Designing Food Fortification Programs Using Household Consumption and Expenditure Surveys (HCES):

A Bangladesh Example

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Micronutrient Forum, June 6, 2014

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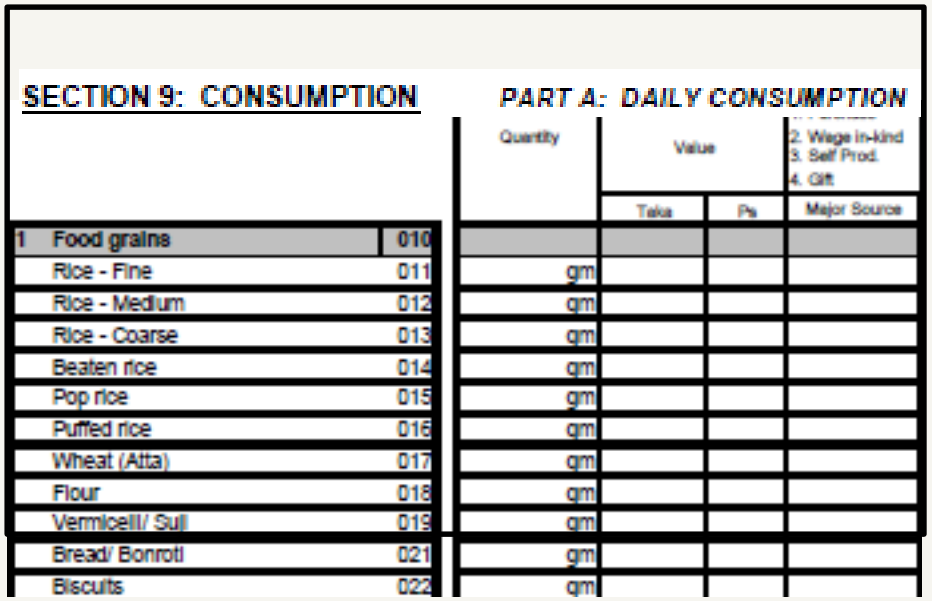
This presentation was made possible by the American people through the U.S. Agency for International Development (USAID) under Cooperative Agreement No. AID-OAA-A-11-00031, the Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) project.

Presentation Outline

- HCES overview
- Database: 2005 Household Income and Expenditures Survey
- Methods, key assumptions
- Results
- Looking forward: Improving HCES

Household Consumption and Expenditure Surveys (HCES)

- A family of large scale, recurring, multi-purpose household surveys (HIES, LSMS, HBS, etc.)
- Generally representative at a subnational (regional or state) level



SECTION 9: CONSUMPTION — **PART A: DAILY CONSUMPTION**

		Quantity	Value		2. Wage in-kind 3. Self Prod. 4. Gift
			Taka	Ps	Major Source
1 Food grains	010				
Rice - Fine	011	gm			
Rice - Medium	012	gm			
Rice - Coarse	013	gm			
Beaten rice	014	gm			
Pop rice	015	gm			
Puffed rice	016	gm			
Wheat (Atta)	017	gm			
Flour	018	gm			
Vermicelli/ Suji	019	gm			
Bread/ Bonroti	021	gm			
Biscuits	022	gm			

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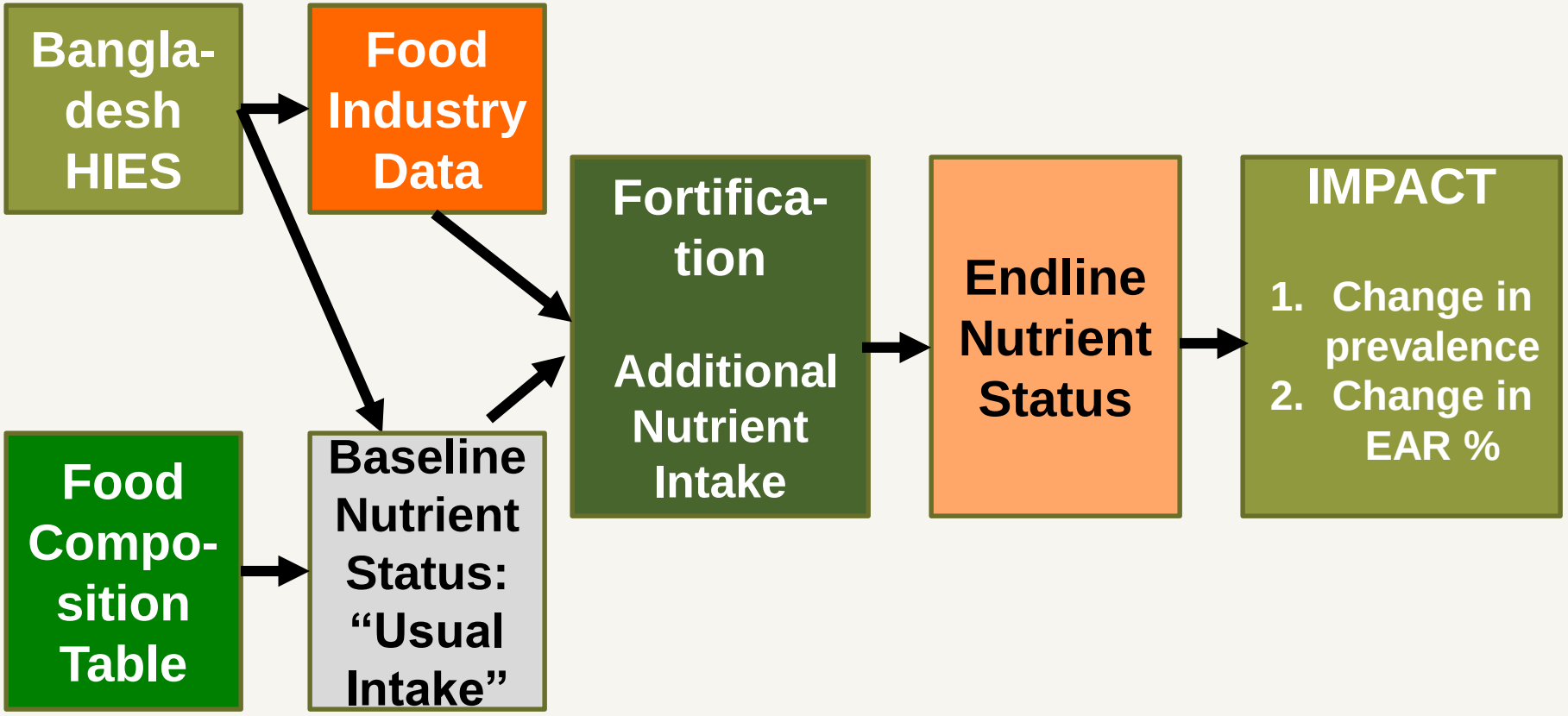
Household Consumption and Expenditure Surveys (HCES)

