



Overview of Micronutrients- The Costs of Deficiencies

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The “Double Burden”

**1 billion
hungry**

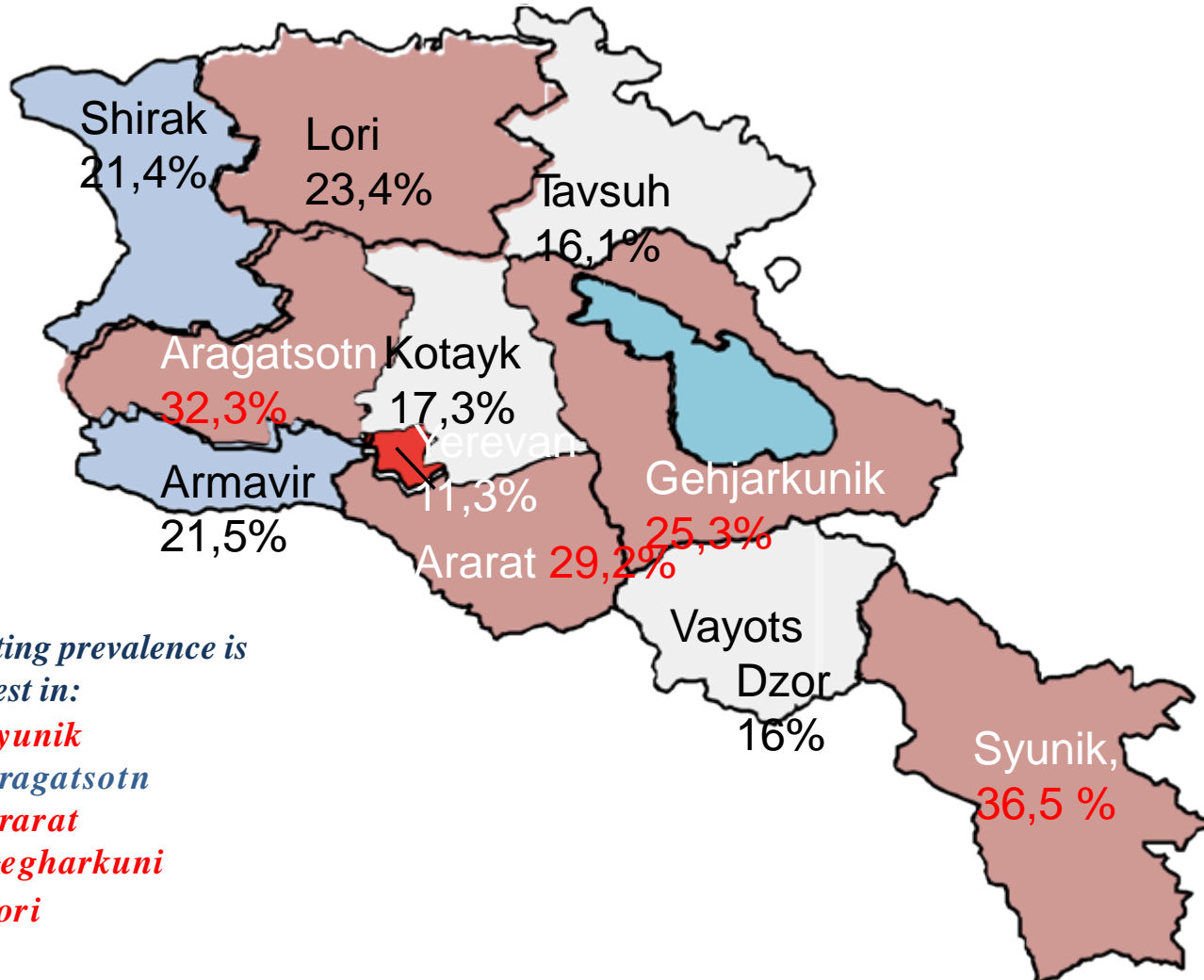
**2 billion
overweight**



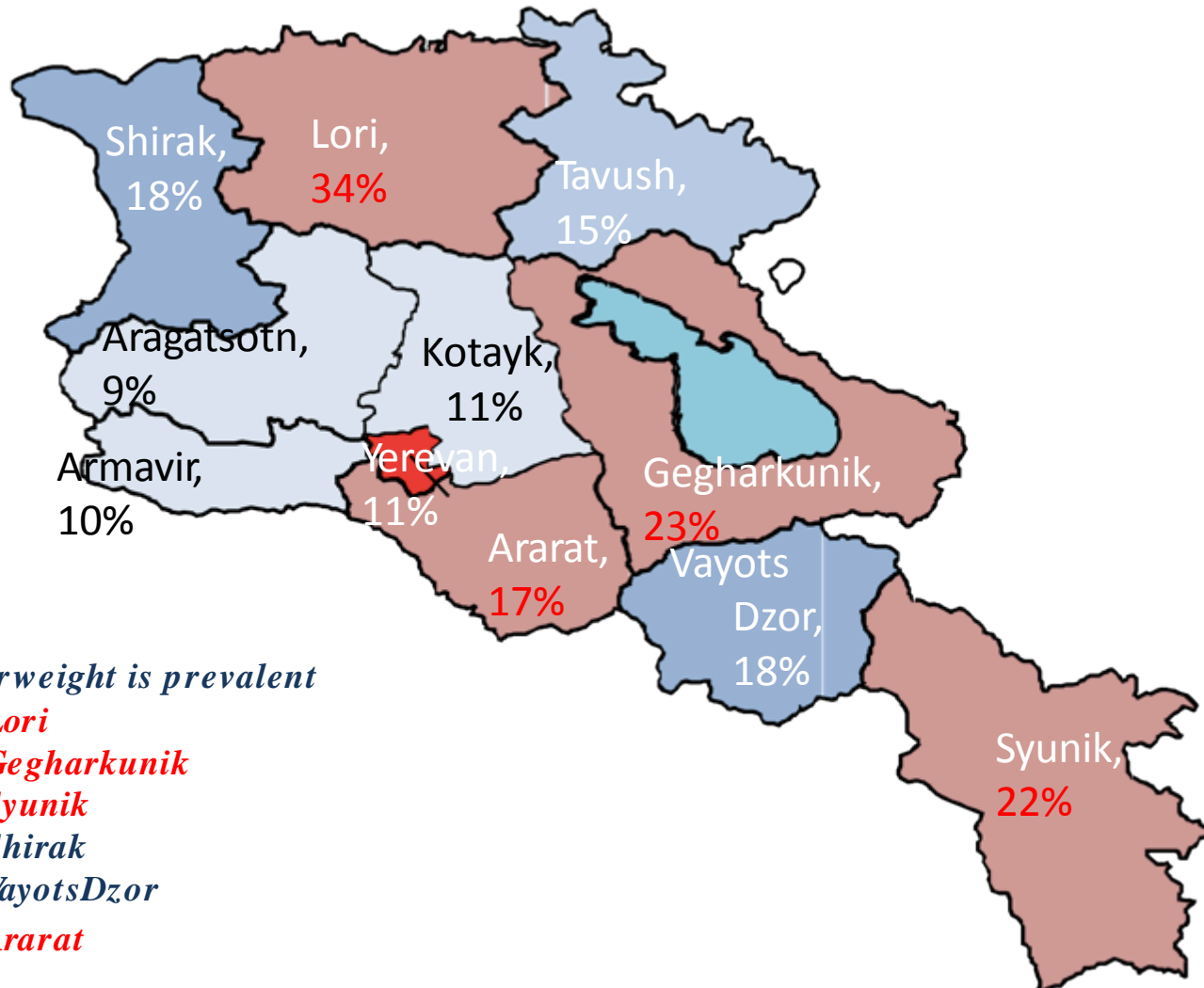
Gustafson, 30 project

ONE GLOBAL ISSUE!

Stunting Prevalence by Geographic Area (DHS-2010)



Overweight Prevalence by Geographic Area (DHS 2010)



“...investments in micronutrients have higher returns than those from investments in trade liberalization, in malaria, or in water and sanitation... *No other technology offers as large an opportunity to improve lives at such low cost and in such a short time.*”

Copenhagen Consensus, 2004

Today's overview → Health and economic costs of micronutrient deficiencies to the individual, to the population, and to the country

“Hidden” Malnutrition

Micronutrient Deficiencies

Focus on 7 sentinel nutrients:

Iron

Iodine

Vitamin A

Zinc

Folic acid

Vitamin D

Calcium

“Treatable” Nutritional Deficiencies in Armenia ????

