VOICES
of the
HUNGRY

Measuring Food Insecurity through people's experiences

State-of-the-art and results from four pilot studies in Sub Saharan Africa

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Special thanks to Mark Nord and to Sara Viviani

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Outline

I. Introducing a proper theory of measurement in the social sciences
- Objective (invariant) measurement of latent traits
- The Rasch model, as the cornerstone of Item-Response Theory (IRT)

II. Application to the severity of food insecurity
- Defining the concept of 'severity of food security' through the FIES
- Analyzing the responses to the FIES

III. Preliminary results of Voices of the Hungry pilot tests in Angola, Ethiopia, Malawi and Niger
- Validation of the tools
- Analysis of relationship between threshold levels and prevalence rates

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A theory of measurement for social science

- In social sciences, the *objects* being measured are often rather elusive (ex.: “democracy”, “wellbeing”, “power”, “intelligence”, “food security”, etc.)
  - These have been termed “**latent traits**” or “**constructs**”
  - Existence is revealed only indirectly, through observable phenomena (behaviors, experiences, consequences, etc.)
- It is impossible to validate measures by reference to a “gold standard”
  - Validity **of the underlying concept**
    - By consensus on its usefulness in informing discussions
  - Validity **of the measurement tool**
    - Based on its theoretical foundation
  - Validity **of particular measures**
    - Performance of the tool in specific conditions

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A theory of measurement for social science

- The validity of the measurement poses special questions as regarding the *objectivity* (invariance) of the measures
  - Measures obtained with one tool ought to be independent of the object being measured
  - Measures of the same object obtained with different tools, should be independent of the tool being used
- Advocates of the **Rasch model** claim that it is the *only* psychometrics model that fulfills these requirements
  - References: Rasch (1960), Fischer and Molenaar (2006), Engelhard (2013)

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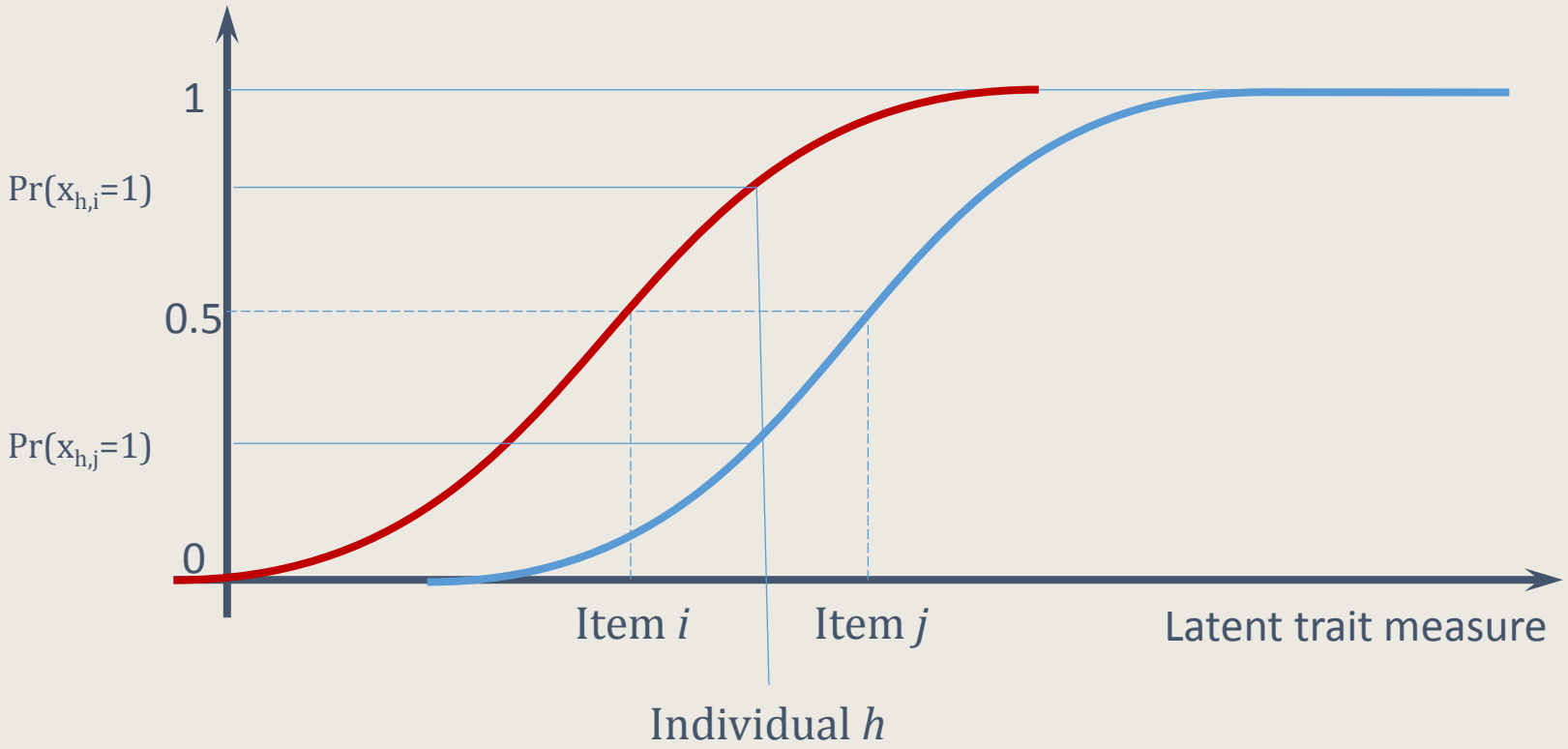
The Rasch model