- Information on a mix of household food consumption and acquisition
- Routinely conducted in more than 115 countries
  - Incremental cost of analyzing the nutrient content of an already-existing HCES: ~$25,000
  - Cost of fully implementing a 24HR (8,500 HHs) $2.3million

Using HCES to Model Fortification



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The Database

- 2005 Bangladesh Household Income and Expenditure Survey, 13th round since 1972
- Two-stage, stratified random sample
- 10,080 households, 48,969 persons
- Representative at the national and divisional (n=7) levels

HIES Consumption Module

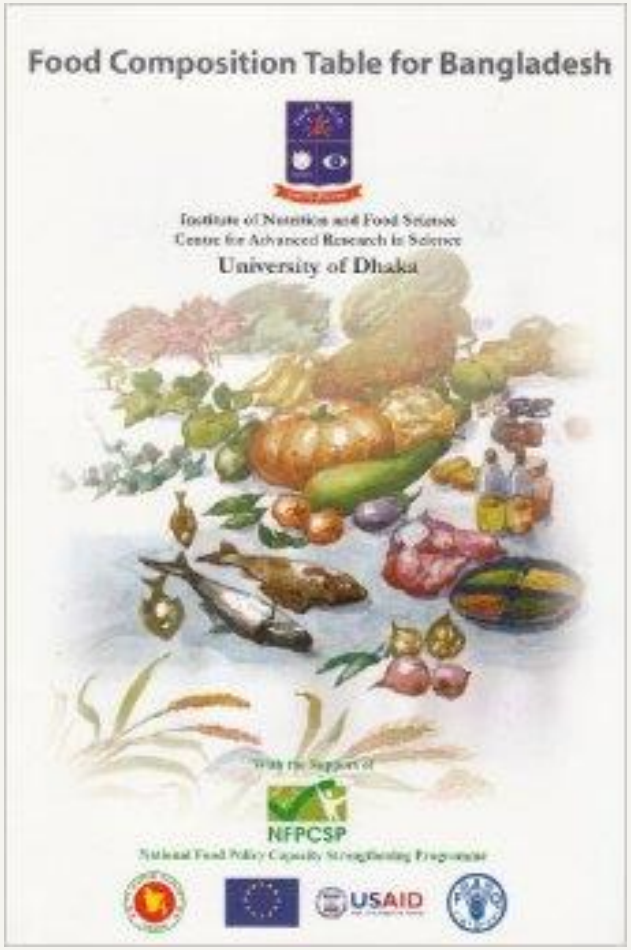
- Seven consecutive 2-day visits to collect food data
- 132-item food list—How "good" is it?
  - Does it adequately capture the most commonly consumed foods?
  - Does it capture the important food sources of nutrients?
  - Does it specify the form of the food? How the food was prepared (e.g., steamed, baked, raw?)
- How much of each food item was:
  - Purchased
  - Consumed from own production
  - Received free from friends, relatives, a social program

Estimating Apparent Nutrient Intake

1. Estimate “apparent daily consumption”
   a. Assume all food acquired/consumed in the past 14 days is consumed and constitutes “usual intake”
   b. Assume none of the food is wasted, spoils, is given away, and there are no food stocks
   c. Calculate total amount of each food acquired/ consumed in the 14 day recall period, divide by 14
2. Match each food list item with a food composition table entry to identify its nutrient content
3. Multiply the quantity of each food by its estimated nutrient content and sum across all foods
4. Estimate the prevalence of apparent nutrient intake

Food Composition Tables (FCTs)

- Provide the nutrient content per 100g of edible food
- How precise are they?
- How unambiguously can they be matched to the HIES food item list?



The Bangladesh FCT

Code	Food Item Name	Serving (g)	Edible	Water (g)	Energy (Kcal)	Iron (mg)	Zinc (mg)	Vit A (RAE)
101	rice	100.00	1.00	13.50	345.50	1.95	1.40	0.00
102	rice – other sources	100.00	1.00	13.30	346.00	1.00	1.40	0.00
103	chira (unhusked rice)	100.00	1.00	13.30	346.00	1.00	0.90	0.00
104	khoi (pop rice, lawa	100.00	1.00	5.80	392.00	1.49	3.00	0.00
105	muri (puffed rice)	100.00	1.00	5.80	392.00	1.49	3.00	0.00
106	other rice products	100.00	1.00	12.63	354.67	2.05	3.00	0.00
107	wheat / atta (wheat flour)	100.00	1.00	12.80	346.00	3.63	2.70	0.00
108	wheat/ atta – other sources	100.00	1.00	10.50	288.00	3.63	2.70	0.00
110	maida (wheat flour)	100.00	1.00	10.59	354.00	3.63	0.62	0.00
111	suji, rawa (Semolina)	100.00	1.00	12.67	360.00	3.63	1.05	0.00
112	sewai, noodles (rice noodle)	100.00	1.00	11.91	364.00	0.70	0.74	0.00
113	bread (bakery)	100.00	1.00	39.00	244.50	1.65	0.90	0.00
114	other wheat products	100.00	1.00	7.28	359.50	3.63	2.70	0.00
115	jowar & its products - (Sorghum)	100.00	1.00	11.90	349.00	4.10	1.60	0.00
116	bajra & its products (pearl millet)	100.00	1.00	12.40	361.00	4.10	3.10	0.00
117	maize & products	100.00	1.00	14.90	342.00	2.30	2.80	9.00

To estimate apparent nutrient intake: Multiply the quantity of each food item by its nutrient content (per 100g) and sum across all food items.

