

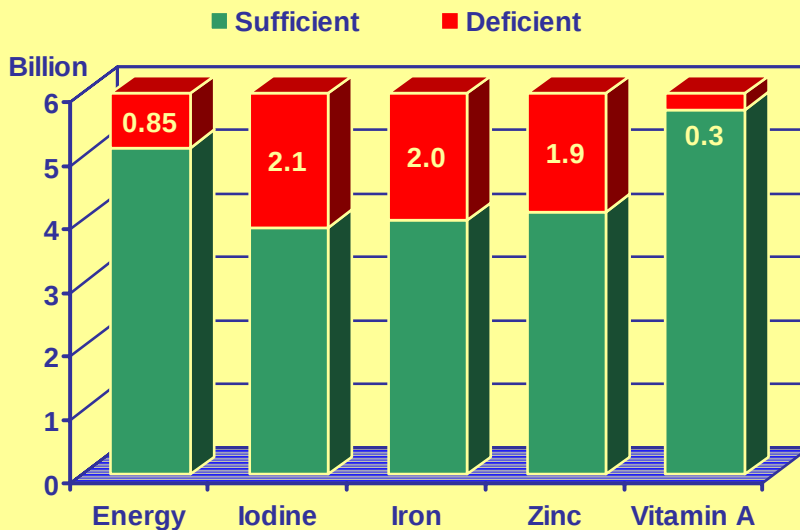
Micronutrient malnutrition and biofortification

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Micronutrient malnutrition



Burden of disease

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- But which condition weighs more heavily?
 - Iodine deficiency: goitre and cretinism
 - Iron deficiency: fatigue, impaired mental development and maternal mortality
 - Zinc deficiency: stunting, diarrhoea, pneumonia and child mortality
 - Vitamin A deficiency: night blindness, blindness, measles and child mortality
- Prevalence rates measure the width but not the depth (or severity) of a disease

Burden of disease

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- A more comprehensive measure are “disability-adjusted life years” or DALYs:
 - incorporate the incidence of a disease
 - weight the severity of a health outcome
 - measure both morbidity and mortality
 - represent common units (DALYs lost)
 - can be summed up across different diseases

Burden of disease

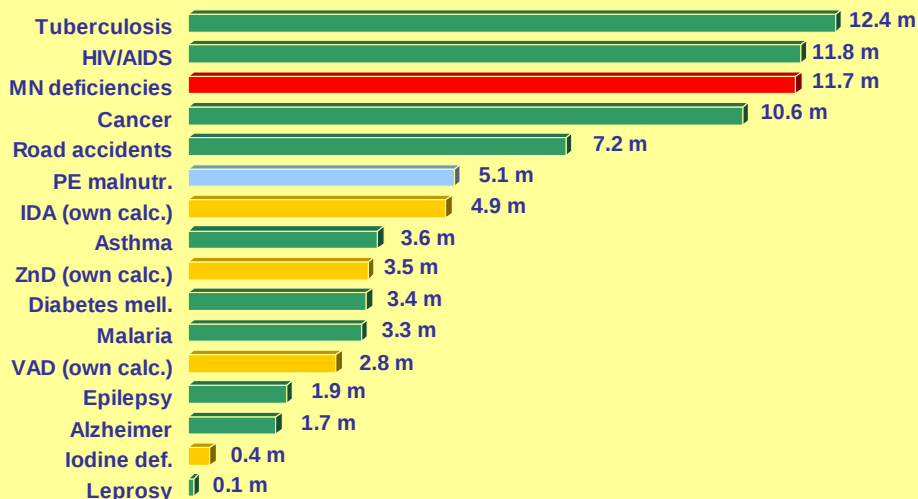
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- The burden of a disease is the sum of
 - (i) years of life lost (*YLL*) due to mortality and
 - (ii) the time (in years) lived with disability (*YLD*)
- *YLD* are made comparable to *YLL* by weighting each disease according to its degree of disability (death: 100% loss of functioning, perfect health: no loss)

$$\text{Burden of disease} = \text{DALYs}_{\text{lost}} = \text{YLL} + \text{YLD}_{\text{weighted}}$$

DALYs lost in South-East Asia

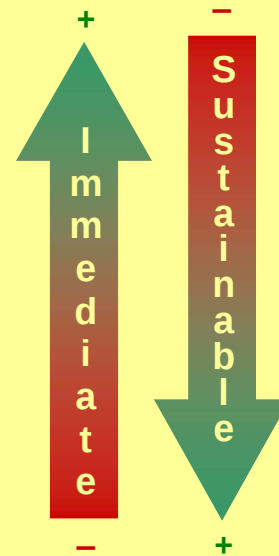
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Micronutrient interventions

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- Pharmaceutical supplementation
- Industrial fortification
- **Biofortification**
- Dietary diversification
- Nutrition education
- Behaviour change
- Poverty reduction



Biofortification in India

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- Burden of iron deficiency 4 million DALYs lost, iron-rich rice and wheat may save 20-60% thereof
- Burden of zinc deficiency 2.8 million DALYs lost, zinc-rich rice and wheat may save 20-50%
- Burden of vitamin A deficiency 2.3 m DALYs lost, Golden Rice may save 10-60% thereof
 - currently 71,600 children die each year due to VAD of which Golden Rice could save 5,500-39,700

Cost-effectiveness

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	US\$/DALY saved		US\$/life saved	
	opti.	pess.	opti.	pess.
Iron-rich rice and wheat	0.5	5.4		
Other iron interventions	5-15			
Zinc-rich rice and wheat	0.7	7.3	12	115
Zinc fortification	~15			
Golden Rice	3.1	19	54	358
Other vitamin A interventions	85-600			
World Bank benchmark	60-200			
WHO benchmark (GDP/p.c.)	620-1860			

Factors for success

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- Other results for different countries
 - Beta-carotene cassava: 8-1000 US\$/DALY
 - Zinc beans: 150-5940 US\$/DALY
- Effectiveness of biofortification
 - Success of breeding to increase MN content?
 - Seed replacement/adoption of crops?
 - Export/import of (biofortified) crops?
 - Importance of target crops in daily diets?
 - Bioavailability/net uptake of MN by individuals?

Factors for success

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- Costs & cost-effectiveness of biofortification
 - Free suitable germplasm available?
 - Number of crop varieties to be biofortified?
 - Prevalence and severity of the deficiency?
 - Absolute size of target group?
- Conclusions
 - Biofortification *can* be a very effective and cost-effective micronutrient intervention
 - Given economies of scale, biofortification should be approached on an international level



**Thank you
for your attention!**

<http://www.AJStein.de>