FACULTY OF
BIOSCIENCE ENGINEERING

POTENTIAL OF NUTRIENT-ENRICHED FOODS IN DEVELOPING COUNTRIES.

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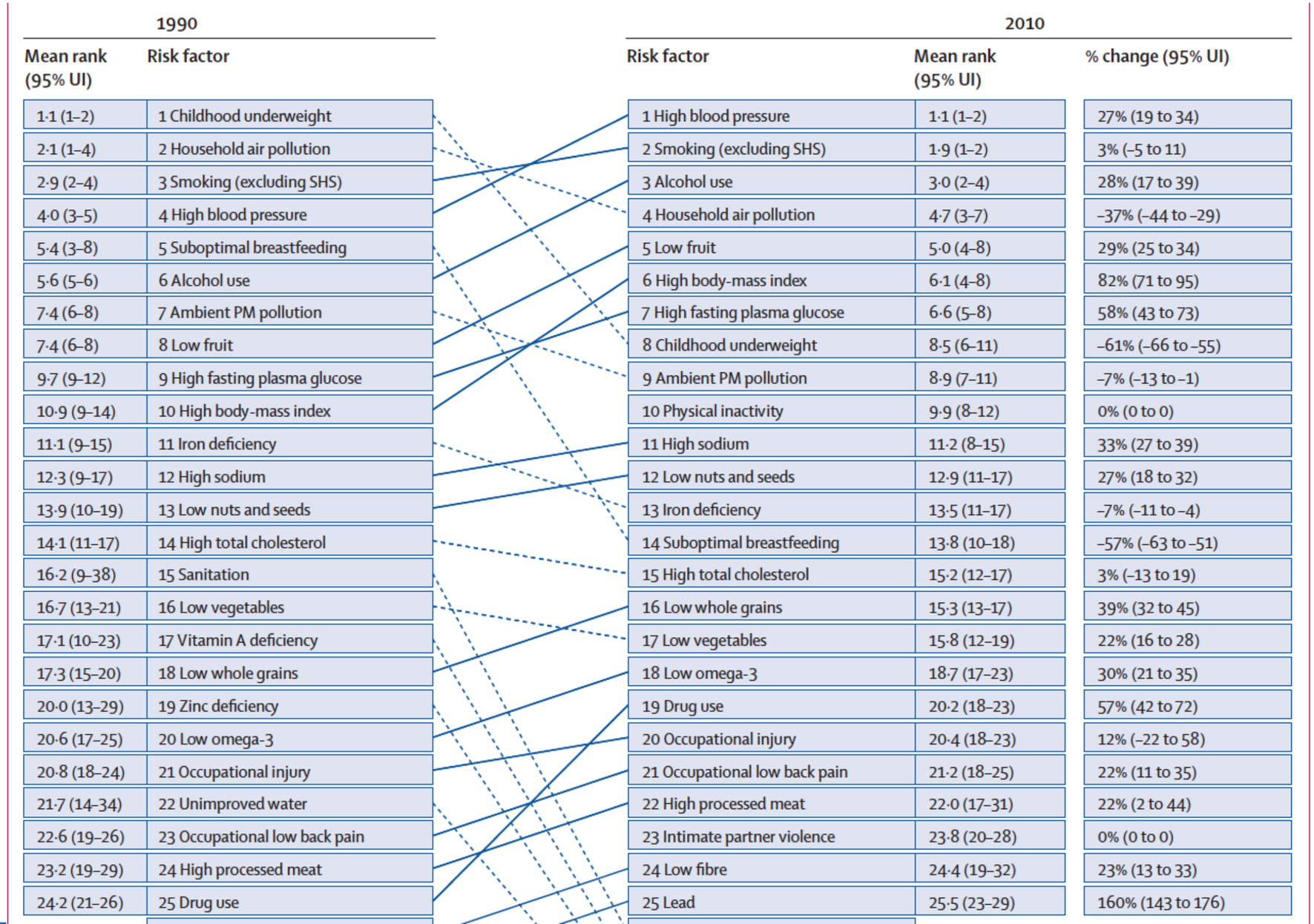
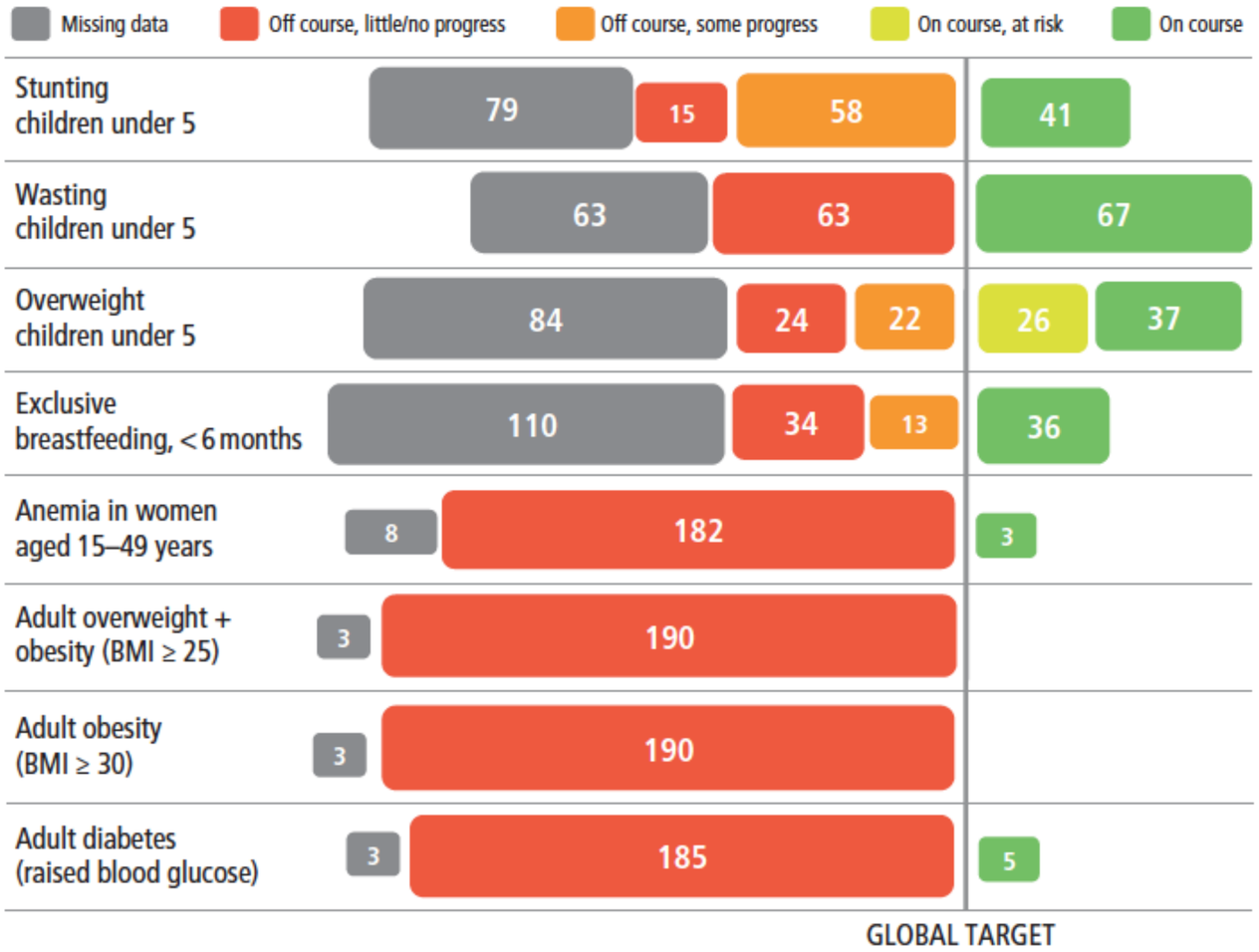
Global Burden of disease *(Lim et al. Lancet 21012)*