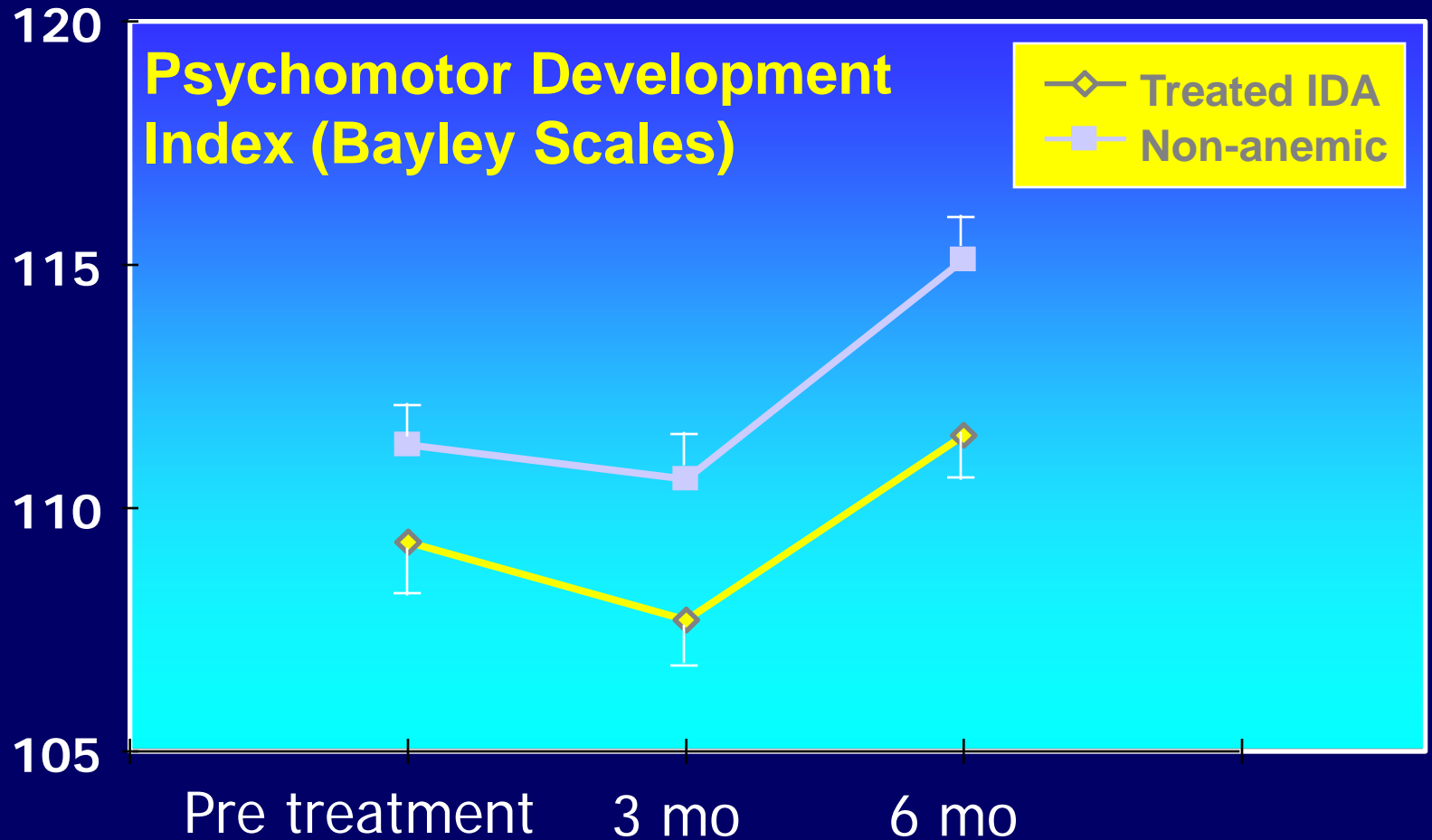
- *Iron*
- *Folic acid*
- *Vitamin D*
- *Calcium*
- *Iodine*
- *Zinc*
- *Vitamin A*

Anemia in Armenia

- Anemia in children 30-60%
- Anemia in women ~12-25%

- <5yrs - 2001 26%
- <5yrs - 2011 34% !!
- <5yrs - 2014 (Talin) 32-68% !!
- <5yrs – 2014 (Tavush) 20-58%

Psychomotor Development Index in Iron Deficiency Anemia and Non-Anemic Groups After Iron Treatment



Costs of Anemia

Decreased - cognitive ability, growth, productivity, physical activity, cell mediated immunity

Increased – preterm delivery, LBW infants, maternal disease burden during pregnancy, hospital length of stay, congestive heart failure, fatigue, falls....., mortality, morbidity

In 10 countries anemia decreased GDP by 4.1%!

Vitamin A deficiency

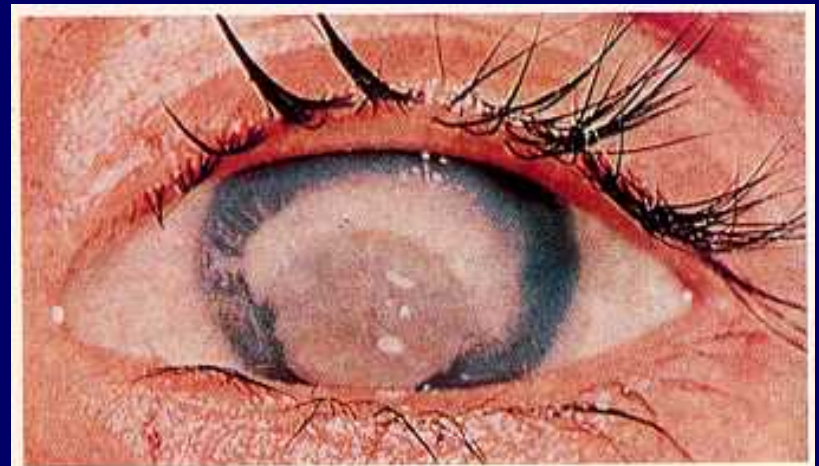


Fig. 3 Keratomalacia in a young child.

Vitamin A “Subclinical” Deficiency

- ↑ ***Morbidity and mortality – infectious diseases***
- ↓ ***Effective immune response***
- ↓ **Reproductive health**
- ↓ **Growth and development**

