and 4. To distinguish from the revised—and final—version of the ACAFSS, the previous iteration is named “ACAFSS_prelim.”<sup>a</sup></p>
<p><b>Description of Preliminary Measures, Datasets, and Results</b></p>
<p><b>Aim 1. ACAFSS Validation in Times of Chronic Economic Hardship: Cross-Sectional Study</b></p>
<p>Before determining the final version of the ACAFSS, a preliminary version was developed and tested. To compose the ACAFSS_prelim, the widely used 6-Item Adult Short Form of the HFSSM<sup>20</sup> was combined with 3 questions (Q) from the child module of the HFSSM, chosen on the basis of prevalence of item response within the CHW-CSS sample: [Q14: <i>In the last 12 months, did you ever cut the size of any of the children’s meals because there wasn’t enough money for food? (yes/no)</i>; Q16: <i>In the last 12 months, did any of the children ever skip a meal because there wasn’t enough money for food? (yes/no)</i>; and Q17 (If yes to Q16): <i>How often did this happen? (Almost every month, some months but not every month, or in only 1 or 2 months)</i>], yielding the 9-item ACAFSS_prelim measure.</p>
<p>The ACAFSS_prelim used standard coding of responses where “often,” “sometimes,” “yes,” “almost every month,” and “some months but not every month” were coded as affirmative (yes). Food security status was determined by the sum of affirmative responses to the ACAFSS_prelim in the past 12 months. Households were classified as food secure if caregivers reported 0 or 1 food insecure condition among the ACAFSS_prelim full set of 9 questions. Households were classified as food insecure if caregivers reported 2 or more conditions. Food insecure households were further classified as having either low food security (2 to 4 conditions) or very low food security (5 or more conditions). In addition, food security status of children in the household was assessed by responses to the 3 child-referenced questions. Households were classified as having food insecurity among children or child food insecurity if caregivers reported 1 or both food-insecure conditions among the children. Households were further classified as having low food security among children (1 condition) or very low food security among children (2 conditions).</p>
<p><b>Statistical Analysis</b></p>
<p>Psychometric analyses—sensitivity, specificity, positive and negative predictive values, accuracy, and the area under the receiver operator curve (AUC)—were used to test the ACAFSS_prelim in relation to the HFSSM in 3 sets of contingency tables: 1) the full form of both scales (HFSSM and ACAFSS_prelim) with household food security status dichotomized as food secure or food insecure (low and very low food security combined); 2) the full form of both scales (HFSSM and ACAFSS_prelim) with food security status dichotomized as not very low food secure (food security and low food security combined) or very low food secure; 3) the child subscale of both scales (HFSSM and ACAFSS_prelim) dichotomized as food secure or food insecure (low and very low food security among children combined). In all validation analyses, the HFSSM served as the standard measure. For detailed descriptions of participants, setting, and measures, please refer to the Methods section of the article. Analyses were conducted using SAS software, version 9.4.<sup>25</sup></p>
<p><b>Preliminary Testing</b></p>
<p>After applying psychometric analyses to examine the validity of the ACAFSS_prelim relative to the HFSSM, first with household food security status dichotomized as “food secure versus food insecure,” then separately as “not very low food security versus very low food security,” both sets of results showed high overall accuracy of the ACAFSS_prelim (Table 1; available at <a href="http://www.jandonline.org">www.jandonline.org</a>). However, when the ACAFSS_prelim child subscale was examined separately, the selected child-referenced questions exhibited an unsatisfactorily low sensitivity indicating a high number of false negatives, or type II error. Given the well-ordered nature of the HFSSM, having question 14 of the HFSSM child-referenced scale as the first ACAFSS_prelim</p>
<p style="text-align: right;"><i>(continued on next page)</i></p>

**Figure 2.** The Abbreviated Child and Adult Food Security Survey (ACAFSS) validation preliminary steps. <sup>a</sup>The information contained in the Figure 2 and Tables 1, 2, and 3 is part of the article entitled “Development and Validation of an Abbreviated Child and Adult Food Security Scale for Use in Clinical and Research Settings in the United States.” Using these documents separately from the article might distort understanding of the development process of the ACAFSS

child-referenced question, the preliminary ACAFSS survey missed those households classified by the HFSSM as having food insecurity among children by affirmative responses to at least 2 of questions 11 through 13. These false negatives are reflected in the 18.5% sensitivity in [Table 1](#) (available at [www.jandonline.org](http://www.jandonline.org)), and the AUC estimate of 59.2%. Thus, a re-evaluation of the child-referenced questions in the ACAFSS\_prelim was conducted.