- Developed to measure latent traits on individuals
  - Developed in educational testing and psychometrics (Rasch, 1960)
  - Known in econometrics as the *logit* model
- The probability of one individual affirming an item (or of making a decision, or of showing a symptom, etc.) depends on the distance between the item and the individual on the latent trait scale

$$\mathrm{Prob}\left(x_{h,i} = 1 \middle| h, i\right) = \frac{e^{h-i}}{1 + e^{h-i}}$$

- As it depends on the *distance* (not the absolute value of the measures) setting the "zero" is arbitrary
- Any affine transformation of the scale would yield the same ranking (arbitrariness of the scale for ranking purposes)
- With *n* items, only *n-1* item parameters can be estimated

The Rasch model



The Rasch model

- A special case of more general latent variable models

$$\mathrm{Prob}(x_i = 1|\boldsymbol{\theta}) = \phi(\boldsymbol{\theta})$$

- Extensions are available for *polytomous* models, where the observed variable is multinomial
- Framing it in probabilistic terms…
  - … recognizes that observations may be affected by errors
  - … provides the basis for *estimating* the parameters of the model by maximizing the likelihood of any observed set of data
    - For dichotomous data, i.e. $\{x_i\} \in \{0,1\}\ \forall\ i$, and assuming independence of the responses

$$L(X|\boldsymbol{\theta}) = \prod_i \phi(\boldsymbol{\theta})^{x_i} \times (1 - \phi(\boldsymbol{\theta}))^{1-x_i}$$

  - … allows for the analysis of goodness of fit as a way to tackle the **empirical validity** question in a rigorous way

The analytics of the Rasch model

- Quite simple in practice, yet sophisticated enough to address all the relevant questions of empirical validity
- Heuristically, it can be described as taking two passages through the data
  - First, by looking at the items, to determine their relative position on the scale
  - Then, by looking at the individuals, to determine their position on the scale

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The Rasch model

Individuals	Items: I	II	II	…	N	Sum (raw score)
1	1	1	0	…	0	T^1
2	1	1	1	…	0	T^2
3	1	1	0	…	1	T^3
…	…	…	…	…	…	…
m	1	0	0	…	0	T^m
Sum	T^I	T^{II}	T^{III}		T^N	T

The logic underpinning the Rasch model

- It imposes the necessary restrictions to allow consistent estimates of the item parameters:
  - Conditionally on items' severity, only response patterns of the type {1, …, 1, 0, …, 0} are admissible.
  - Only non-extreme responses (i.e., at least one 0 and at least one 1) are informative
  - This implies that the raw scores (i.e., the sums of the elements in the response vector) is a *sufficient statistics* for the respondent severity
  - Under the truth of the model, and given the items' severity, each pattern of responses has a definite expected probability to be observed
  - Measures of *fit* can be produced by analyzing the expected probability of observed patterns, and by computing and analyzing "residuals" as the difference between the actual response and the expected probability of a positive response

Tests of the Rasch model

- Fit statistics
  - 0.8 – 1.2 : adequate fit
  - 0.7 – 1.3 : productive for measurement, though revealing potential problems
- Robustness of the severity items to split-samples
  - Invariance of the measure implies that the severity associated with the items should not depend on the particular set of respondents
- Factor analysis of the “residuals”
  - To detect the presence of additional dimensions not captured by the scale
- In case the Rasch model does not fit the data
  - Revise the choice of the items (excluding the problematic ones)
  - Use more sophisticated models to score cases
    - Probabilistic assignment of cases to classes
    - 2PLM, allowing for unequal discrimination among items

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Scaling and equating

- As the Rasch measure is scale invariant, and because different application may produce measures on different scales, comparison across samples requires bringing the measure to a common scale
  - A common scale can be developed, by equalizing the mean and standard deviation of a group of common items (at least 2, and up to all items in the scale)
  - If not all items are common items, raw scores cannot be compared across applications

Important: all items in the scale contribute to the measure.
It makes little sense to analyze each question separately.