Intra-Household Distribution of Food

Assumption: Each member receives their proportionate share of the household's total adult consumption equivalents (ACEs)

Adult males, age 18-30 y, are the benchmark for comparison

ADULT MALE CONSUMPTION EQUIVALENT		
MALE	AGE (y)	FEMALE
0.217	0 -1	0.2167
0.311	1 -2	0.2787
0.369	2 -3	0.3443
0.443	3 -5	0.4098
0.516	5 -7	0.4672
0.598	7 -9	0.5574
0.705	9 -11	0.6557
0.836	11 -13	0.7459
0.984	13 -15	0.8033
1.115	15 -18	0.8197
1.000	18 -30	0.7869
0.967	30 -60	0.7705
0.803	60 +	0.6885

Prevalence of Apparent Intake Inadequacy

Estimate the prevalence of inadequate intake: the percent of individuals with intakes below the Estimated Average Requirement (EAR).

1. For vitamin A and zinc: Cut-point method
2. For Iron: Probability method.

Probability tables for alternative levels of bioavailability are available from Institute of Medicine's Dietary Reference Intakes. Washington, DC: National Academy Press, 2006.

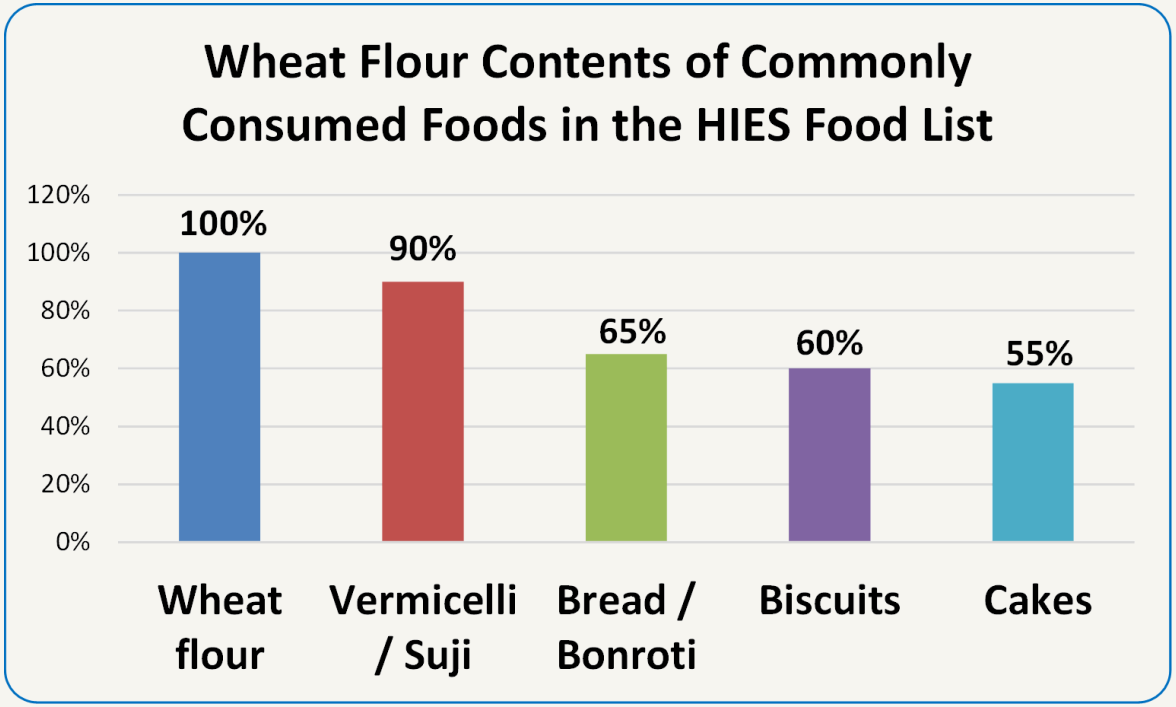
Download free-of-charge: http://www.nap.edu/catalog.php?record_id=11537

