Psychometric assessment of the FIES in the St Lucia survey

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The household version of the Food Insecurity Experience Scale (FIES-H) was included in a pilot survey in St Lucia of 1500 households in 2016. Questions were asked with reference to the previous 12 months. Post-stratification weights were provided and results can be considered as informative at national level. The Voices of the Hungry (VoH) project of the United Nations Food and Agriculture Organization (FAO) offered its service to give a preliminary evaluation the quality of the FIES data and to provide guidance for classification of food security status in this survey.

The assessment includes two parts:

- Assessment[1] of the quality of the FIES-H measure in the St Lucia data for use within the survey (and, by extension, the potential usefulness of the same measure in future surveys of similar populations).
- Assessment of the comparability of the FIES-H measure in St Lucia data with global results from the 2014 and 2015 Gallup World Poll (GWP).

Summary of the main findings: the FIES has worked very well in this application. All items discriminate equally on the food insecurity latent trait, the reliability is high and the scale unidimensional. No outliers have been identified in the data. The sum of affirmative responses (raw score) can be used as an ordinal measure of food insecurity. Raw scores 4 or more and 8 can be used as thresholds to calculate approximately comparable prevalence rates to the results published by FAO at moderate+severe and severe levels.

[1] Psychometric statistical methods based on the Rasch measurement model are the main basis of the assessment, readers who are not familiar with these statistical methods may want to consult the VoH report, *Introduction to item response theory applied to food security measurement: Basic Concepts, Parameters and Statistics*, available at http://www.fao.org/3/a-i3946e.pdf for further information on the statistics.

Questionnaire

The standard FIES-H survey module referenced to the previous 12 months was used in the St Lucia survey.

Data and Missing Responses

Data were provided for 1500 households. There were 41 missing responses in total. The percentage of missing responses to each of the items does not vary much and it is higher for the "went hungry" item (0.6%).

Psychometric results are based on the subsample with complete and non-extreme responses (N=481) i.e., omitting those who said "no" to all items (raw score 0, 61.3 percent of cases) and those who said "yes" to all 8 items (raw score 8, 5.8 percent of cases) respectively.

Comparison data

Item severity parameters of the FIES-H scale calculated from the St Lucia data were compared with those of the VoH Global Standard, based on data from 151 countries in the 2014 and 2015 pooled Gallup World Poll (GWP).

These comparisons assess the extent to which severity measures and prevalence rates are comparable with rates published by VoH for other countries.

Statistical methods

Valid answers to each of the questions in the FIES-H model are "Yes" or "No," coded 0 and 1, respectively.

Statistical methods based on the single-parameter Rasch model were used to assess data quality for the FIES-H (i.e., consistency with the measurement model). The measurement model provides estimates of the severity level measured by each item as well as the severity of food insecurity experienced by each respondent ("respondent severity parameters"). Item and respondent parameters are on the same continuum of severity. Respondent parameters are sometimes referred to as "raw-score parameters" because, for a given set of items, they are the same for all respondents with the same raw score (sum of affirmative responses). The methods also provide fit statistics for each item, overall measure reliability, and inter-item residual correlations.

Quality of the FIES-H measure in the St Lucia data

Item "infit" statistics assess the important Rasch-model assumption that all items discriminate equally (i.e., are have the same strength of association with the latent trait of food insecurity). The expected value is 1.0 for all items. Higher values indicate weaker association with the latent trait (i.e., higher chi square). Values between 0.8 and 1.2 are generally considered to indicate good consistency with the model assumption of equal discrimination, and 0.7 to 1.3 indicate acceptable consistency for positive contribution to the measure.

The infit statistics for these data are very good. All items had infits between 0.8 and 1.2, except for the "went hungry" item (infit equal to 0.68). This value, however, can be considered good enough not to discard the item. Item "outfit" statistics are similar to infits except that, since they are not information-weighted, they are very sensitive to unexpected outliers. Such outliers may indicate idiosyncratic conditions, careless responses, or incorrect coding of responses. No item reported a particularly high outfit in this application.