1990		2010		
Mean rank (95% UI)	Risk factor	Risk factor	Mean rank (95% UI)	% change (95% UI)
1·1 (1–2)	1 Childhood underweight	1 High blood pressure	1·1 (1–2)	27% (19 to 34)
2·1 (1–4)	2 Household air pollution	2 Smoking (excluding SHS)	1·9 (1–2)	3% (–5 to 11)
2·9 (2–4)	3 Smoking (excluding SHS)	3 Alcohol use	3·0 (2–4)	28% (17 to 39)
4·0 (3–5)	4 High blood pressure	4 Household air pollution	4·7 (3–7)	–37% (–44 to –29)
5·4 (3–8)	5 Suboptimal breastfeeding	5 Low fruit	5·0 (4–8)	29% (25 to 34)
5·6 (5–6)	6 Alcohol use	6 High body-mass index	6·1 (4–8)	82% (71 to 95)
7·4 (6–8)	7 Ambient PM pollution	7 High fasting plasma glucose	6·6 (5–8)	58% (43 to 73)
7·4 (6–8)	8 Low fruit	8 Childhood underweight	8·5 (6–11)	–61% (–66 to –55)
9·7 (9–12)	9 High fasting plasma glucose	9 Ambient PM pollution	8·9 (7–11)	–7% (–13 to –1)
10·9 (9–14)	10 High body-mass index	10 Physical inactivity	9·9 (8–12)	0% (0 to 0)
11·1 (9–15)	11 Iron deficiency	11 High sodium	11·2 (8–15)	33% (27 to 39)
12·3 (9–17)	12 High sodium	12 Low nuts and seeds	12·9 (11–17)	27% (18 to 32)
13·9 (10–19)	13 Low nuts and seeds	13 Iron deficiency	13·5 (11–17)	–7% (–11 to –4)
14·1 (11–17)	14 High total cholesterol	14 Suboptimal breastfeeding	13·8 (10–18)	–57% (–63 to –51)
16·2 (9–38)	15 Sanitation	15 High total cholesterol	15·2 (12–17)	3% (–13 to 19)
16·7 (13–21)	16 Low vegetables	16 Low whole grains	15·3 (13–17)	39% (32 to 45)
17·1 (10–23)	17 Vitamin A deficiency	17 Low vegetables	15·8 (12–19)	22% (16 to 28)
17·3 (15–20)	18 Low whole grains	18 Low omega-3	18·7 (17–23)	30% (21 to 35)
20·0 (13–29)	19 Zinc deficiency	19 Drug use	20·2 (18–23)	57% (42 to 72)
20·6 (17–25)	20 Low omega-3	20 Occupational injury	20·4 (18–23)	12% (–22 to 58)
20·8 (18–24)	21 Occupational injury	21 Occupational low back pain	21·2 (18–25)	22% (11 to 35)
21·7 (14–34)	22 Unimproved water	22 High processed meat	22·0 (17–31)	22% (2 to 44)
22·6 (19–26)	23 Occupational low back pain	23 Intimate partner violence	23·8 (20–28)	0% (0 to 0)
23·2 (19–29)	24 High processed meat	24 Low fibre	24·4 (19–32)	23% (13 to 33)
24·2 (21–26)	25 Drug use	25 Lead	25·5 (23–29)	160% (143 to 176)