Determinants of Intervention Impact

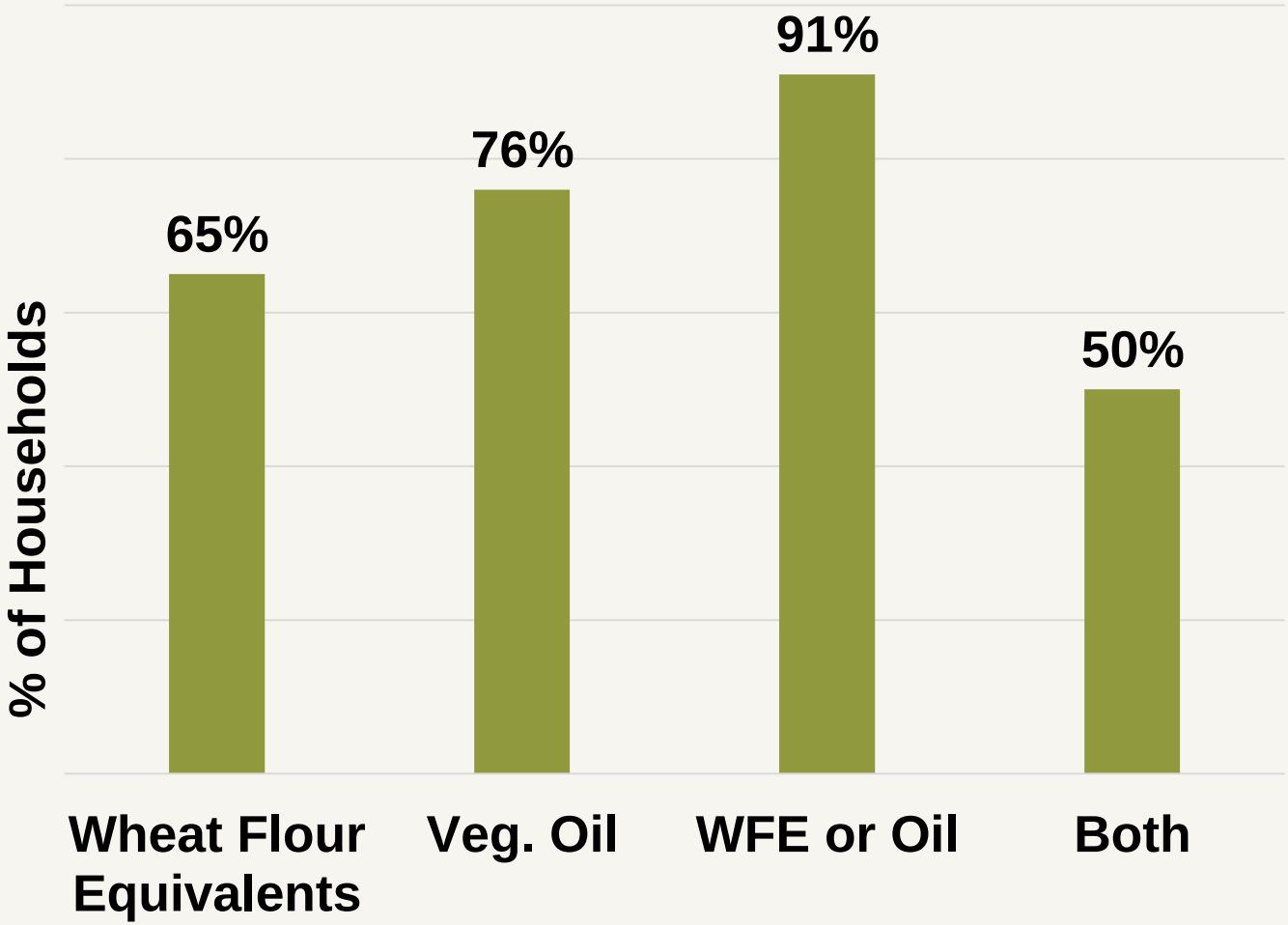
1. Prevalence of deficiency/inadequate intake
2. Severity of deficiency/inadequate intake
3. Coverage
4. Consumption (of those with inadequate intake)
5. The intervention's nutrient concentration
   - Net of nutrient losses and bioavailability considerations
6. Safety considerations must constrain efforts to maximize impact

Simulating Vitamin A Fortification

- Assume only purchased foods are fortifiable
- Identify fortification vehicles and estimate their consumption



Selecting a Fortification Vehicle or Portfolio



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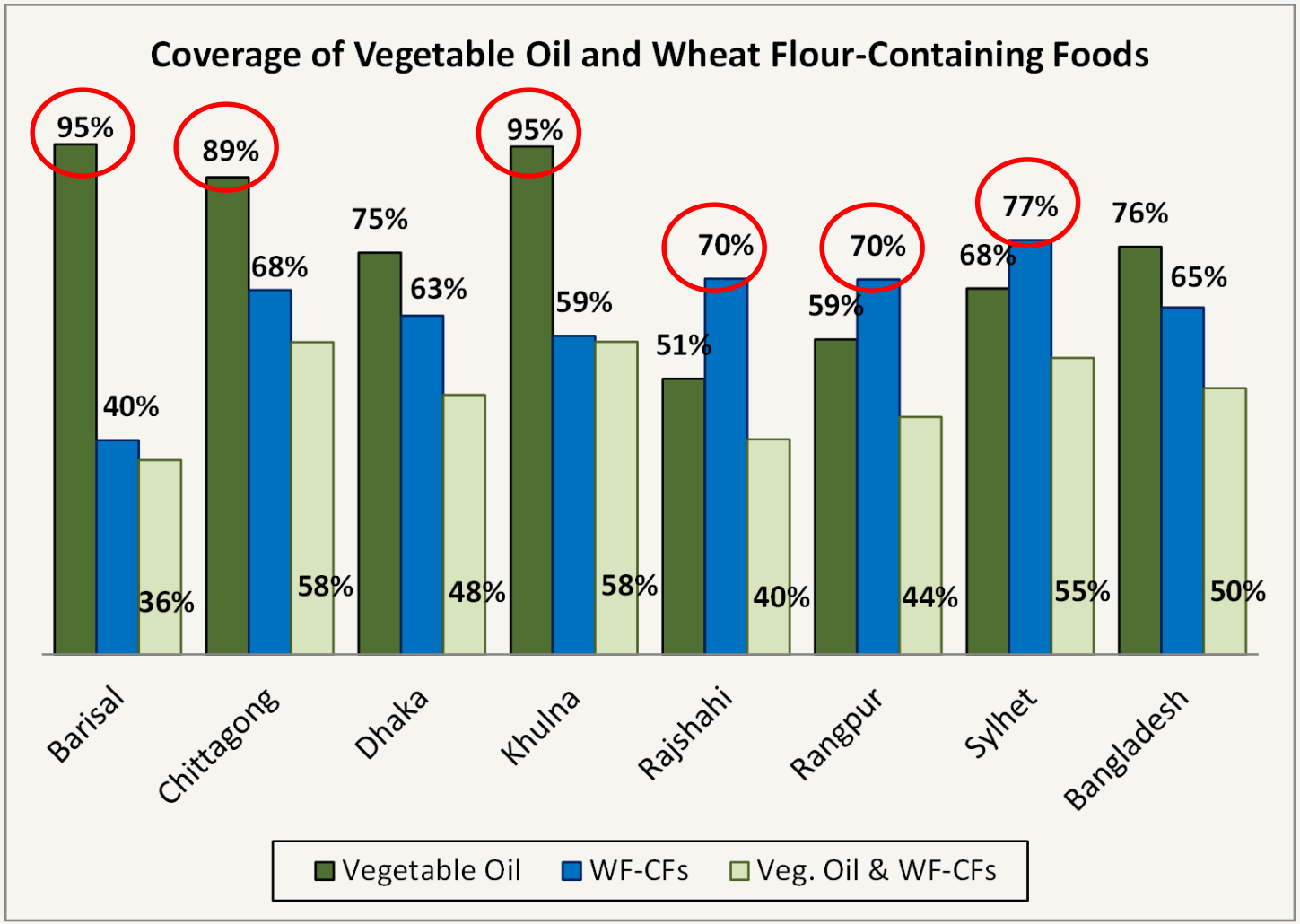
Analyze Coverage of Potential Vehicles