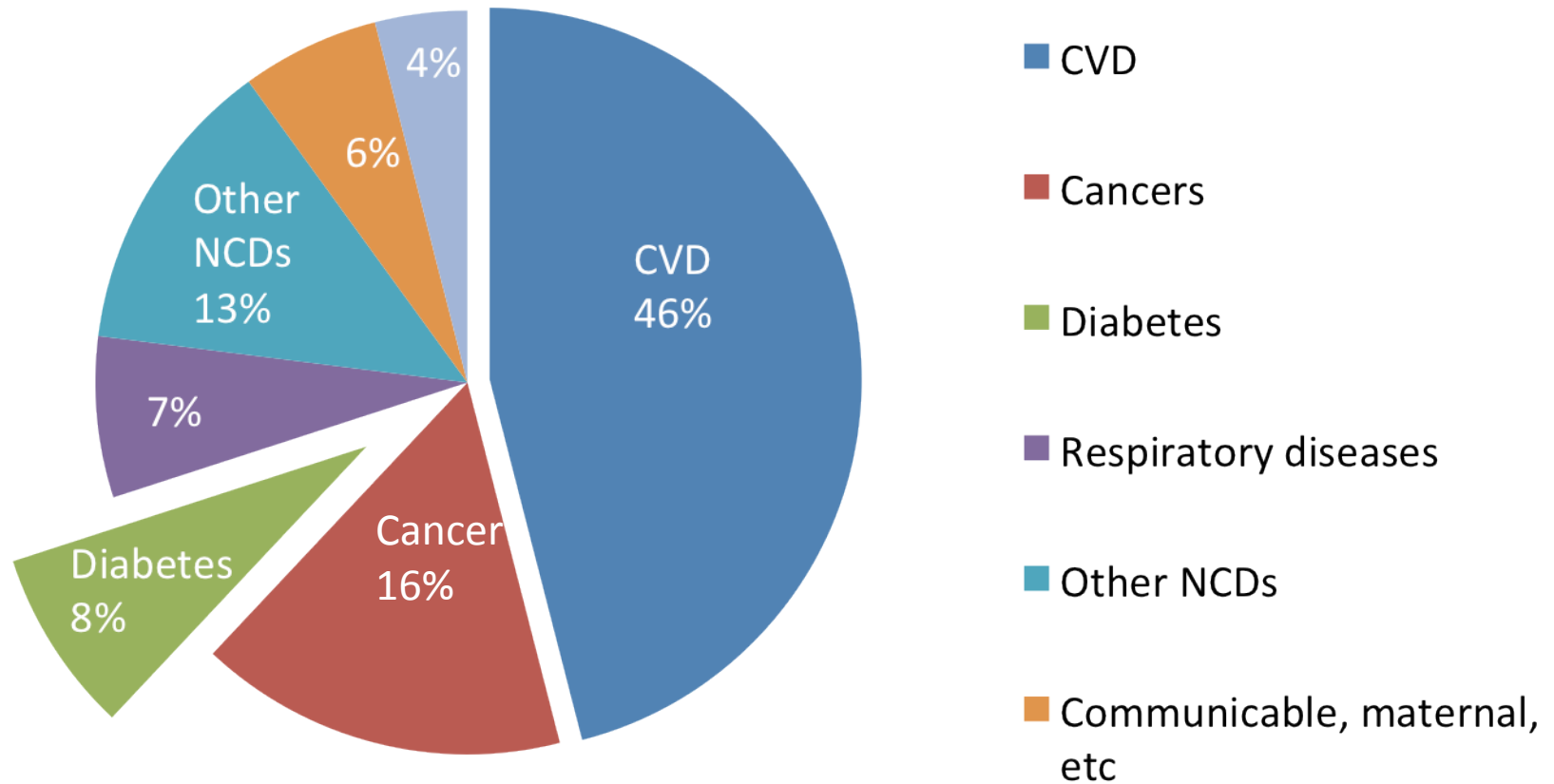
Vitamin D deficiency



NCDs Account For 90% of All Deaths, Armenia 2011

Does subclinical Vitamin D deficiency contribute?

Proportional Mortality (% of total deaths, all ages)



Iodine Deficiency



Iodine “Subclinical” Deficiency

- ↑ Stillbirths, abortions, congenital anomalies
- ↓ Mental function - IQ

Folic Acid Deficiency

- **NTDs, spina bifida**
- **Anemia**
- **Stomatitis**
- **GI symptoms, diarrhea**

