

Re-conceptualizing food insecurity with a new, multi-dimensional scale

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ABSTRACT

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Background

- USDA's **Food Security Survey Module** – measure of food insecurity
- Used for **national monitoring and surveillance** in Canada and US
- FSSM has important **limitations**

Objective

To develop and evaluate a **new, multi-dimensional measure of food insecurity** for use in programs and research.

Methods

- Cross-sectional data (2014-2015) from prospective project
 - **Voices Into Action: The Families, Food, and Health Project**
- **Diverse sample** of mothers from North Carolina ($n=109$)
- **Qualitative and quantitative data**
 - In-depth interviews
 - Surveys
- **Four Dimensional Food Insecurity Scale (4D-FIS)** reflects four dimensions of food insecurity:
 - Quantitative
 - Qualitative
 - Psychological
 - Social
- **Categorization of severity:**
 - Food secure
 - Mildly food insecure
 - Severely food insecure
- Confirmatory factor analysis (CFA) to examine the **hypothesized, four-factor structure of 4D-FIS**
- Concordance analysis to **compare categorization between the two food insecurity scales:** 1) 4D-FIS and 2) USDA FSSM adult scale (2)

Results

- Data **supported** the four-factor model
- 4D-FIS categorized **more participants as food insecure** vs. USDA scale
- **Fair to moderate agreement** in categorization between scales

Conclusions

- Promising **alternative measure**
- Implications for programs, interventions, and research applications

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SCALE DEVELOPMENT

Figure 1 – Sample Items for the Four Dimensional Food Insecurity Scale (4D-FIS)



- Applied **scale development principles** (1)
- Created **scoring protocol** for 4D-FIS to categorize severity
 - Analyzed **qualitative data** to determine severity of food insecurity
 - Analyzed descriptive statistics (**4D-FIS subscale scores**) within each category
 - Identified patterns
 - **Conceptually similar categories** (USDA)
 - **Cut-offs** to define categories: food secure, mildly food secure, and severely food insecure

Figure 2 – Key differences in severity categories for the 4D-FIS and USDA scale

Definition	4D-FIS	USDA Scale
Food secure	No affirmative response	≤ 2 affirmative responses
Food insecure	≥ 1 affirmative response	≥ 3 affirmative responses
Severity	Subscale scores *Quantitative* most severe	Total # affirmative responses (↑ responses, ↑ severity)

SCALE EVALUATION

CFA Results

Good overall fit (3)

- $\chi^2 = 94$, $df = 98$, $p = 0.6$; 1:1 $\chi^2:df$ ratio
 - $p > 0.05$; $\chi^2:df$ ratio less than 3:1
- **RMSEA** = 0.00; 90% CI: 0.00, 0.05
 - RMSEA < 0.06;
 - $CI_{Lower} \approx 0$ and $CI_{Upper} < 0.08$
- **CFI** = 1.0
 - CFI > 0.95
- **Standardized factor loadings** > 0.7
- **Correlations** between factors: 0.38-0.83
- Mplus® software

Table 1 – Internal consistency for 4D-FIS subscales and overall scale

4D-FIS component	Number of items	Cronbach's α
Quantitative	3	0.69
Qualitative	6	0.79
Psychological	3	0.91
Social	4	0.76
Overall scale	16	0.90

SAS® Software used to calculate Cronbach's alpha. DeVellis recommends Cronbach's alpha > 0.7 (1).

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CATEGORIZATION

Table 2 – Categorization of food insecurity status determined by the 4D-FIS and USDA scale

4D-FIS	USDA Scale			TOTAL
	Not food insecure	Mildly food insecure	Severely food insecure	
Food secure	33	1	1	35
Mildly food insecure	27	14	1	42
Severely food insecure	6	12	14	32
TOTAL	66	27	16	109

Categorization was done according to each scale's protocol to categorize severity of food insecurity. Both scales categorize severity of food insecurity status based on the number of affirmative responses. The USDA scale uses the three categories shown as high and marginal food security, low food security, and very low food security, where high and marginal food security are considered food secure, and low and very low food security are food insecure (5). The 4D-FIS categorization considered affirmative responses to the quantitative subscale as more severe than the other subscales (qualitative, psychological, and social).

CONCORDANCE

- **Fair agreement** between scales (overall kappa ≤ 0.4)

Table 3 – Agreement between 4D-FIS and USDA scale in **three-level** categorization

Category	kappa	Asymptotic Standard Error (ASE)	z	p
Food secure	0.35	0.096	3.7	0.0001
Mildly food insecure	0.13	0.096	1.4	0.09
Severely food insecure	0.47	0.096	4.9	<0.0001
Overall	0.31	0.069	-4.5	<0.0001

Suggested benchmarks for interpreting kappa coefficients are: <0.005, 0.0-0.2 slight, 0.2-0.4 fair, 0.4-0.6 moderate, 0.6-0.8 substantial, and 0.8-1 almost perfect (6). A non-significant p indicates that the agreement was not more than due to chance alone.

For three-level categorization:

- Differed in extreme vs. middle category
- **Positive association and concordance** between scales (Kendall = 0.81, $p < 0.005$)

DISCUSSION

- Preliminary evidence for convergent and discriminant validity (3)
- Differences in categorization by design
- Future research needed to apply and evaluate 4D-FIS in other contexts
- 4D-FIS promising tool for:
 - Identifying underserved populations
 - Supporting programs/interventions to mitigate food insecurity



Photo: USDA Infographic (2017). Available at: <https://www.ers.usda.gov/amber-waves/2016/december/what-is-very-low-food-security-and-who-experiences-it/>

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