GLOBAL PROGRESS

FIGURE 2.3 Number of countries at various stages of progress against the global targets on nutrition



Source: Authors, based on data from Stevens et al. (2013), UNICEF (2016b), UNICEF, WHO, and World Bank (2015), and WHO (2015a).

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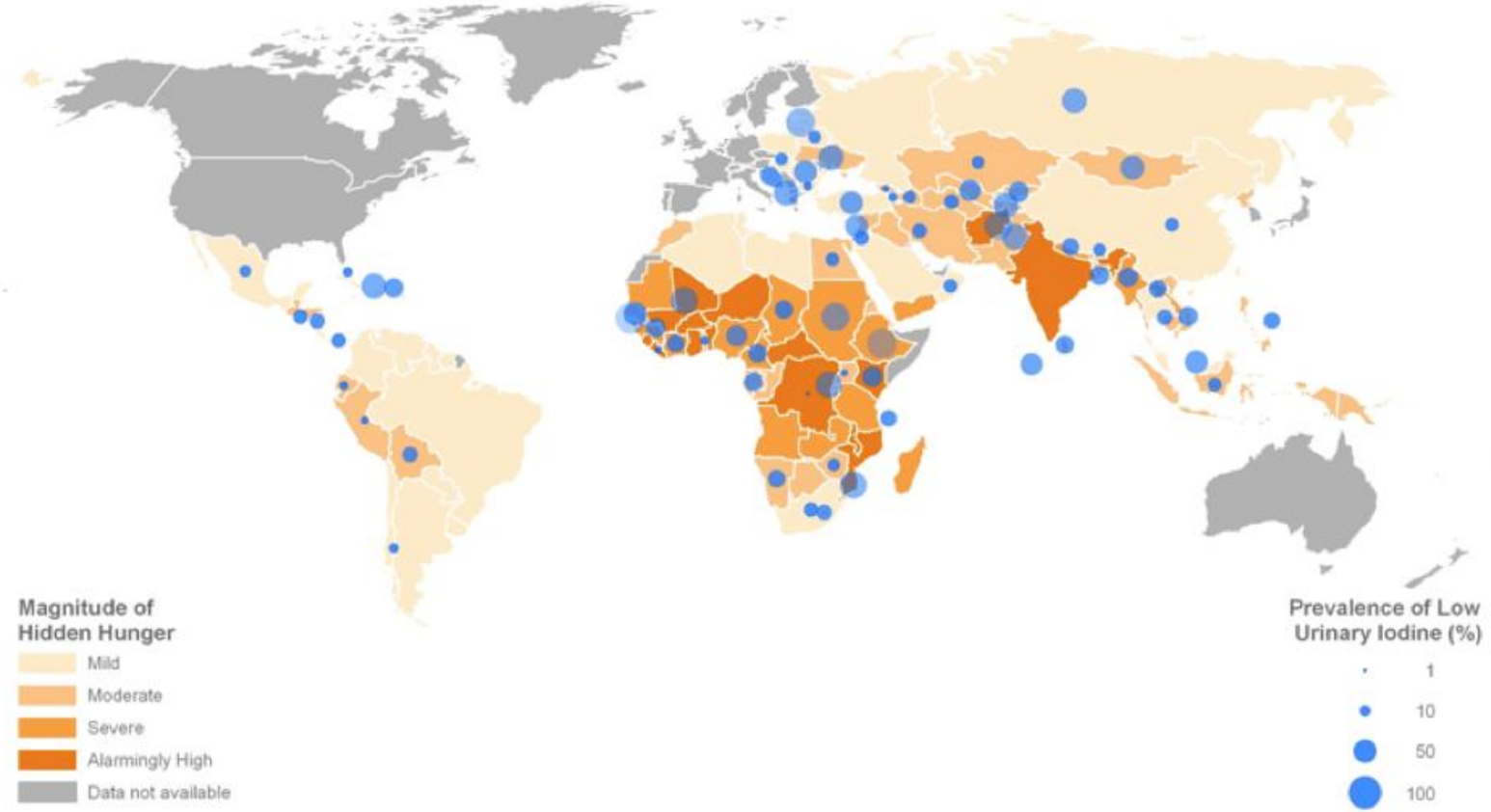
Micronutrient Initiative