Lifetime costs of spina bifida > \$620,00

NTDs cost \$52,000/year/patient

The Cost of Undernutrition

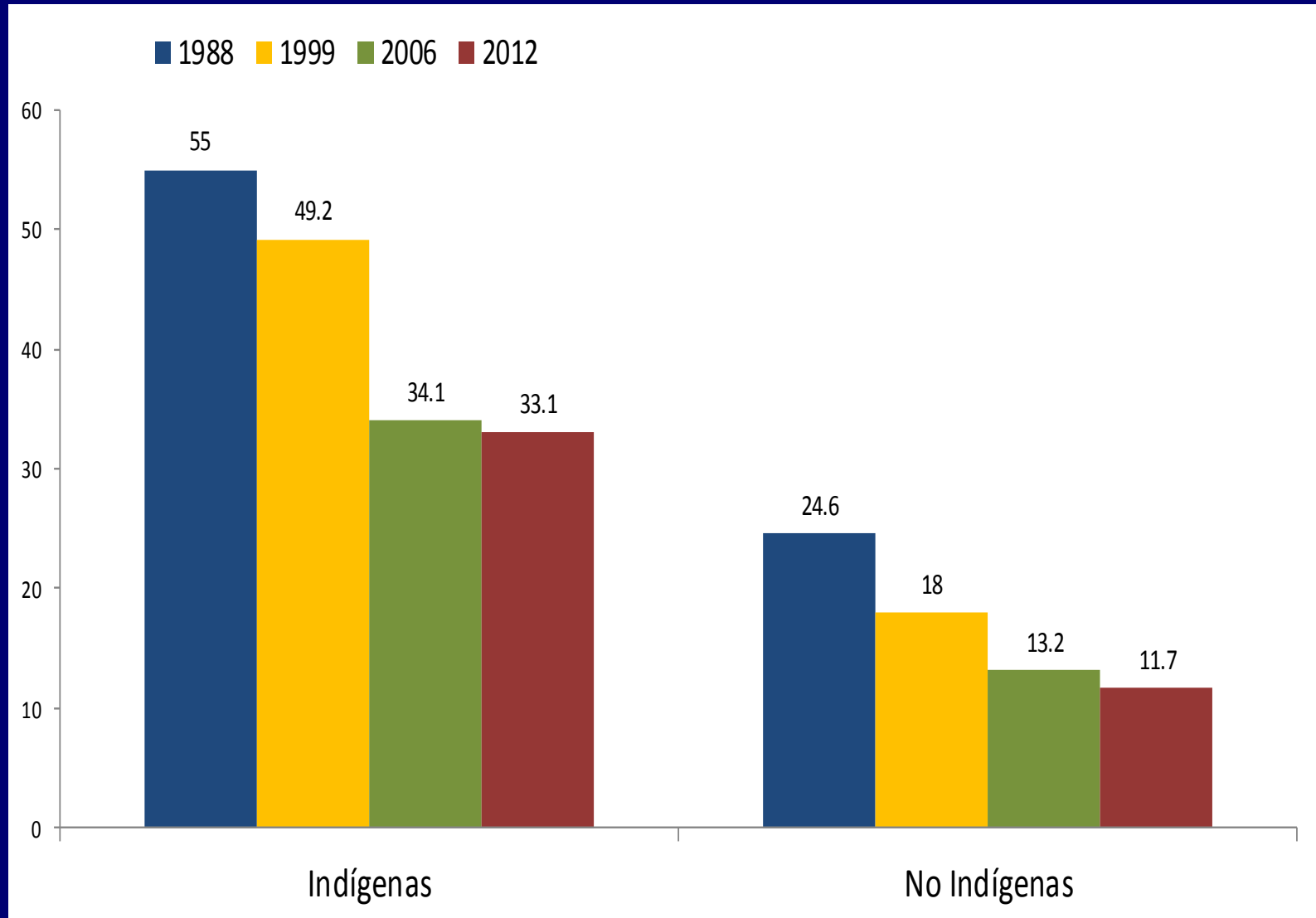
- There is evidence that **46 million years of productive, disability-free life were lost** in 1990, the result of lost social productivity caused by four types of malnutrition: **stunting** and disorders related to iodine, **iron** and vitamin A deficiency.

SOLUTIONS

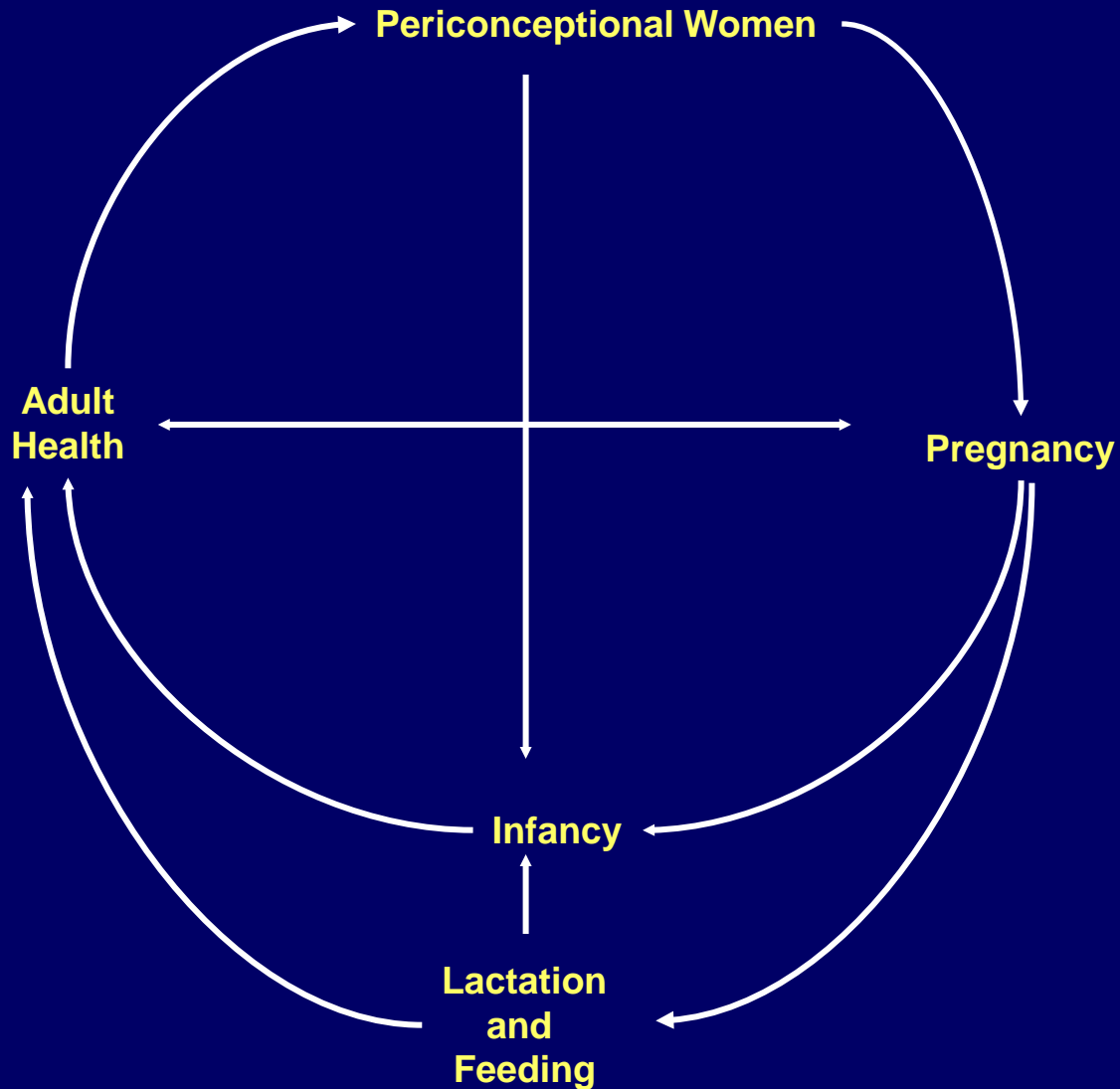
????