The second model assumption to be tested is conditional independence of items. The Rasch model assumes that responses to any two items are correlated only because of their mutual association with the underlying latent trait. In practical terms, this means that we do not want two questions that ask about essentially the same behaviour or condition caused by food insecurity. Conditional correlations among items may also indicate a second dimension in the response data, whereas the Rasch model assumes unidimensionality. Conditional independence is assessed by comparing observed correlations among items with the correlations expected given item and raw-score parameters and the distribution of cases across raw scores. On this assessment, there was no area of concern, and we can safely conclude that the FIES-H data are unidimentional.

Finally, the reliability of the measure is assessed by Rasch reliability statistics. The standard Rasch reliability statistic is, conceptually, the proportion of total variance of severity of food insecurity *in the sample* (actually, in the sample omitting extreme raw scores 0 and 8) that is accounted for by the measure (i.e., by the difference in raw-score severity parameters of respondents). A modified version of Rasch reliability that weights each raw score equally (rather than by the proportion of the sample in each raw score) is highly correlated with overall model fit across surveys using the same scale. this "equal-weighted" Rasch reliability statistic is used as a proxy for model fit by the VoH project, since the standard Rasch

reliability and other measures of model fit such as the likelihood ratio, are affected by the distribution of cases across raw scores as well as by model fit.

In general, higher reliability indicates response patterns that are more consistent with the severity-order of the items. It is expected that if a respondent says "yes" to an item, he or she will also say "yes" to all items that are less severe, and if a respondent says "no" to an item, he or she will also say "no" to all items that are more severe. It is not expected that this pattern will be absolute—only probabilistic. The extent to which this pattern predominates increases the dispersion of item parameters, which, in turn, increases the dispersion of respondent parameters relative to measurement error and, thus, increases reliability. In practical terms, high reliability indicates that respondents understood questions consistently, responded thoughtfully, that responses were recorded accurately, and that the way food insecurity is experienced and described in the sample is consistent across respondents.

The Rasch reliability in the St Lucia data was .79, and the equal-weighted statistic was .8. These results are higher than the global average in GWP data (around .75).

In summary, the performance of the FIES-H in the St Lucia data was very good. Raw score can be used as an ordinal measure of severity of food insecurity of respondents and for categorizing respondents as to food security status for within country assessments. Respondent (raw-score) parameters are an interval-level measure of severity of food insecurity, suitable for analyses such as regression and correlation analysis, with certain caveats as discussed in the next section. (Note that raw score is ordinal, but not interval, with respect to the latent trait and is not suitable for regression or correlation analysis.)

Respondent parameters: The measure of severity of food insecurity

Statistics for respondents by raw score on the FIES-H are presented in Table 2. Respondent severity parameters are an interval-level (i.e., linearized) measure of severity of food insecurity and are suitable for use in analyses such as regression and correlation that require an interval-level measure. The parameters shown for raw scores zero and 8 are somewhat rough approximations, based on the standard VoH 2014 methodology. (In fact, the parameter and error for raw score zero are unimportant in the VoH standard methodology because for classification purposes such respondents are assumed to be highly food secure with no measurement error.) A modelling alternative that is often preferable is to represent food insecurity as a set of dummy variables to indicate either raw score or raw-score-based categories of food insecurity. This allows for a more flexible fit, since associations of many

outcomes with food insecurity may not be linear. If food insecurity is the dependent variable, it may be modelled as a binary variable based on raw score, using logistic or probit regression. Two or more analyses can be conducted at different levels of severity to provide a more complete picture of associations.

Comparability of FIES -H results in the St Lucia data with national and global results from other surveys using the same or similar instruments

Figure 1 shows the comparison of the FIES scale applied in St Lucia data with the VoH 2014-2015 global standard. The St Lucia scale is readily adjusted to the VoH Global Standard scale. Only one item is considerably far away from the 45 degree line ("household running out of food").