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The severity of food insecurity

The FIES:
a set of questions revealing experiences spanning the range of severity

	Food security	Food insecurity			
		mild	moderate		severe
experiences		**Worries**	Compromising food **quality and variety**	Compromising **food quantity**	**Hunger**
consequences	**Wellbeing**	**Welfare reduction** (Psychological costs, reduction of other essential expenses)	**Malnutrition** (obesity, micronutrient deficiencies, reduced work capacity)	**Undernutrition** (stunting, wasting)	**Starvation**

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The (current version of the) FIES

*"During the last 12 months, was there a time when, **because of lack of money or other resources**:*

1. *You were **worried** you would not have enough food to eat?*
2. *You were unable to eat **healthy and nutritious** food?*
3. *You ate only a **few kinds** of foods?*
4. *You had to **skip a meal**?*
5. *You **ate less** than you thought you should?*
6. *Your household **ran out** of food?*
7. *You were **hungry** but did not eat?*
8. *You went **without eating for a whole day?"***

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Linguistic and cultural adaptation

- Each question aims at detecting “typical” experiences associated with increasing severity
- The *meaning* of the question must be clearly understood by the respondent to give informative answers
  - Need to express it in the language of the respondent, and to adapt it the local cultural context
  - The importance of the “lack of resources” qualifier
  - And of proper training of the interviewers
- Despite all efforts in cultural and linguistic adaptation, estimated severity for some items may differ across countries
  - Equating must be based on a restricted number of common items
  - Probabilistic assignment of cases to food security classes to calculate prevalence levels, taking into consideration both common and idiosyncratic items

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Applying the FIES through the GWP

- Individual experiences
  - Consistent with the GWP reference population
  - Increases the reliability of the responses
  - Allows for analysis of possible gender discrimination
- 12 months reference period
  - Consistent with the need of an annual monitoring on a global scale
  - To ensure comparability of assessments across countries
- No follow up questions related to the frequency of experience
  - While undoubtedly important, frequency of occurrence is a *distinct dimension* of the food insecurity experience, calling for 2-dimensional classification

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Results from the four pilot studies

- The FIES was adapted to local languages in Ethiopia, Angola, Malawi and Niger
  - Reports of the adaptation are available on the VoH webpage
- Included in the 2013 round of the Gallup World Poll™
  - Nationally representative samples of the adult (15+) population in each country
  - Sample size: 1000
  - Face-to-face interviews in local languages
- Results have been analyzed to:
  - validate the concept by analyzing the fit of the Rasch model
  - determine the most appropriate procedure for scoring and classification
  - analyze robustness of prevalence estimates to threshold settings

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Results from the pilot studies: Angola

Item	Severity	Standard Errors	Infit	Outfit
WORRIED	-1.59	0.14	1.18	1.46
HEALTHY	-0.76	0.12	0.86	1.04
FEWFOOD	-0.37	0.11	1.07	1.28
SKIPPED	-0.24	0.11	0.87	0.74
ATELESS	-0.44	0.11	0.92	0.81
RUNOUT	0.25	0.11	0.86	0.72
HUNGRY	0.87	0.11	1.00	0.98
WHLDAY	2.27	0.13	1.18	1.63
Mean	0			
St. Dev.	1.09			
N (complete, non extreme)	505			

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Results from the pilot studies: Ethiopia

Item	Severity	Standard Errors	Infit	Outfit
WORRIED	-0.75	0.11	1.4	2.25
HEALTHY	-2.17	0.13	0.92	2.19
FEWFOOD	-2.63	0.14	0.96	1.11
SKIPPED	-0.02	0.11	0.74	0.71
ATELESS	-0.6	0.11	0.84	0.85
RUNOUT	1.36	0.12	0.76	0.69
HUNGRY	1.64	0.13	0.84	0.8
WHLDAY	3.16	0.17	1.1	3.7
Mean	0			
St. Dev.	1.84			
N (complete, non extreme)	597			

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Results from the pilot studies: Malawi

Item	Severity	Standard Errors	Infit	Outfit
WORRIED	-0.49	0.13	1.11	1.17
HEALTHY	-0.36	0.13	1.16	1.36
FEWFOOD	-1.00	0.14	0.84	0.62
SKIPPED	0.22	0.12	0.97	0.88
ATELESS	-0.70	0.14	0.94	0.97
RUNOUT	0.12	0.12	0.9	0.81
HUNGRY	0.54	0.12	1.03	1.05
WHLDAY	1.67	0.12	1.04	1.14
Mean	0			
St. Dev.	0.79			
N (complete, non extreme)	423			

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Results from the pilot studies: Niger

Item	Severity	Standard Errors	Infit	Outfit
WORRIED	-1.37	0.11	1.24	1.62
HEALTHY	-0.64	0.1	0.92	0.76
FEWFOOD	-1.00	0.11	1.01	0.9
SKIPPED	0.80	0.09	1.06	1.05
ATELESS	-0.49	0.1	0.98	1.02
RUNOUT	0.46	0.09	0.79	0.68
HUNGRY	0.30	0.09	0.82	0.75
WHLDAY	1.95	0.1	1.21	1.33
Mean	0			
St. Dev.	1.02			
N (complete, non extreme)	734			