To minimize false negatives, 3 additional sets of HFSSM child-referenced questions were investigated: **combination A = Q12, Q16, Q17** [Q12: *We couldn't feed our children a balanced meal, because we couldn't afford that. Was that often, sometimes, or never true for you in the last 12 months?*; Q16: *In the last 12 months, did any of the children ever skip a meal because there wasn't enough money for food?(yes/no)*; Q17: *(If yes to question 16) How often did this happen? (Almost every month, some months but not every month, or in only 1 or 2 months)*]; **combination B = Q12, Q15** [Q12: *We couldn't feed our children a balanced meal, because we couldn't afford that. Was that often, sometimes, or never true for you in the last 12 months?*; Q15: *In the last 12 months, were the children ever hungry but you just couldn't afford more food? (yes/no)*]; and **combination C = Q12, Q16** [Q12: *We couldn't feed our children a balanced meal, because we couldn't afford that. Was that often, sometimes, or never true for you in the last 12 months?*; Q16: *In the last 12 months, did any of the children ever skip a meal because there wasn't enough money for food? (yes/no)*]. Using the CHW-CSS dataset, new psychometric analyses were performed yielding high accuracy measurements, independently of the combination chosen ([Table 2](#); available at [www.jandonline.org](http://www.jandonline.org)). Given the well-ordered nature of the HFSSM, Q12 and Q15 are the least-severe questions able to indicate low and very low levels of food security, respectively, in the child subscale. Therefore, the revised version of the ACAFSS included the 6-Item Adult Short Form of the FSSM with Q12 and Q15 from the HFSSM child module, yielding an 8-item ACAFSS measure. An additional benefit of using Q12 and Q15 as the child subscale of the ACAFSS\_rev was to reduce its total number of questions from 9 to 8. Although the number of items in the final version of the ACAFSS decreased, the food security category cutoffs remained the same as in ACAFSS\_prelim. Confirmatory psychometric tests (sensitivity, specificity, positive and negative predictive values, accuracy, and AUC) with the same variables but with different cutoffs were made to distinguish levels of severity (analysis available per request to authors).

#### Aim 4. Validation of the ACAFSS in a Period of Acute Economic Hardship: Longitudinal Study

Given the nature of the COVID-19 pandemic, it was initially identified as a period of acute economic hardship to validate the ACAFSS. In spring 2021, families who previously participated in Children's HealthWatch cross-sectional study (CHW-CSS, detailed in the article) between January 2018 and March 2020 and had a complete interview containing the 18-item HFSSM were invited to enroll in the longitudinal Children's HealthWatch COVID-19 Follow-up Study (CHW-COVID). They were contacted by phone by trained bilingual English/Spanish research assistants to obtain consent to participate in a second interview, in which the ACAFSS\_prelim was implemented. Data collection took place between September 2021 and March 2022, yielding a final sample of 597 surveys. Each Children's HealthWatch site obtained Institutional Review Board approval for the longitudinal phase and all individuals consented their participation.

Because the CHW-COVID study was conducted concomitantly with the ACAFSS validation process, when validation iterations showed that the ACAFSS\_prelim did not carry the same psychometric properties as the HFSSM, due to Institutional Review Board and other study protocols it was not possible to use the CHW-COVID sample to test the next iteration of the ACAFSS in this survey. Despite displaying poor psychometric properties in the child-referenced subscale, authors opted for examining the ACAFSS\_prelim performance in times of acute economic hardship during the COVID-19 pandemic recession period using the CHW-COVID dataset. McNemar test showed that the ACAFSS\_prelim was not able to capture changes in proportions of household food insecurity during the COVID-19 pandemic ([Table 3](#); available at [www.jandonline.org](http://www.jandonline.org)).

#### Considerations

Preliminary investigations of data are an integral part of every new scientific discovery. The development of the ACAFSS was not different. Before the final scale was found satisfactory, 4 different scales were tested. Documenting the process of trial and error is fundamental to advancing science. In 2023, Children's HealthWatch will implement the revised—and final—version of the ACAFSS in the Wave 3 of the CHW-COVID study.

**Figure 2.** (continued) The Abbreviated Child and Adult Food Security Survey (ACAFSS) validation preliminary steps. <sup>a</sup>The information contained in the [Figure 2](#) and [Tables 1, 2, and 3](#) is part of the article entitled "Development and Validation of an Abbreviated Child and Adult Food Security Scale for Use in Clinical and Research Settings in the United States." Using these documents separately from the article might distort understanding of the development process of the ACAFSS



**Table 1.** Initial psychometric analyses to validate the ACAFSS\_prelim<sup>a</sup> relative to the Household Food Security Survey Module: Cross-sectional data from 1998 to 2020 (n<sup>b</sup> = 69,040)