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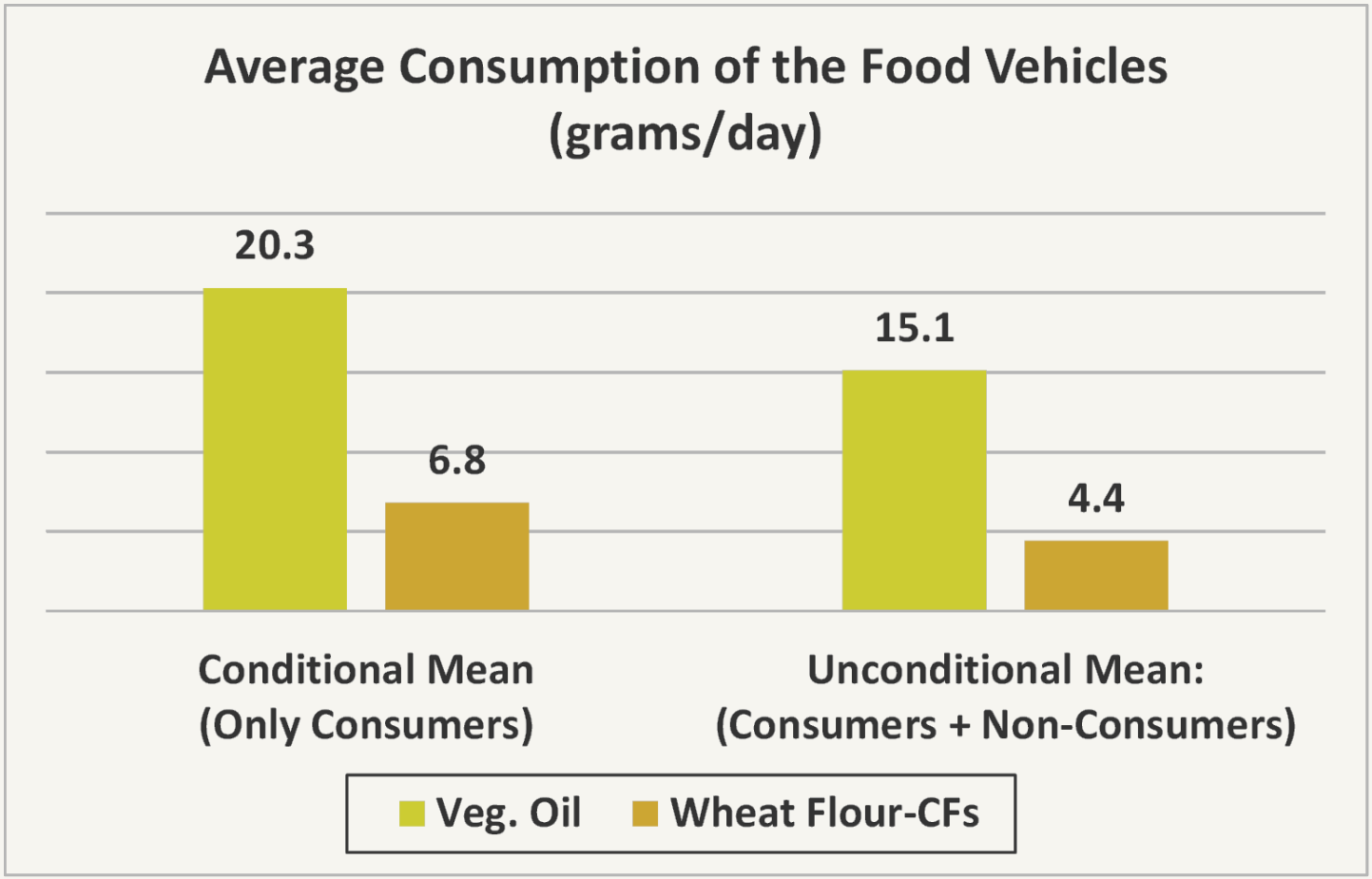
Incremental Coverage of Adding Wheat Flour to Vegetable Oil

Division	Vege-table Oil	Wheat Flour-Containing Foods	Veg. Oil or WF-CFs	Vegetable Oil and WF-CFs	*Incremental Changes of Adding WF to Oil* % Point Change in Coverage	Persons Newly Covered
Barisal	95%	40%	99%	36%	4%	332,106
Chittagong	89%	68%	99%	58%	10%	2,589,512
Dhaka	75%	63%	90%	48%	15%	6,623,772
Khulna	95%	59%	96%	58%	1%	182,148
Rajshahi	51%	70%	81%	40%	30%	5,103,547
Rangpur	59%	70%	84%	44%	26%	4,201,985
Sylhet	68%	77%	90%	55%	22%	1,934,176
Bangladesh	**76%**	**65%**	**91%**	**50%**	**15%**	**20,967,246**

Estimate consumption of food vehicles



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Specify fortification levels