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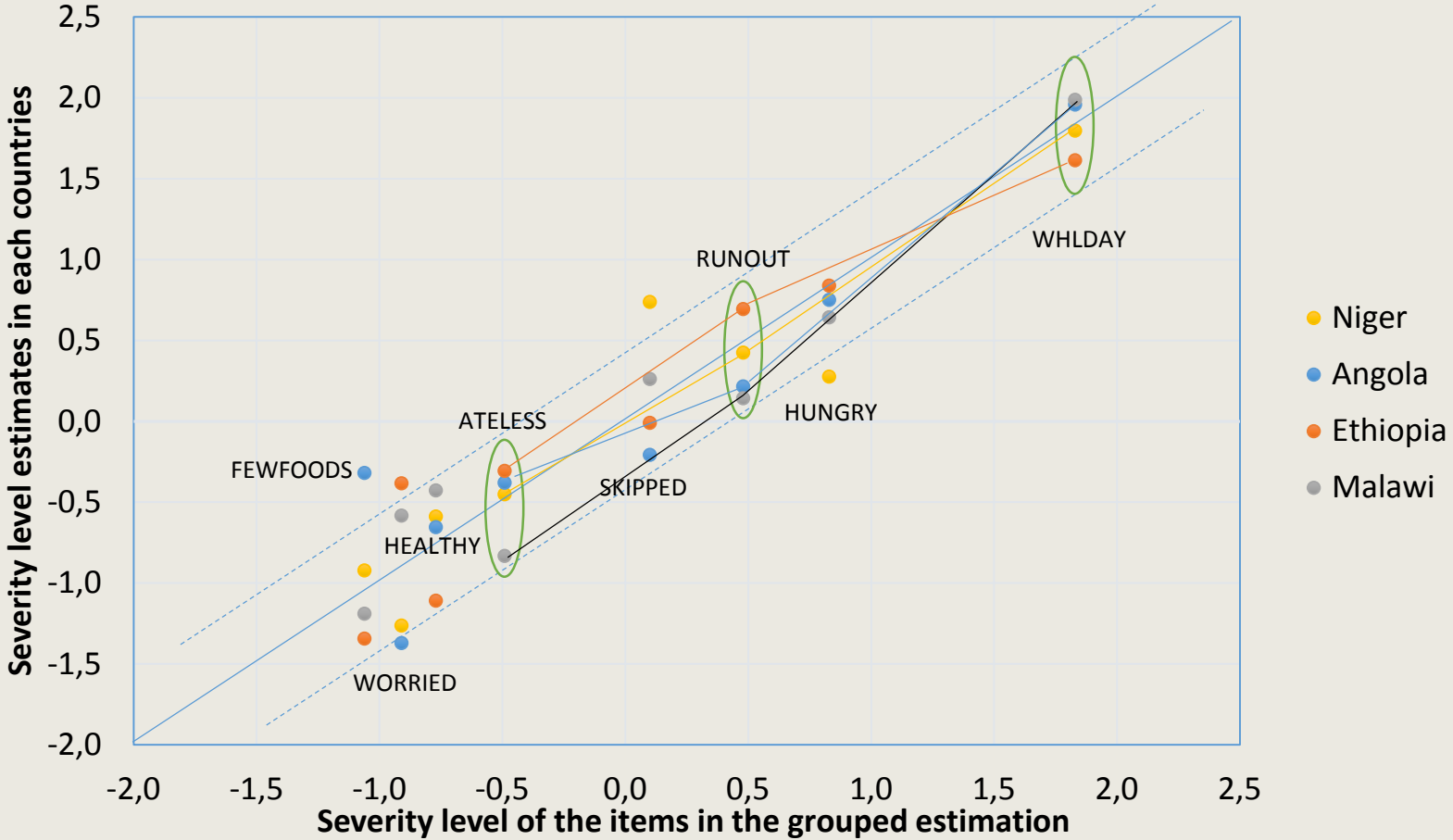
Comparison after rescaling, to identify common items



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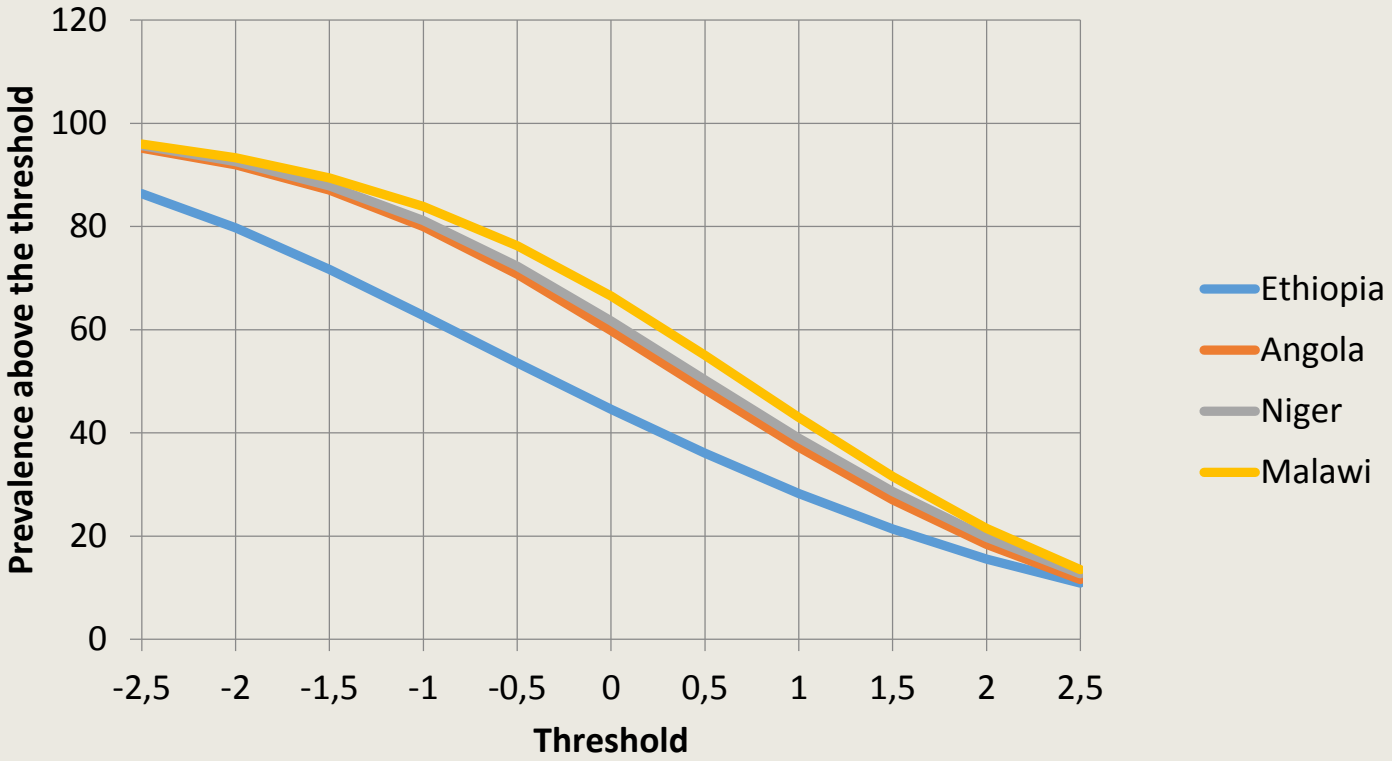
Prevalence rates at different thresholds

