

## Background

- **Micronutrient deficiency** affects over 2 billion people globally [1], leading to several adverse health outcomes.
- **Food fortification**, a key intervention scaled up by the World Food Programme, addresses this issue by adding essential nutrients to commonly consumed foods. Evaluating the effectiveness of fortification is challenging due to the **specificity** of existing micronutrient inadequacy indicators, while programs often target **multiple micronutrients**.
- Existing composite indicators offer a high-level summary of inadequacy but **have not yet been evaluated for how well they represent individual micronutrient inadequacy**

## Aim

To **evaluate** and **compare** the extent to which composite indicators of inadequate micronutrient intake can be used for **fortification programmes** to identify **populations at risk**, nationally and sub-nationally.

## Objectives

1. What are the composite indicators and how do they compare against one another?
2. Do the composite indicators represent multiple micronutrients within large scale food fortification programs, and to what extent?

## Methods

### Data Sources and Study Design

- Secondary data analysis
- Household Consumption and Expenditure Surveys (HCES)
- Food composition tables
- Nutrient Intake reference values
- Food based dietary guidelines

### Study Population

- **Ethiopia** (N = 30,221)
- **Nigeria** (22, 117)
- **India**(15, 065)

### Analysis

- Construction of the composite indicators
- Comparison of distributions
- Descriptive Analysis
- Correlational Analysis

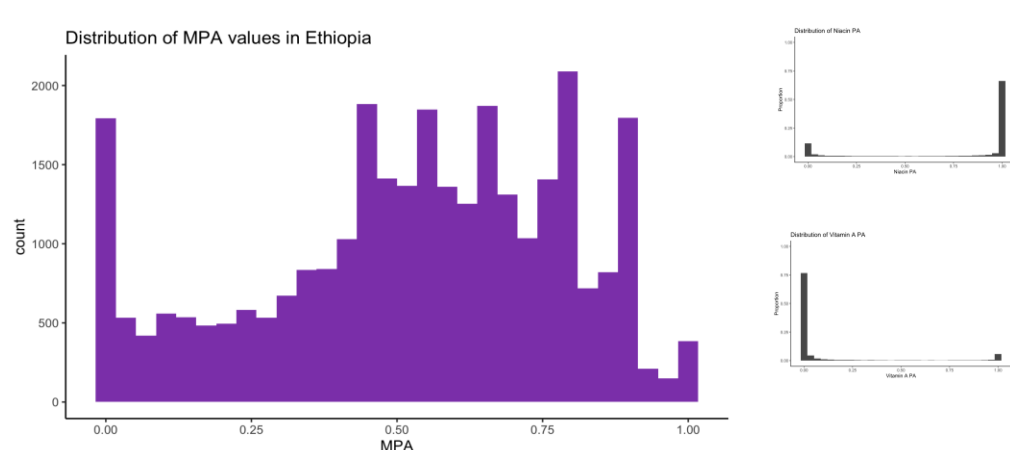
## Results

### Objective 1

#### Mean Probability of Adequacy (MPA)

$$MPA = \frac{\sum \text{Probability of Adequacy (PA)}}{\text{no. of micronutrients}}$$

(or 0 - 100 if represented as a %)



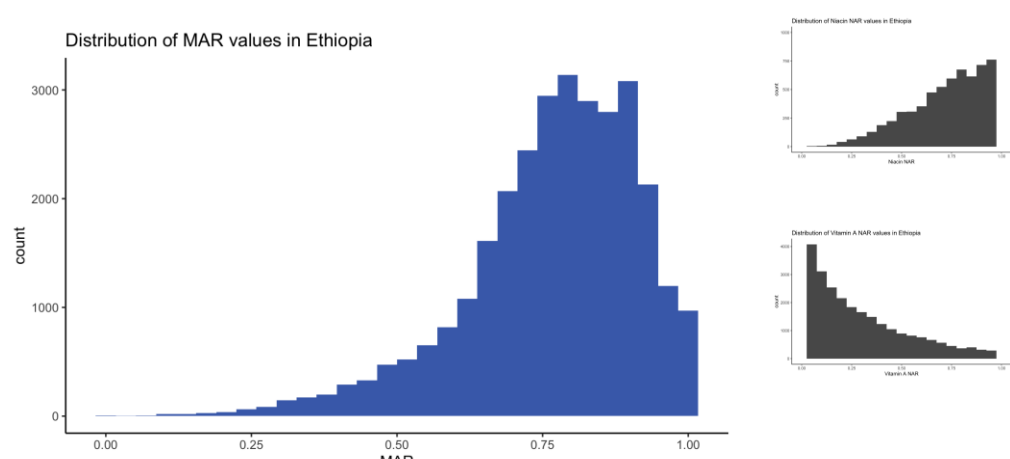
- **Likelihood of adequacy**
- Spiky distribution
- Peaks reflects a group of micronutrients with similar PA values.
- Peak at 0 for micronutrients which have high prevalence of inadequacy (e.g. PA = 0).
- The aggregated distribution reflects individual PA distributions.