Decreases in < 5yr Stunting in Indigenous and Non-Indigenous Mexican Children -1988 to 2012

(Prof. Juan A. Rivera-Dommarco, INSP, 2012)

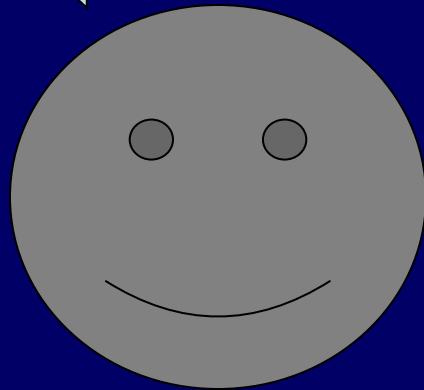


Lifecycle Nutrition Perspective

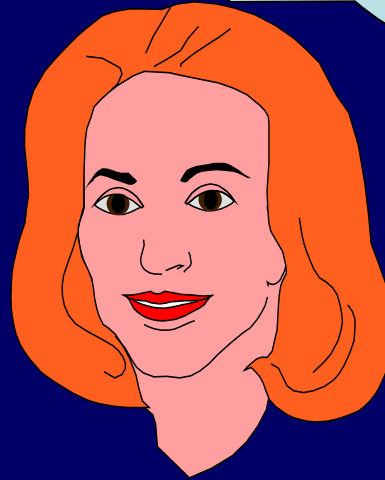


Intervention Strategies--how to decide?

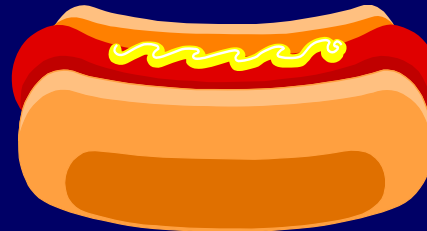
'Pop a Pill'