	Thresholds										SD (within countries)
	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	
Grouped sample											
Prevalence (%)	**90.8**	**85.2**	**77.7**	**68.3**	**57.6**	**46.5**	**35.8**	**26.2**	**18.0**	**11.6**	
Index	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	
Individual countries											
Ethiopia	**79.7**	**71.7**	**62.8**	**53.6**	**44.6**	**36.1**	**28.3**	**21.4**	**15.6**	**10.9**	
	88	*84*	*81*	*78*	*77*	*78*	*79*	*82*	*86*	*93.6*	5.6
Angola	**92.0**	**87.1**	**80.0**	**70.7**	**59.9**	**48.4**	**37.3**	**27.1**	**18.4**	**11.6**	
	101	*102*	*103*	*104*	*104*	*104*	*104*	*103*	*102*	*100*	1.4
Niger	**92.6**	**87.9**	**81.2**	**72.3**	**61.7**	**50.3**	**39.0**	**28.6**	**19.8**	**12.7**	
	102	*103*	*104*	*106*	*107*	*108*	*109*	*109*	*110*	*109*	3.1
Malawi	**93.3**	**89.4**	**83.9**	**76.3**	**66.5**	**55.1**	**43.0**	**31.5**	**21.5**	**13.5**	
	103	*105*	*108*	*112*	*116*	*118*	*120*	*120*	*119*	*116*	7.2
SD (between countries)	7.1	9.7	12.4	14.7	16.4	17.4	17.4	16.3	13.9	9.9	