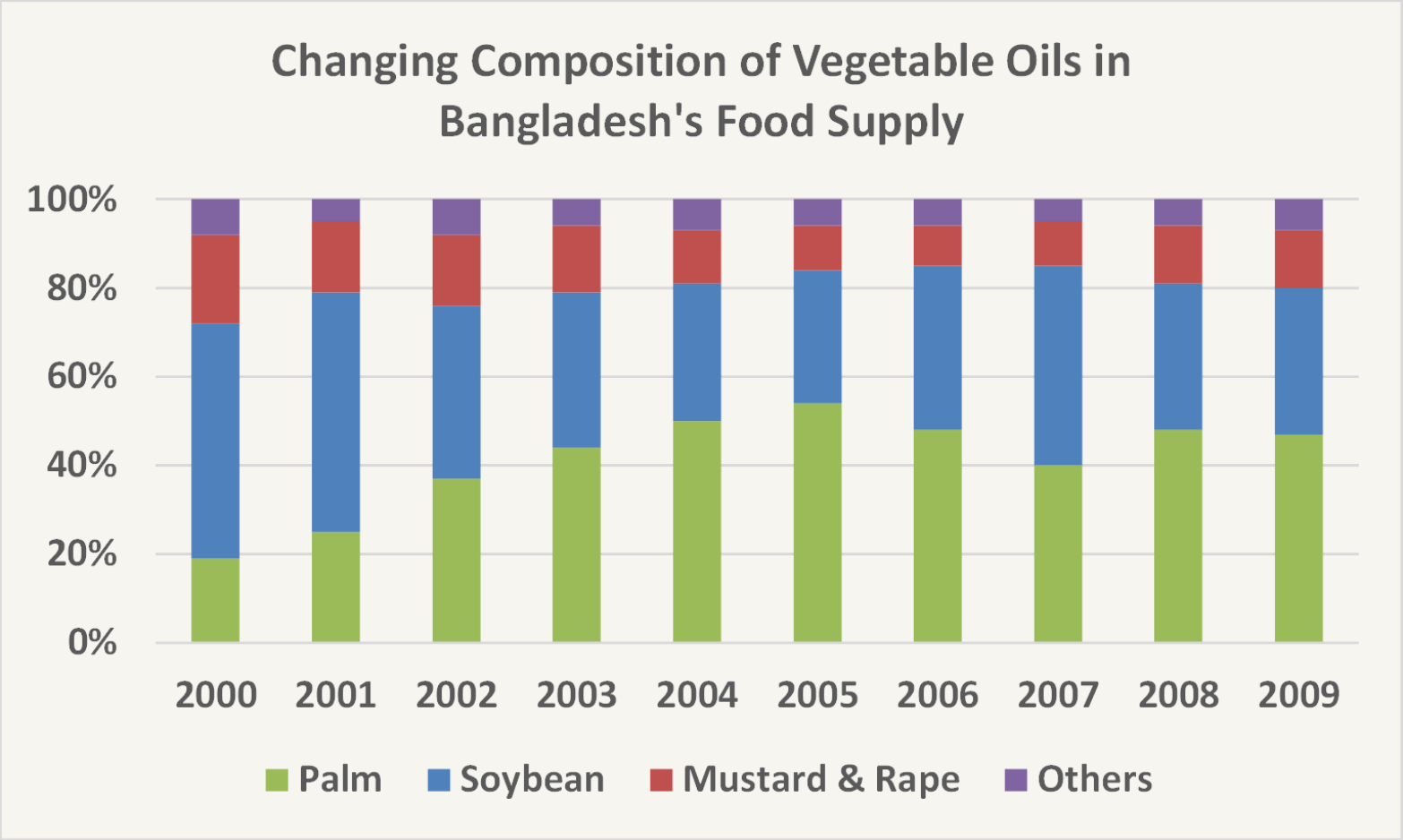
Bangladesh Standards and Testing Institution Fortification Regulations			
Product	**Regulation**	**Nutrient**	**Level**
1. Soyabean Oil	BDS 1769: 2006	Vitamin A	10.0 - 15.0 µg / gram
2. Edible Palm Oil	BDS 1770: 2006	Vitamin A	10.0 - 15.0 µg / gram
3. Fortified Wheat Flour (Both maida and atta flours)	BDS 1771: 2006	Calcium	53 g/kg
		Iron	55 mg/kg
		Thimine	6
		Riboflavin	4
		Niacin	15 mg/kg
		Pyridoxine	5 mg/kg
		Vitamin B12	.01 mg/kg
		Zinc	27 mg/kg
		Vitamin A	10,000 IU/kg (3 mg/kg)
		Folic Acid	2 mg/kd

Estimating the Impact of Fortification

Estimate additional nutrient intake from fortification

- Only purchases of soybean and palm oil are fortifiable
- Assumption: Only wheat flour produced by ***roller*** mills—not that of ***chakki*** mills—is fortifiable
- Assumption: Fortification levels the Bangladesh Standards and Testing Institution regulations
- Bioavailability assumptions:
  - Iron: 5%
  - Zinc: varies by age and gender (a la iZiNCG), assuming a high cereal diet (e.g., Non-pregnant, non-lactating women 19y+: 25%)