#### Mean Adequacy Ratio (MAR)

$$MAR = \frac{\sum \text{NAR}}{\text{no. of micronutrients}}$$

(or 0 - 100 if represented as a %)

Nutrient Adequacy Ratio: Ratio of intake of a nutrient relative to the recommended allowance. Truncated at 1 (100% of the NRV). Using adult female equivalent units.

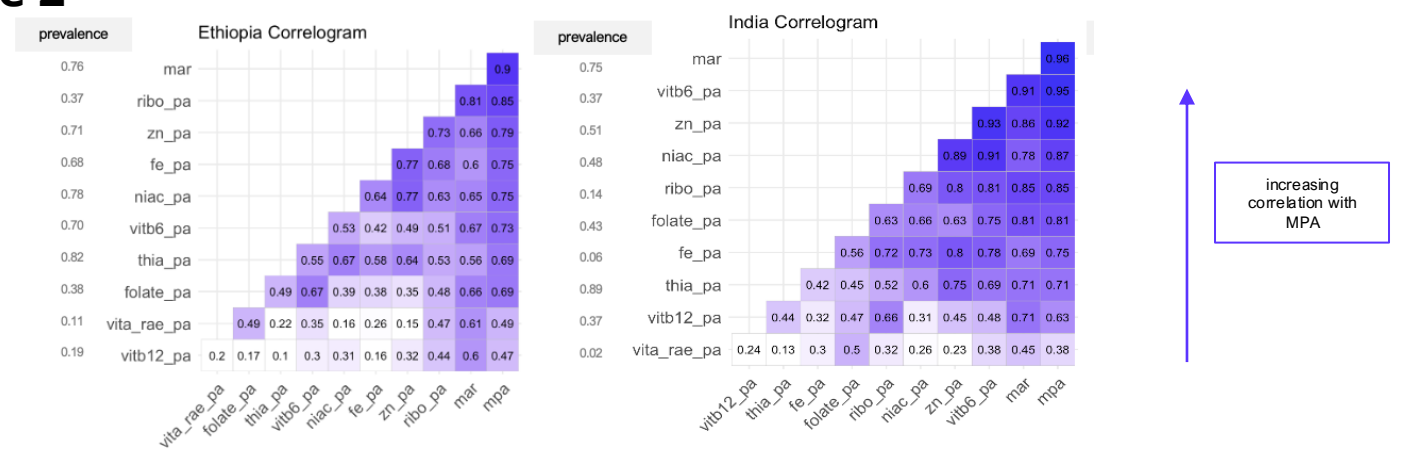


- **Magnitude of adequacy**
- Left skewed distribution indicates that most of the population have an MAR close to 1.
- Not reflective of individual NAR distributions (e.g. Vitamin A and B12 are left-skewed, with most of the population having a MAR near 0).

- MAR estimates are consistently higher than the MPA estimates at both the national and sub-national levels (e.g. when stratified by residence or socio-economic position)
- The MAR **underestimates the risk of inadequacy** compared to the MPA

	Ethiopia (N=30221)	India (N=15605)	Nigeria (N=22106)	Overall (N=67932)
<b>Mean Adequacy Ratio</b>				
Mean (SD)	0.766 (0.149)	0.754 (0.138)	0.731 (0.201)	0.752 (0.166)
Median [IQR]	<b>0.788 [0.186]</b>	0.773 [0.193]	0.765 [0.299]	0.779 [0.217]
<b>Mean Probability of Adequacy</b>				
Mean (SD)	0.528 (0.262)	0.365 (0.243)	0.414 (0.277)	0.453 (0.272)
Median [IQR]	<b>0.556 [0.375]</b>	0.327 [0.389]	0.355 [0.454]	0.455 [0.449]

### Objective 2



The composite indicators do not equally represent micronutrients targeted in large-scale food fortification programs.

- **Best represented micronutrients:** Minerals (Zinc & Iron), Vitamin B6, Niacin, Thiamine, Folate.
- Typically come from staple grains, legumes, pulses
- **Least represented micronutrients:** Vitamin A, Vitamin B12.
- Specific foods such as animal-source foods (A), green leafy vegetables (B12)
- **Context-dependent micronutrient:** Riboflavin.
- Sources vary between country

## Discussion & Way Forward

- The composite indicators reflect different aspects of micronutrient inadequacy.
- **MAR** is easier to calculate but more likely to underestimate inadequacy risk compared to MPA.
- **MPA** is a more robust measure, offering precise estimates by calculating probability and accounting for variability in requirements.
- **Representation of micronutrients** by composite indicators varies depending on their food group.
- Future work can investigate how composite indicators can relate to other WFP programs (e.g. dietary diversity)