Prevalence rates at different thresholds



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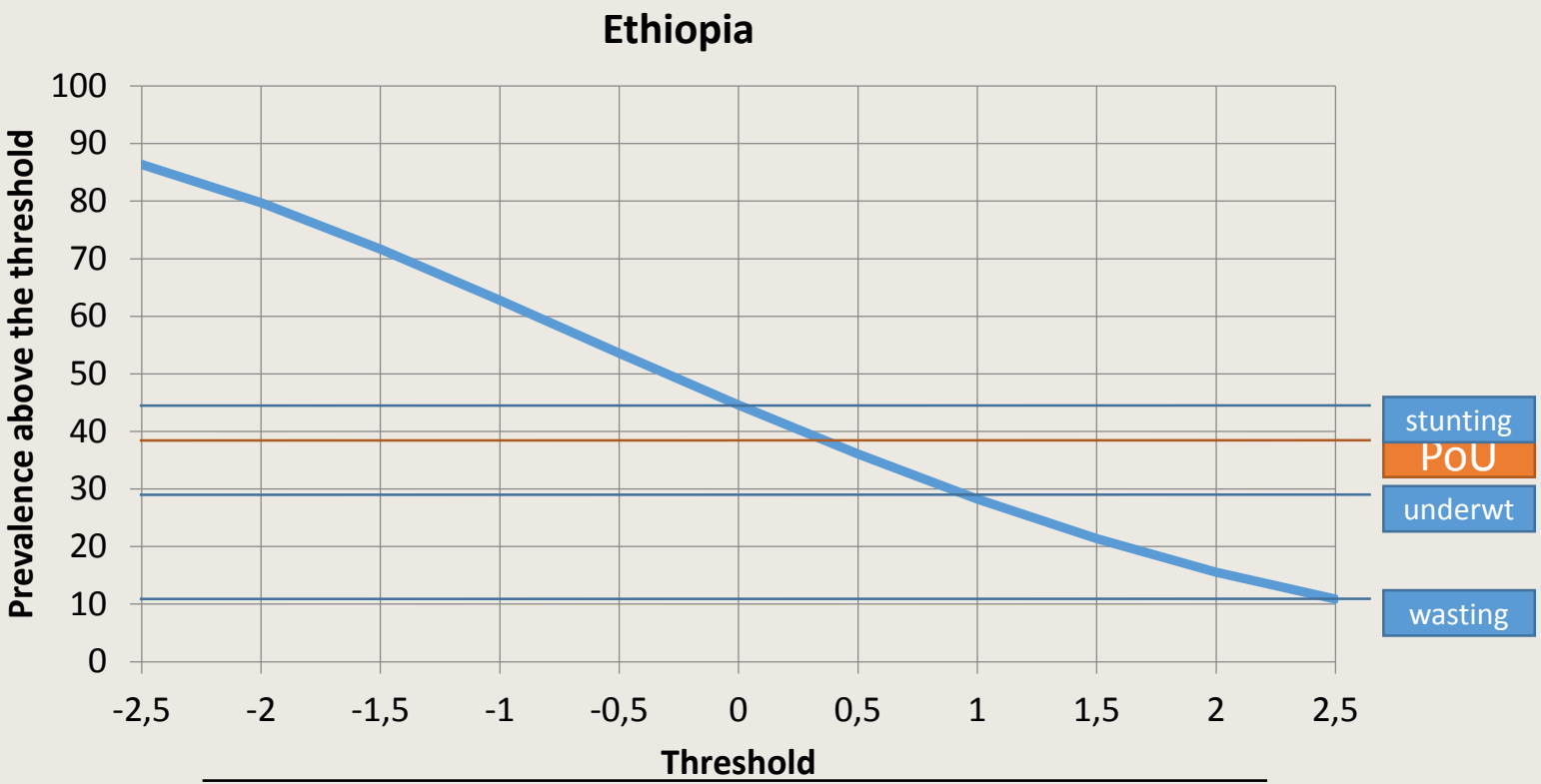
Prevalence rates at different thresholds



	PoU (2011-13)	Child anthropometrics (% among under 5)			
		Wasting	Underweight	Stunting	(2011)
Ethiopia	37.1	10.1	29.2	44.2	

To the scale

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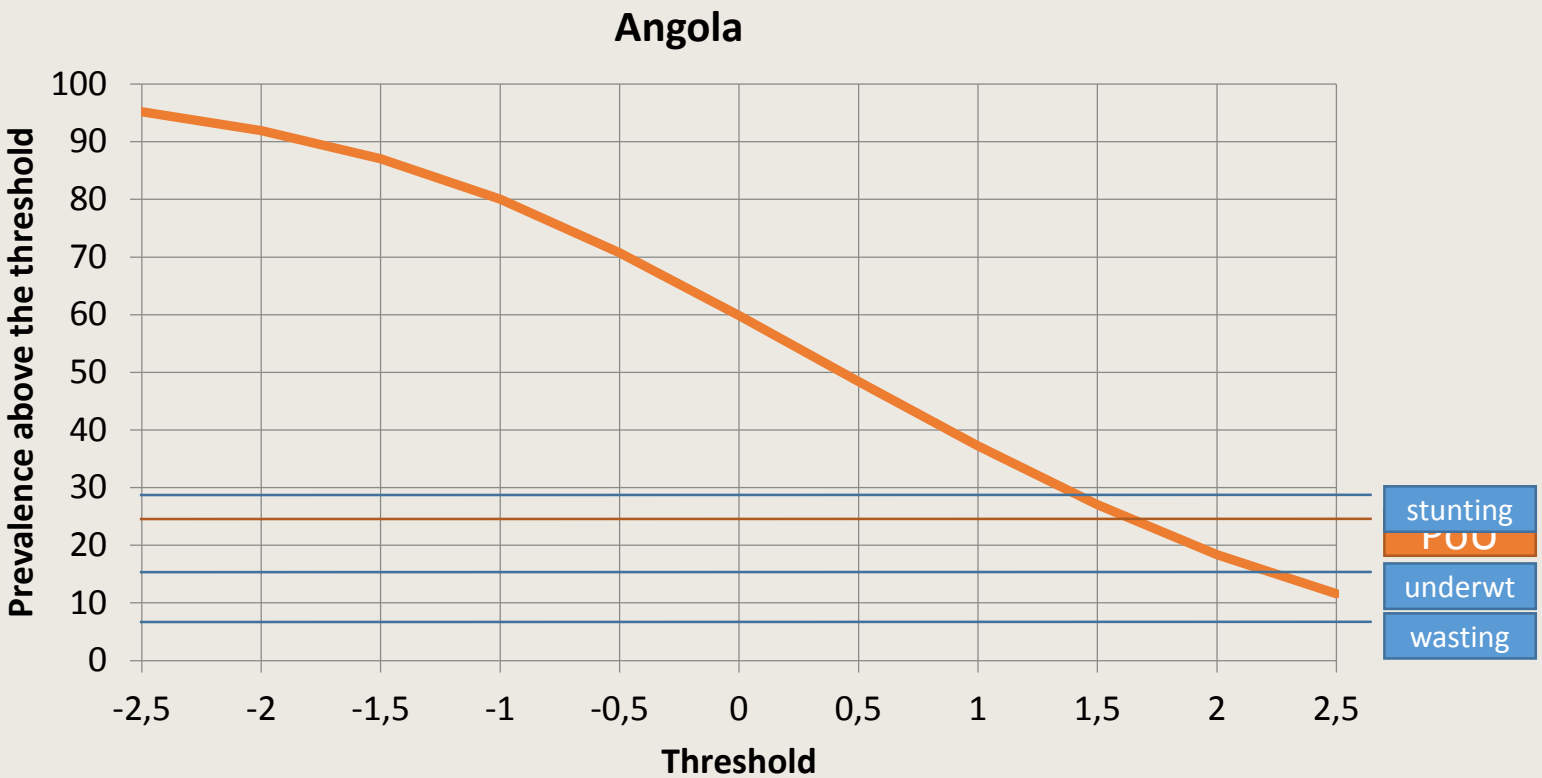
Prevalence rates at different thresholds