www.micronutrient.org

Micronutrient deficiencies especially prevalent in developing countries…



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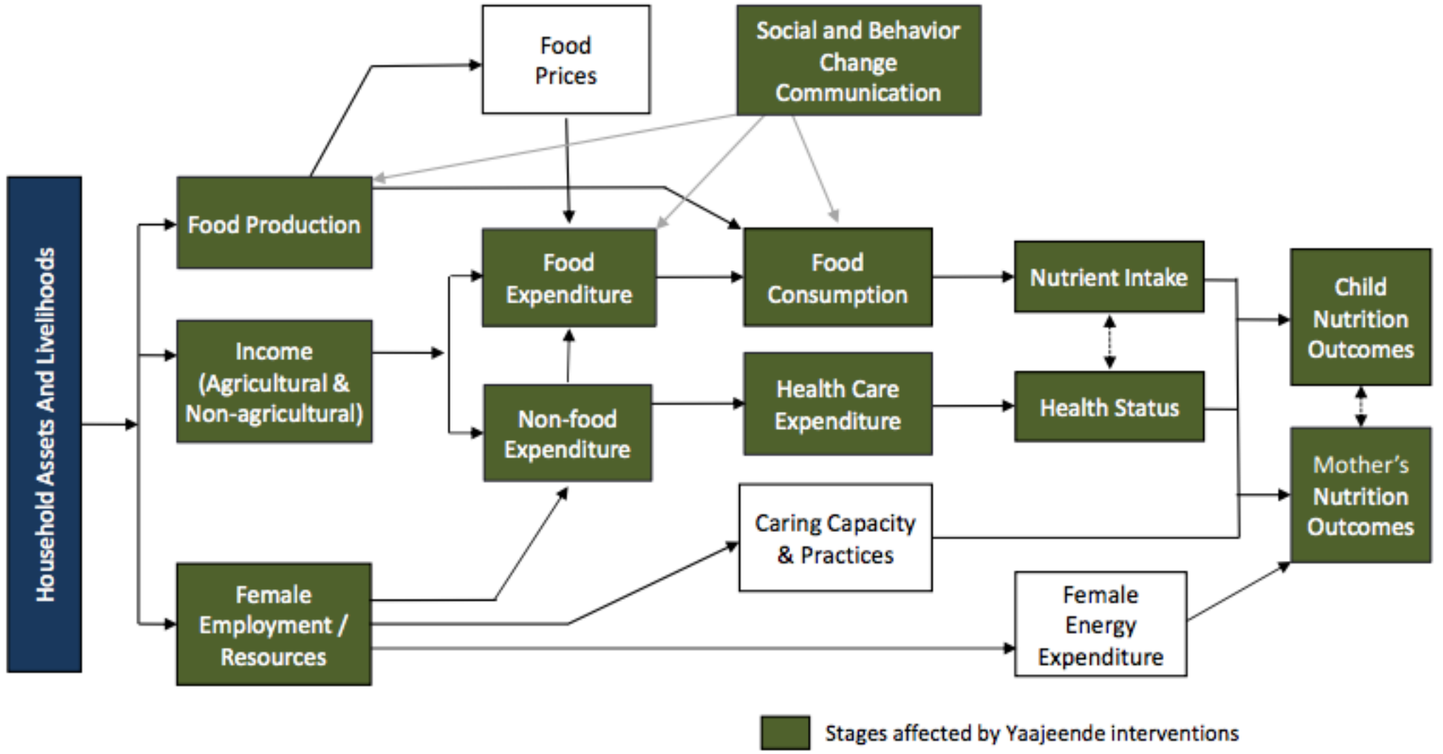
Source: Global Nutrition Report, 2014

AG NUT LINKAGES



REPRESENTATIVE INTERVENTIONS

Production → Consumption
- Households growing nutritious local crops
- Cooking demonstrations using homegrown vegetables

Income → Food Purchase
- Improved growing techniques to increase quantity and quality
- Improving links to markets and facilitating sale of agricultural inputs

Women's Control of Income → Resource Allocation
- Bio-reclamation of Degraded Land