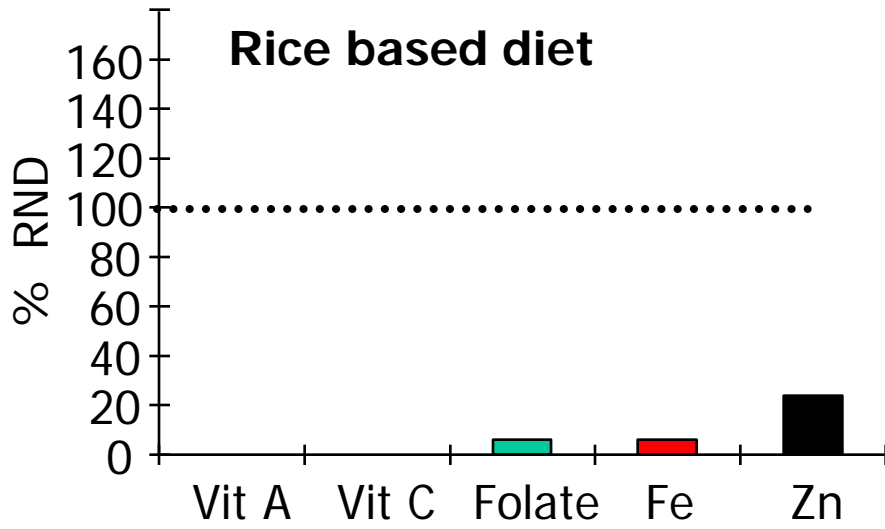
Eat your green leafy vegetables



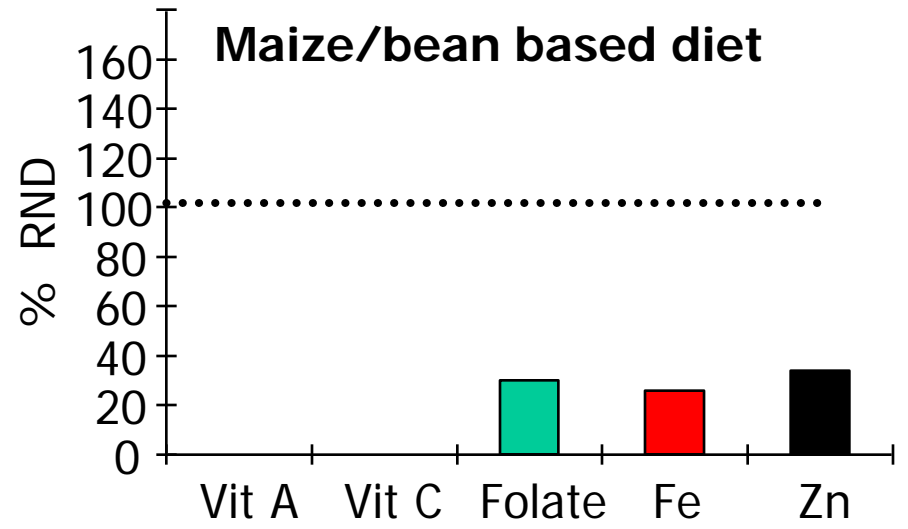
Just put it in the flour



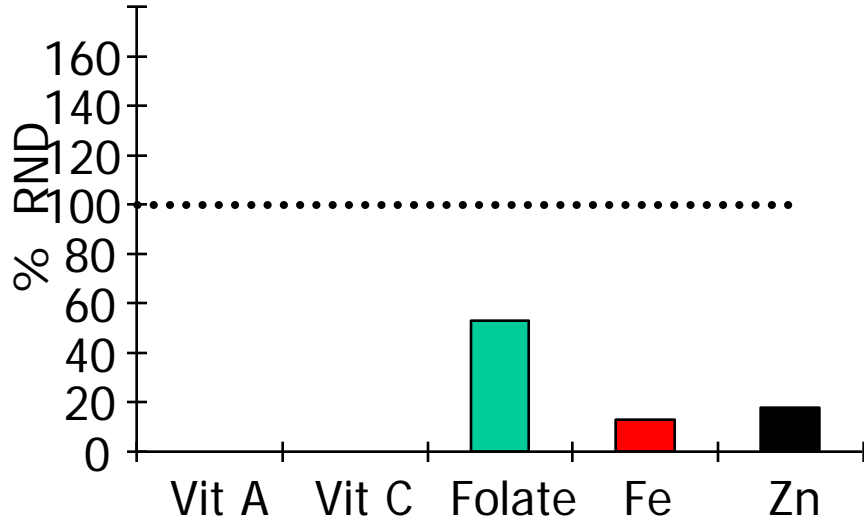
Rice based diet



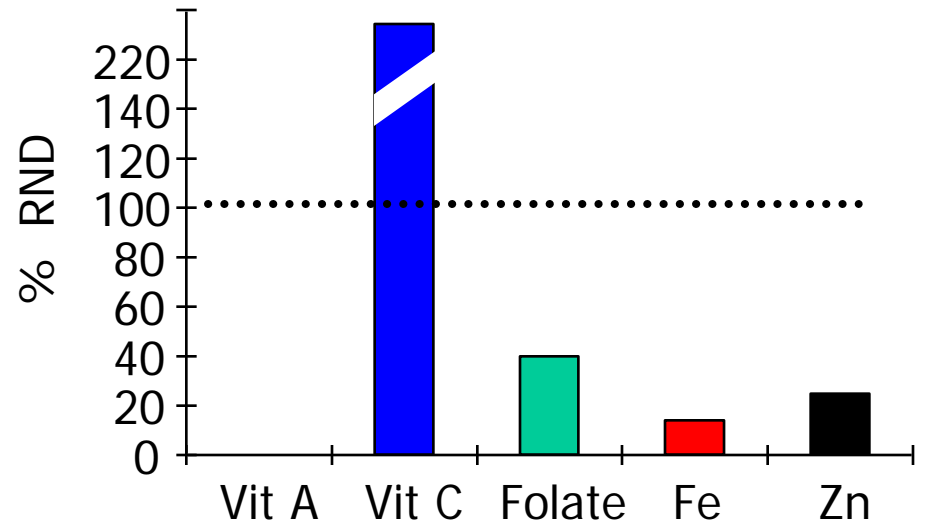