	PoU (2011-13)	Child anthropometrics (% among under 5)			
		Wasting	Underweight	Stunting	(2006)
Angola	24.4	8.2	15.6	29.2	

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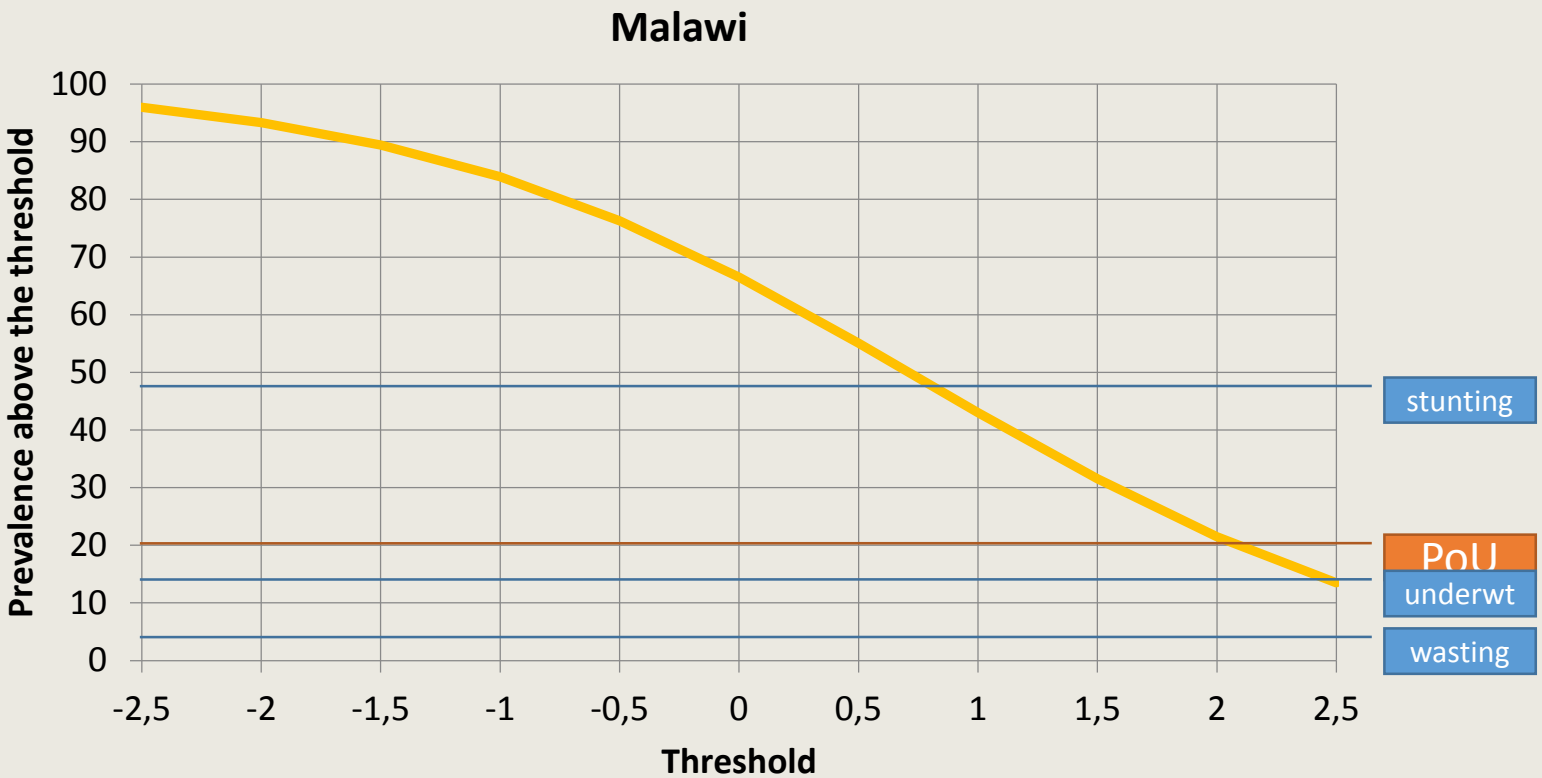
Prevalence rates at different thresholds