Variable	FI <sup>c</sup> ACAFSS_prelim (9-item scale)	VLFS <sup>d</sup> ACAFSS_prelim (9-item scale)	Child FI <sup>e</sup> ACAFSS_prelim (3-item child subscale)
	← estimate (95% CI) →		
Sensitivity	86.5 (85.9-87.0)	87.0 (86.0-88.0)	<b>18.5 (17.6-19.4)</b>
Specificity	99.7 (99.6-99.7)	99.0 (99.0-99.1)	99.9 (99.9-99.9)
Positive predictive value	98.7 (98.5-98.9)	86.4 (85.4-87.4)	96.9 (96.0-97.8)
Negative predictive value	96.4 (96.2-96.5)	99.1 (99.0-99.2)	91.02 (90.8-91.2)
Accuracy	96.8 (96.7-96.9)	98.2 (98.2-98.3)	91.1 (30.9-91.3)
Area under the receiver operator curve	99.1 (99.0-99.1)	99.5 (99.5-99.5)	59.2 (58.8-59.7)

<sup>a</sup>ACAFSS\_prelim = preliminary Abbreviated Child and Adult Food Security Scale.

<sup>b</sup>n = number of households.

<sup>c</sup>FI = food insecurity.

<sup>d</sup>VLFS = very low food security.

<sup>e</sup>Child FI = food insecurity among children.

**Table 2.** Comparison of psychometric analyses among 3 candidate sets of child-referenced questions for the child subscale of the ACAFSS<sup>a</sup> relative to child items in the HFSSM<sup>b</sup>: Cross-sectional data from 1998 to 2020 (n<sup>c</sup> = 69,040)

Variable	Child FI ACAFSS_prelim <sup>d</sup> (questions 14, 16, and 17)	Child FI ACAFSS_A <sup>e</sup> (questions 12, 16, and 17)	Child FI ACAFSS_B <sup>f</sup> (question 12 and 15)	Child FI ACAFSS_C <sup>g</sup> (question 12 and 16)
	← estimate (95% CI) →			
Sensitivity	18.5 (17.6-19.4)	94.5 (94.0-95.0)	94.9 (94.4-95.4)	94.5 (94.0-95.0)
Specificity	99.9 (99.9-99.9)	99.1 (99.1-99.2)	99.1 (99.0-99.2)	99.1 (99.1-99.2)
Positive predictive value	96.9 (96.0-97.8)	93.0 (92.5-93.6)	92.9 (92.3-93.5)	93.1 (92.5-93.6)
Negative predictive value	91.02 (90.8-91.2)	99.3 (99.3-99.4)	99.4 (99.3-99.4)	93.3 (99.3-99.4)
Accuracy	91.1 (30.9-91.3)	98.6 (98.6-98.7)	98.7 (98.6-98.7)	98.6 (98.6-98.7)
Area under the receiver operator curve	59.2 (58.8-59.7)	96.9 (99.6-97.1)	97.1 (96.8-97.3)	96.8 (96.6-97.1)

<sup>a</sup>ACAFSS = Abbreviated Child and Adult Food Security Scale.

<sup>b</sup>HFSSM = Household Food Security Survey Module.

<sup>c</sup>n = number of households.

<sup>d</sup>Child FI ACAFSS\_prelim = preliminary version of the ACAFSS child food insecurity subscale containing 3 HFSSM questions.

<sup>e</sup>Child FI ACAFSS\_A = revised version of the ACAFSS child food insecurity subscale containing 3 HFSSM questions.

<sup>f</sup>Child FI ACAFSS\_B = revised version of the ACAFSS child food insecurity subscale containing 2 HFSSM questions.

<sup>g</sup>Child FI ACAFSS\_C = revised version of the ACAFSS child food insecurity subscale containing 2 HFSSM questions.

**Table 3.** Comparison of household food security prevalence between pre-COVID and during the COVID pandemic within the same household using the ACAFSS\_prelim<sup>a</sup>: Longitudinal COVID dataset from 2018 to 2022 (n<sup>b</sup> = 597)<sup>c</sup>

Household Food Security	ACAFSS_prelim pre-COVID			Total
	Very low food security	Low food security	Food security	
ACAFSS_prelim during COVID	← n (%) →			
Very low food security	13 (28.9)	13 (14.8)	21 (4.5)	47 (7.9)
Low food security	8 (17.8)	16 (18.2)	56 (12.1)	80 (13.4)
Food security	24 (53.3)	59 (67.0)	387 (83.4)	470 (78.7)
Total	45 (7.5)	88 (14.7)	464 (77.2)	597 (100.0)

<sup>a</sup>ACAFSS\_prelim = preliminary version of the Abbreviated Child and Adult Food Security Survey.

<sup>b</sup>n = number of households.

<sup>c</sup>McNemar  $\chi^2$  statistic: 0.689.