Gillespie et al. IFPRI Discussion Paper 01187

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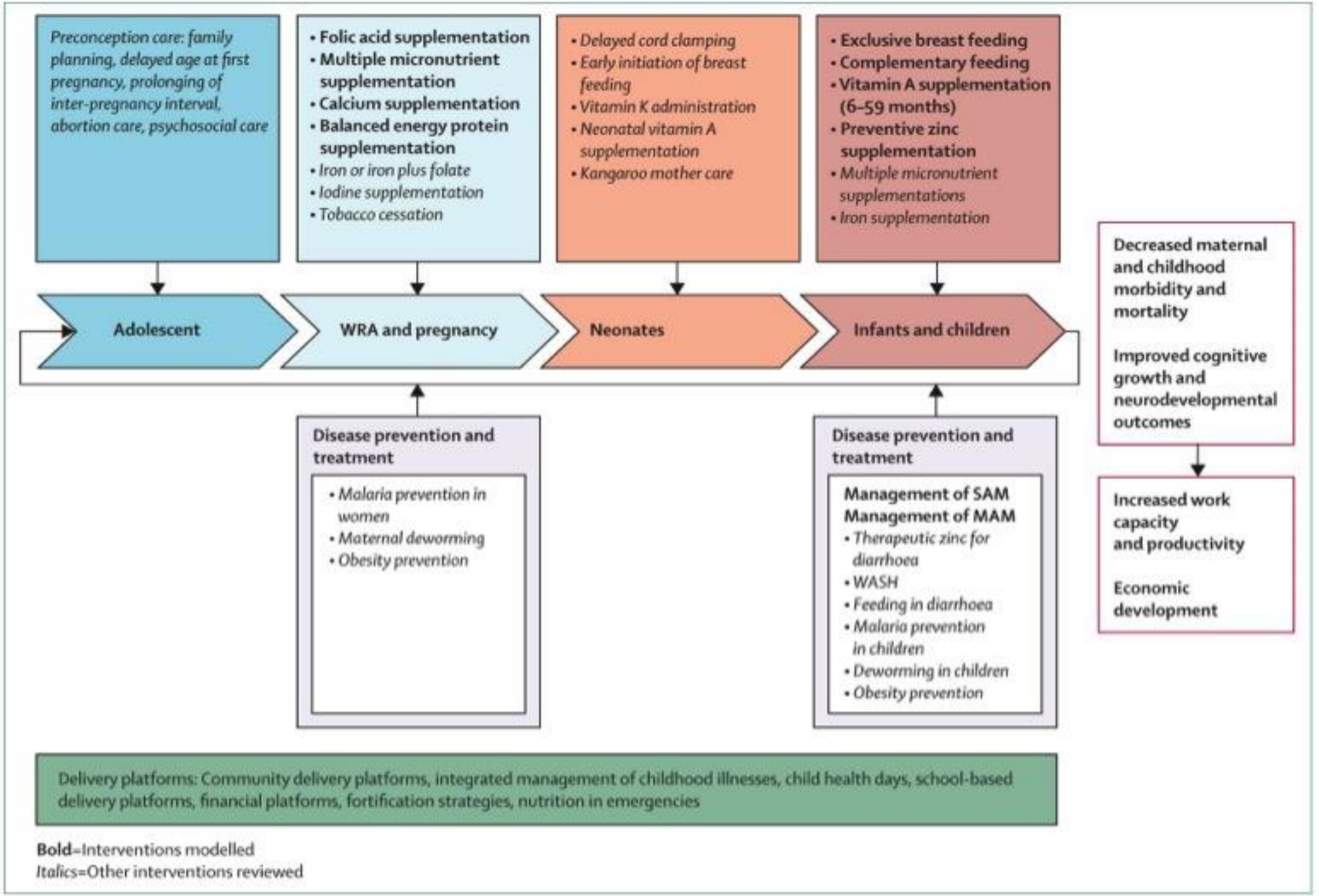

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Weapons to Fight Deficiency:

Supplementation

Commercial Fortification

Dietary Diversity

Biofortification

Micronutrient Initiative

DIETARY DIVERSIFICATION

- Selection of diverse diet or of foods with high effective nutrient supply
- Seen as a sustainable approach because it empowers individuals and households to take ultimate responsibility for the quality of their diet by growing their own nutrient-rich foods and making informed consumer choices
- Are appealing because they can address multiple nutrients simultaneously without the risk of antagonistic nutrient interactions or overload
- Contribution of local agrobiodiversity to promote nutrition remains unexplored