	PoU (2011-13)	Child anthropometrics (% among under 5)			
		Wasting	Underweight	Stunting	(2010)
Malawi	20.0	4.1	13.8	47.8	

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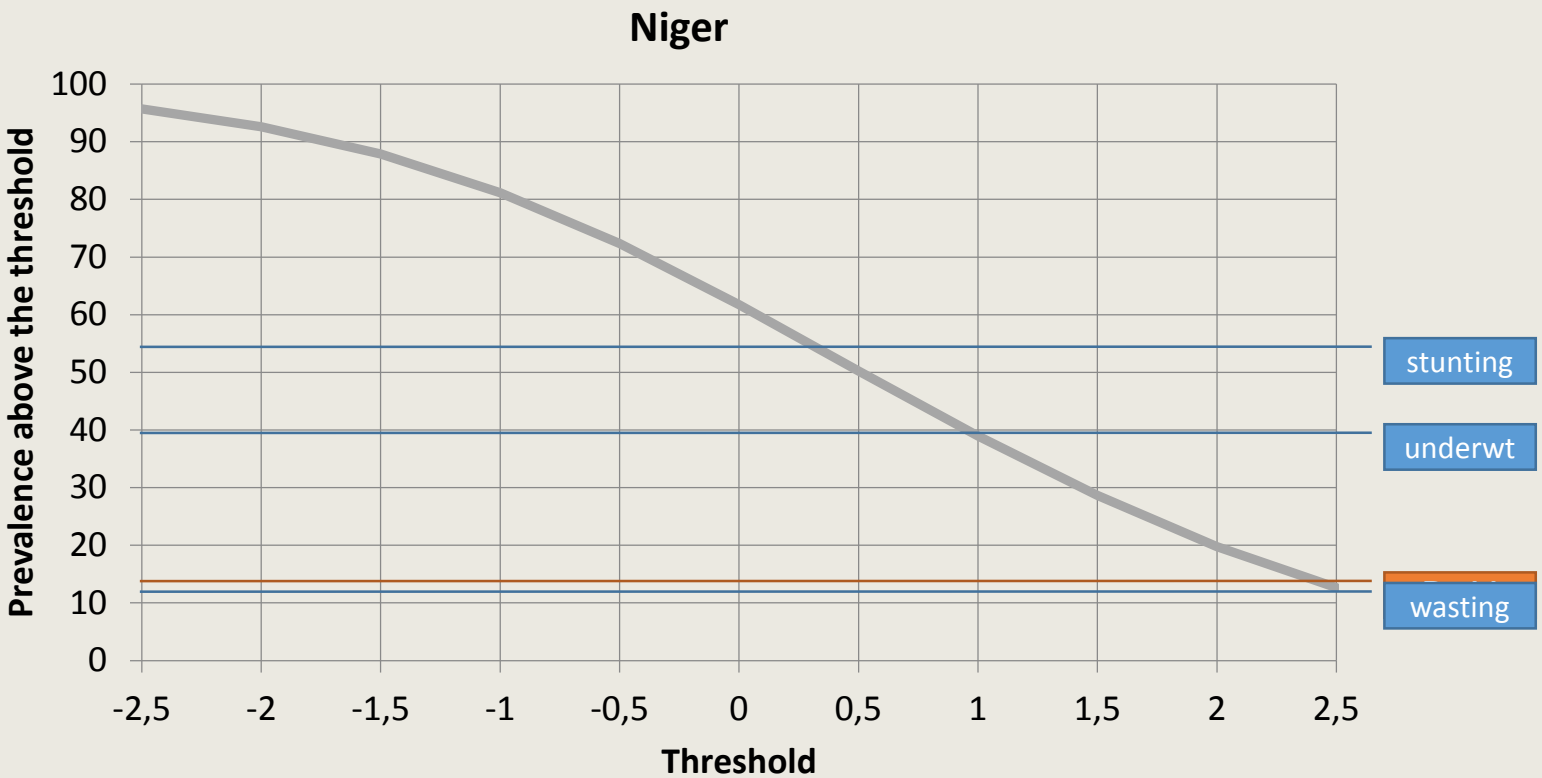
Prevalence rates at different thresholds



	PoU (2011-13)	Child anthropometrics (% among under 5)			
		Wasting	Underweight	Stunting	(2006)
Niger	13.9	12.4	39.9	54.8	

What's ahead?

- Global data collection in 2014
  - 150+ countries covered by the GWP
  - Face to face interviews in 112 countries
- Calibration of the global standards for common item severities and threshold settings
  - Data will be processed as they are made available from Gallup according to the GWP calendar
  - Once a sufficient number of countries from the various regions of the World are available, we will identify the severity of the common items, to be used as a reference for equating the scales and setting the thresholds
  - Scoring and corresponding prevalence rates will be determined in each country, considering both the common and the idiosyncratic items
- Two national level indicators based on prevalence rates
  - Food insecurity
  - Severe food insecurity (high risk of hunger)

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