The specifications of food security status by raw score as presented in Table 2 are based on the adjustment of the St Lucia scale to the VoH Global Standard depicted in Figure 1. Given the good match of the FIES-H St Lucia scale to the VoH Global Standard scale, the food security status as specified in Table 2, and prevalence rates based on those specifications, should be fairly consistent with corresponding statistics indicated for and other countries in the VoH report on the 2014 GWP survey data. Raw score thresholds for the moderate+severe, and severe food insecurity status are 4 and 8, respectively.

Table 1. Item parameters and fit statistics for the FIES-H calculated from the St Lucia data

Item[1]	Severity parameter	Std. error of parameter	Infit	Std. error of infit	Outfit
Worried food would run out	-2.46	0.14	1.18	0.07	0.07
Could not afford healthy nutritious meals	-2.08	0.14	0.98	0.07	0.07
Ate only a few kinds of food	-2.52	0.14	0.97	0.07	0.07
Skipped meals	0.86	0.15	0.94	0.09	0.09
Ate less than should	-0.93	0.13	0.83	0.07	0.07
Household ran out of food	0.08	0.14	0.93	0.08	0.08
Hungry and did not eat	2.59	0.20	0.68	0.14	0.14
Did not eat for whole day	4.47	0.29	1.10	0.23	0.23
Standard deviation	2.54				
N[2]	481				

Notes:
[1]Full wording of each question included a reminder of the 12-month reference period and the specification that the behaviour or condition occurred "because there was not enough money or other resources to get food."

[2]Respondents with raw score 0 (n=894) or raw score 8 (n=84) were omitted from the psychometric analysis. They will be included in substantive analysis, classified as being very food secure and very food insecure, respectively, but their responses provide no information about the relative severity of items.

Table 2. Respondent parameters and measurement errors in the FIES-H based on the St Lucia data

Raw score	Severity parameter	Measurement error[1]	Number of cases (weighted)	Percent of cases	Provisional food security status[2]
0[3]	-4.13	1.52	900.30	61.27	
1	-3.27	1.16	76.19	5.21	
2	-2.18	0.98	56.37	3.98	
3	-1.26	0.96	81.80	5.83	
4	-0.31	0.99	85.43	6.03	Moderately food insecure
5	0.74	1.07	57.64	3.98	
6	2.03	1.21	58.27	4.46	
7	3.76	1.43	56.56	3.50	
8[3]	4.94	1.52	82.77	5.76	Severely food insecure

Notes:
[1]Measurement error can be thought of as the standard deviation (around the severity parameter—which is the mean severity within the raw score) of true severity of food insecurity of respondents represented by the sampled individual.
[2]Provisional food security status is based on the thresholds used by the Voices of the Hungry project to classify respondents in the Gallup World Poll. Those thresholds are used with probabilistic assessment to estimate national prevalence rates after adjusting each country's scale to the global standard. The raw-score assignment indicated here most nearly approximates the prevalence rates calculated by adjusting the FIES-H scale based on the St Lucia data to the global standard for 2014- 2015. NOTE: The VoH thresholds on which these raw-score-based food-security status categories are based are more severe than those for similarly labelled categories in most countries that use experiential measures of food security for official national monitoring. For example, raw scores 3 and higher would correspond more closely to food insecurity as measured in the U.S., raw scores 2 and higher would correspond more closely to food insecurity as measured in Canada, and 6-10 would approximate the severity range of "very low food security" in the United States and severe food insecurity in Canada.
[3]Severity parameters and measurement error cannot be calculated for raw scores 0 and 8 using the conditional maximum likelihood methods used in this analysis. Hence, an approximation based on pseudo raw scores 0.5 and 7.5 are used.

Figure 1: Comparison of the FIES-H St Lucia scale with VoH Global Standard