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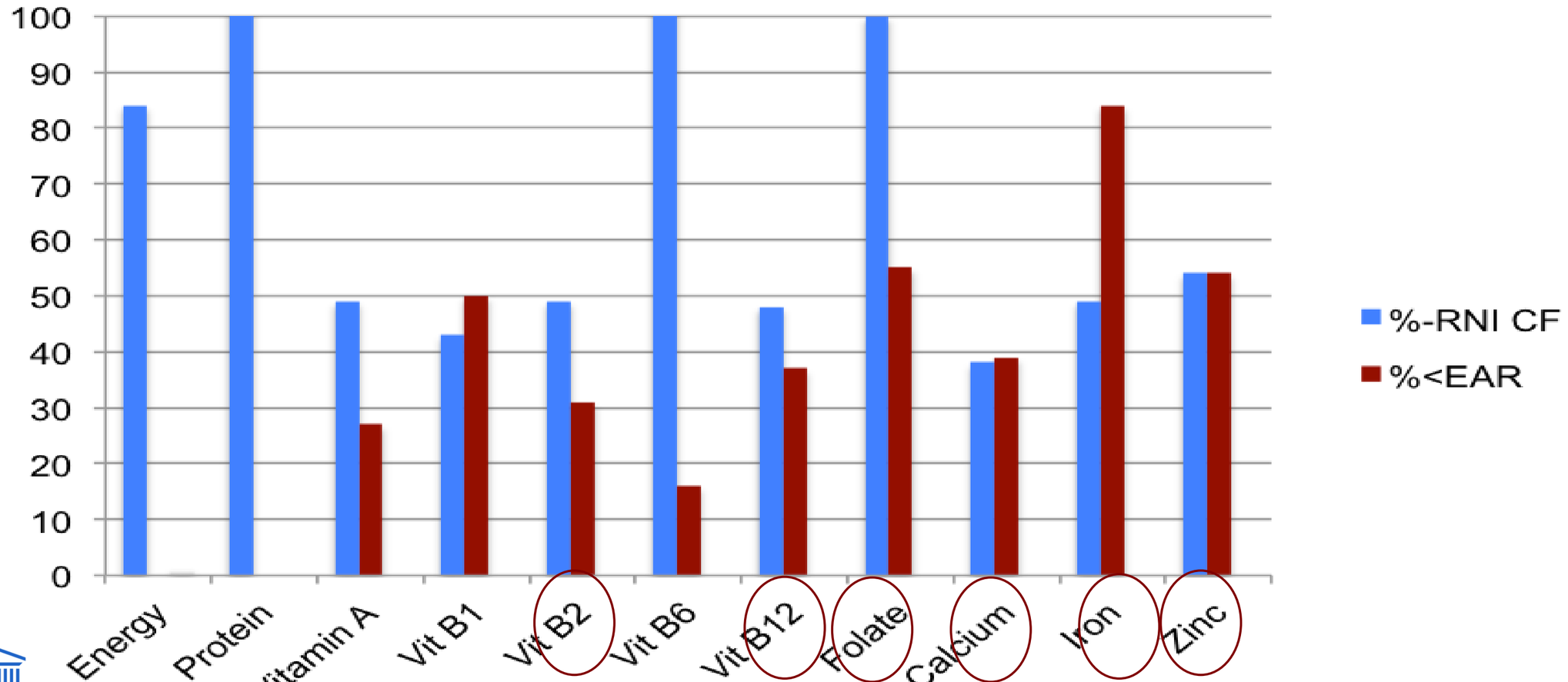
BUT DIETARY DIVERSIFICATION NOT A SOLUTION FOR ALL:
CHILDREN 6-23 MONTHS OF AGE CANNOT ACHIEVE DIETARY ADEQUACY FOR ALL MICRONUTRIENTS WITH LOCAL FOODS ALONE