Adjust for Non-Fortifiable Product



We estimate that 85% of purchased vegetable oil is fortifiable

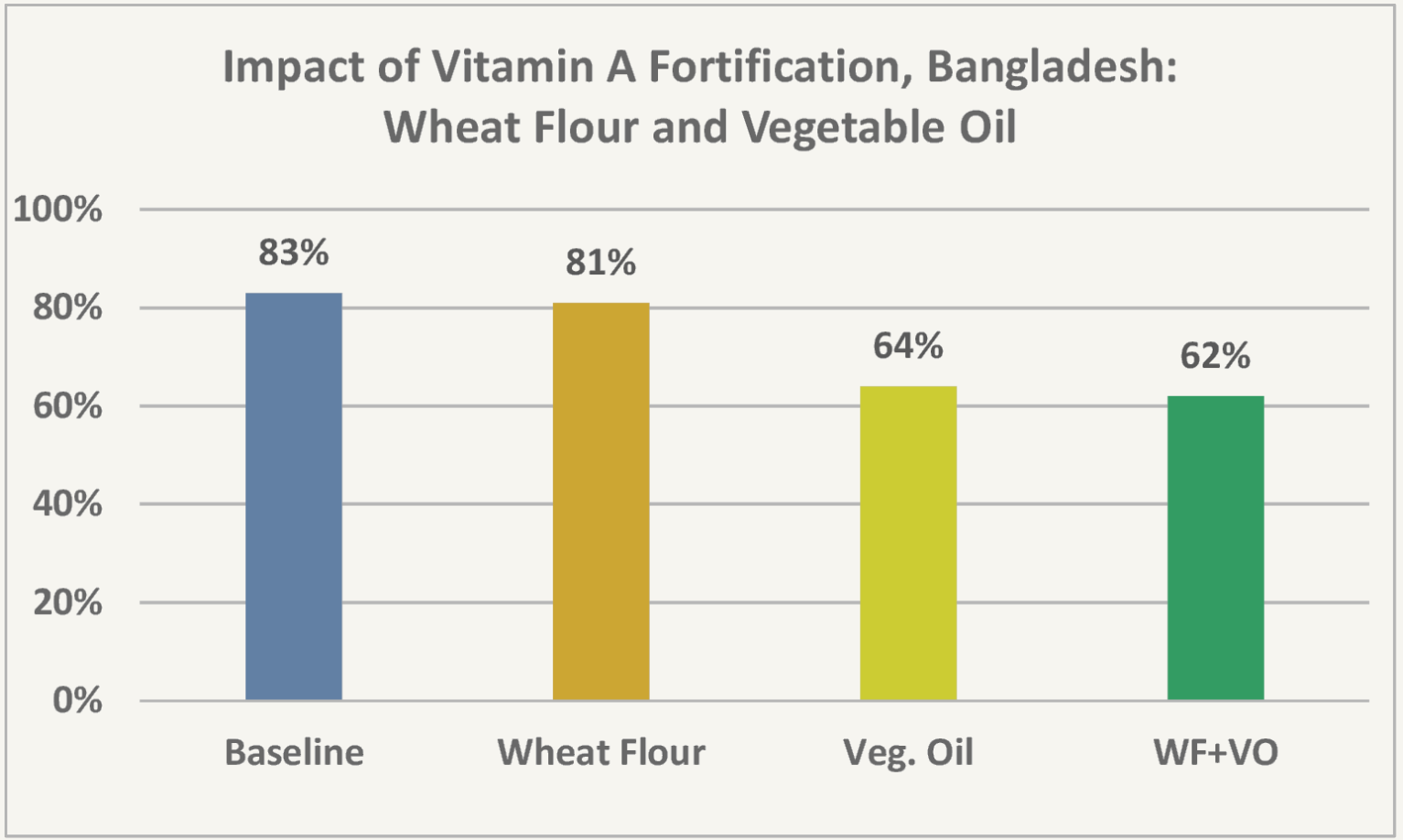
Total Wheat Flour from All Sources in Bangladesh, HIES 2005
Includes Roller Mill and Chakki Milled Flours, Both Pre-milled and On-Demand Milling

			Atta Flour			*Maida Flour*		
Item	**Total Wheat Flour (MT)**	**Percent of Total Flour**	**Percent Assumed to be Atta**	**Total Atta**	**Atta % of Total Flour**	**Percent Assumed to be Maida**	**Total Maida**	**Maida % of Total Flour**
Wheat (grain)	576,531	71%	100%	576,531	71%	0%	0	0%
Wheat flour	26,901	3%	50%	13,450	70%	50%	13,450	2%
Vermicelli/Suji	63,227	8%	0%	0	0%	100%	63,227	8%
Bread/bonroti	42,175	5%	50%	21,087	3%	50%	21,087	3%
Biscuits	94,820	12%	0%	0	0%	100%	94,820	12%
Cakes	5,099	1%	0%	0	0%	100%	5,099	1%
Totals:								
1. Pre-Milled + On-Demand	808,752	100%		611,069	76%		197,683	24%
2. Pre-Milled Only	232,221	29%		34,538	15%		197,683	85%

"All sources" includes all purchases, consumption from own production, in-kind wages and gifts.

We estimate that 29% of purchased, pre-milled flour is fortifiable

Impact = Baseline Minus Endline: Changes in Vitamin A Intake Adequacies



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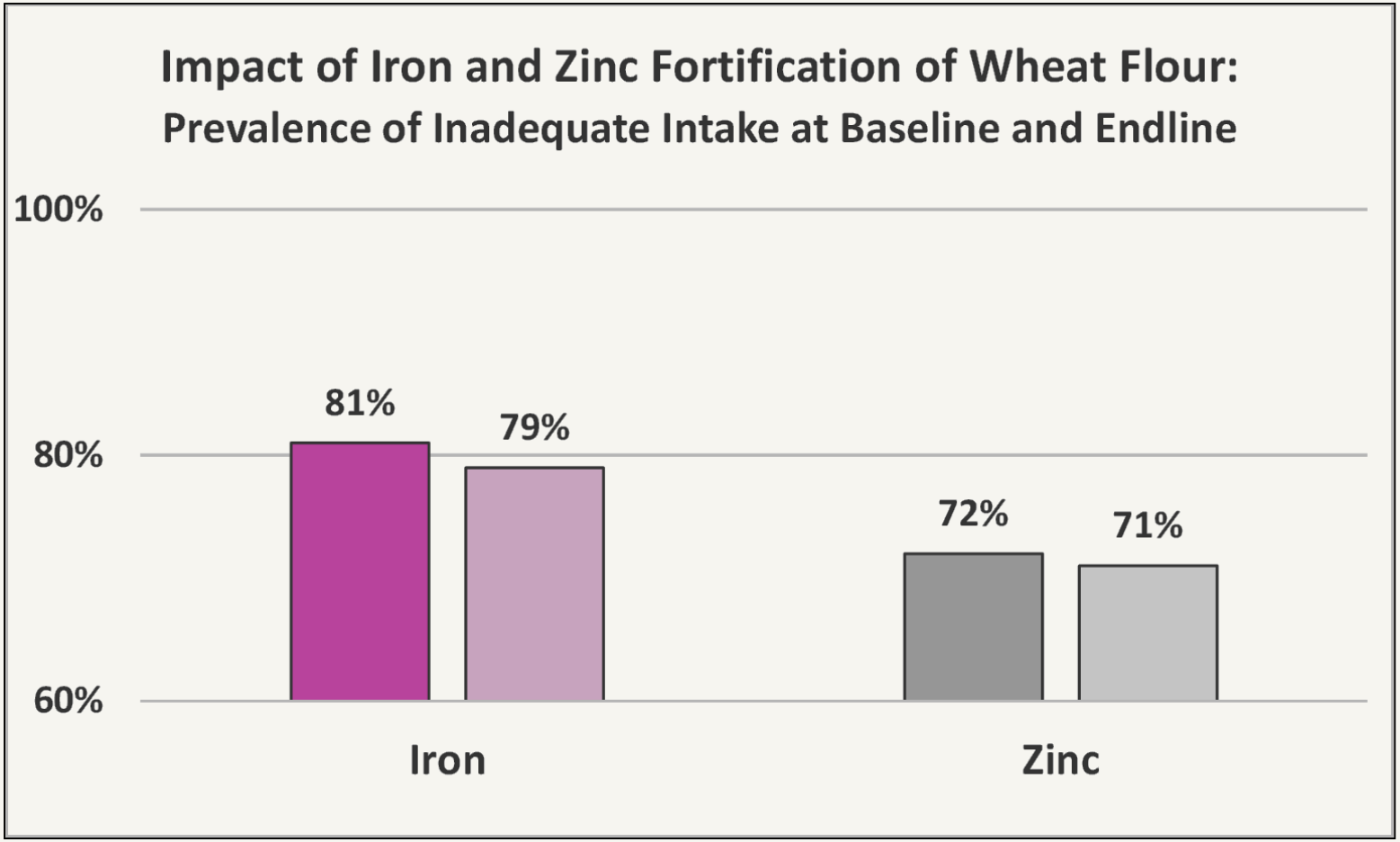
Baseline and Endline Iron and Zinc Intake Adequacies