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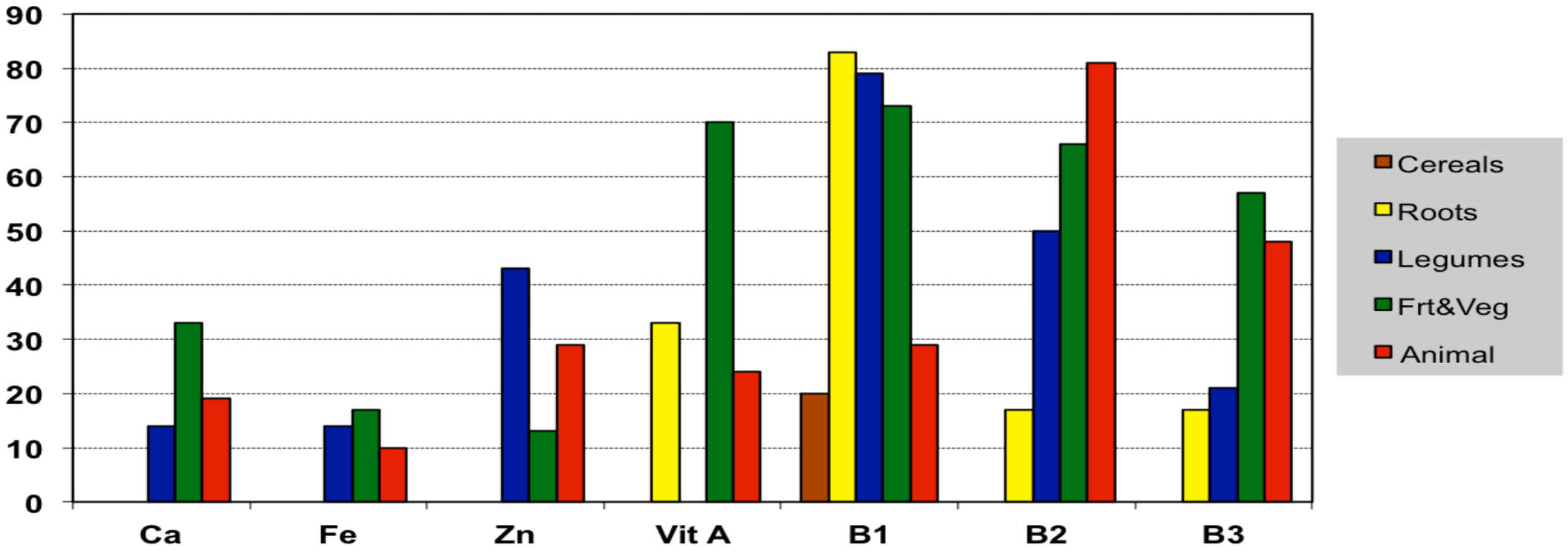
Source: Osendarp et al. (submitted)

WHICH FOOD GROUPS CONTRIBUTE TO CRITICAL NUTRIENT DENSITY REQUIREMENTS OF THE DIET IN INFANTS?

% Foods per Food Group Achieving WHO Desired Densities[1]



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[1]Dewey & Brown, 2003; for 9-11 m olds with average breast milk intakes; assumes moderate bioavailability

SUPPLEMENTATION

- Useful in resource poor environments and/or when needs cannot be met with dietary approaches alone

- Examples:
  - High dose vitamin A supplementation in children 6-59 mo of age
  - Antenatal iron-folic acid supplementation pregnant women
  - Zinc supplementation for management of diarrhea

?

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BIO-FORTIFICATION AND AGRONOMIC BIO-FORTIFICATION

- Aim: increasing nutrient content & bioavailability
  - to increase concentration of certain trace minerals and vitamins
  - To increase bioavailability of micronutrients by reducing inhibitors or by increasing enhancers of micronutrient absorption
- Bio-fortification
  - By breeding
  - By genetic engineering
- Agronomic biofortification
  - soil and/or foliar application of micronutrient-containing mineral fertilizer

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QUESTIONS TO BE ADDRESSED

- Is there a demonstrated and clear need?
- Is the food to be altered important for the population and will it be delivered reliably and continually?
- Will it be acceptable?
- Are there other more cost-effective approaches available?
- Is breeding for high nutrient content scientifically feasible?
- What is the nutritional efficacy?
- What is the nutrition and health (and environmental) impact?

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BIOFORTIFIED FOOD CROPS HAVE SHOWN TO HAVE A POSITIVE IMPACT ON NUTRITIONAL AND FUNCTIONAL HEALTH OUTCOMES.

- Vitamin A bio-fortified flesh sweet potato, maize:
  - Improved indicators of vitamin A status (b-carotene status, retinol)
  - Improved visual outcomes

- Iron bio-fortified millet, rice, beans:
  - Improved indicators of iron status (Hemoglobin, serum ferritin, transferrin receptor, iron body stores)
  - Reduced iron deficiency anemia
  - Improved cognitive performance (reaction time and attention)

- Zinc bio-fortified rice and wheat:
  - No differences in zinc status or functional outcomes
  - More studies underway

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Source: De Moura et al, Advances in Nutrition, 2014 Harvest Plus

PROPOSITIONS

1. Public health risks and contributions are unknown: proceed with care

2. Focus on nutrients is confusion for consumers and not helpful to guide behaviour change

3. The window of opportunity for micronutrients has closed. Current focus is on sustainable diets

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