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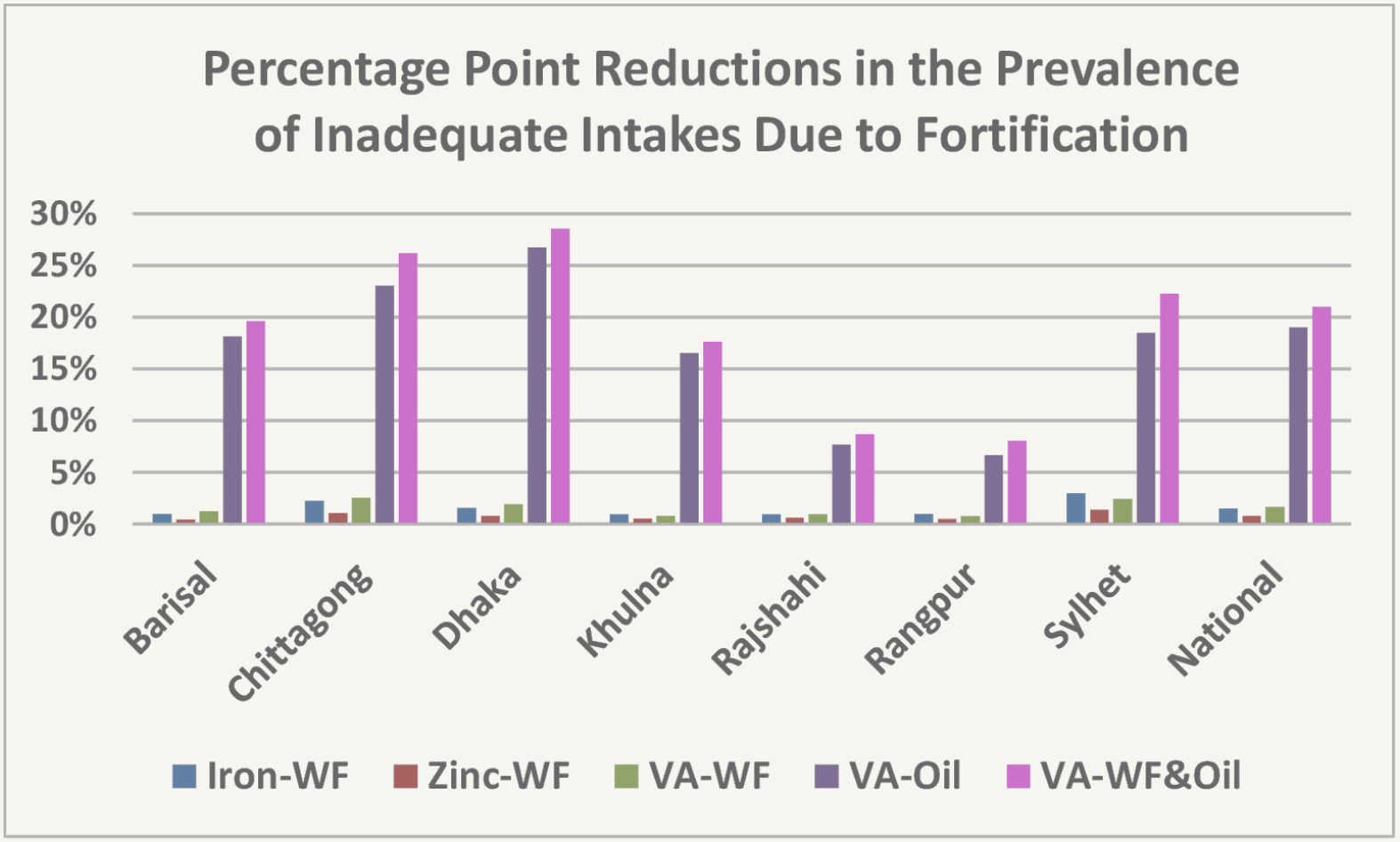
Divisional Fortification Impacts



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Looking Forward: Strengthening HCES

- The World Bank-FAO-International Household Survey Network-UN Statistical Commission: Working Group
- Assessment of the precision of 115 countries' HCES
- 2014 Agenda (with National Statistical Offices)
  - Pregnancy, lactating, breastfeeding status
  - Methods for improving the food list
  - Standardizing quantitative reporting units
  - Better capturing processed foods and
  - Food consumed away from home
- Recent release of ***ADePT: Food Security Module***
  - A free software that will facilitate processing HCES & producing food and nutrition analysis