Maize/bean based diet

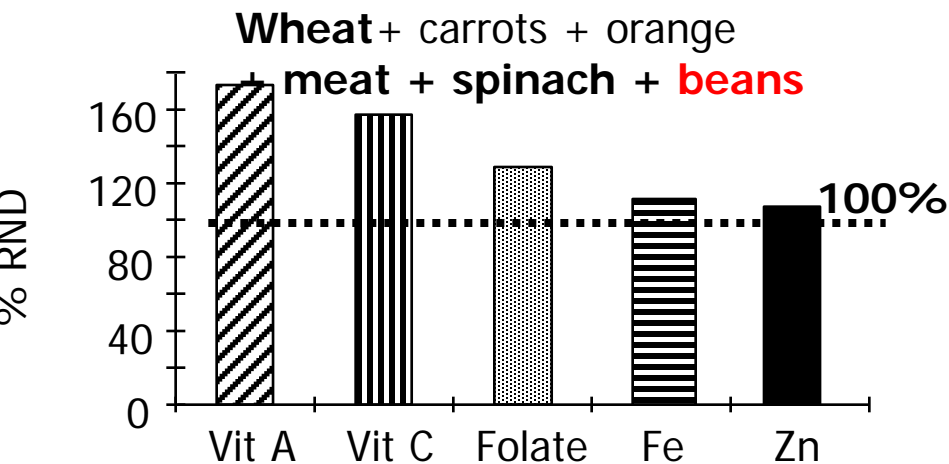
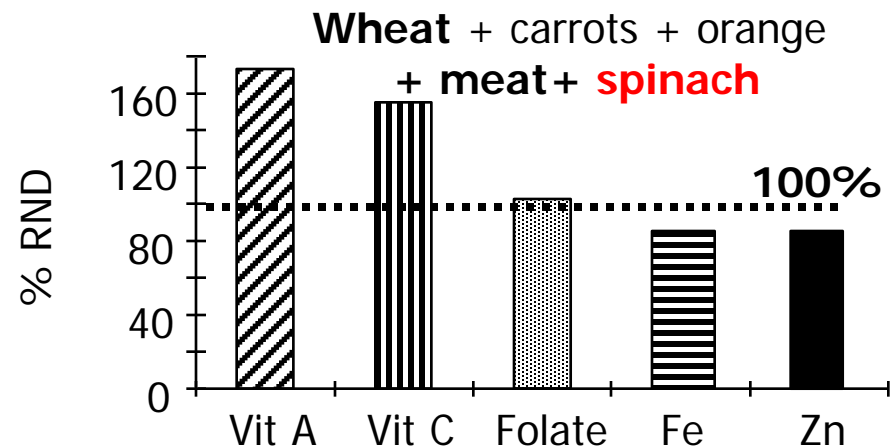
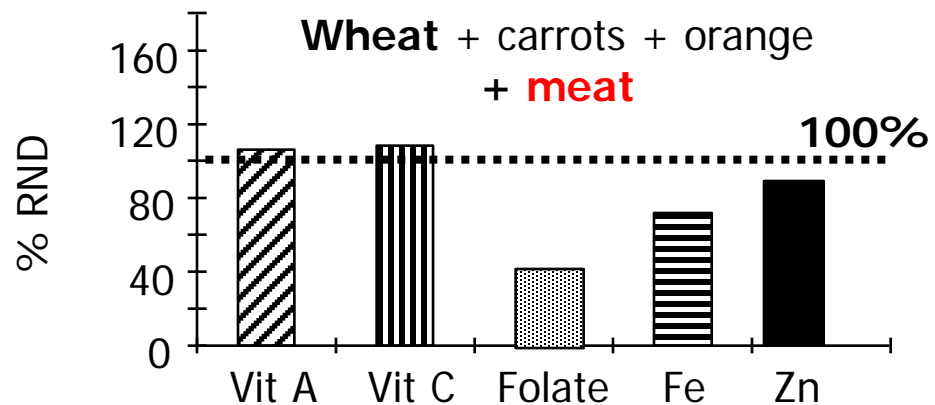
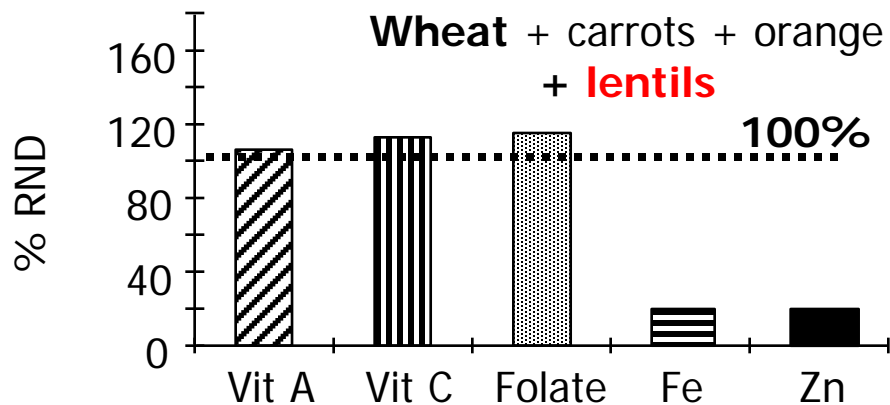
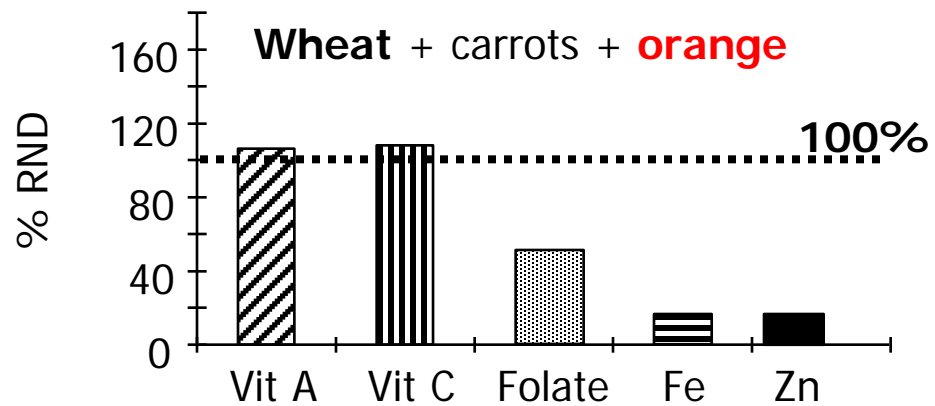
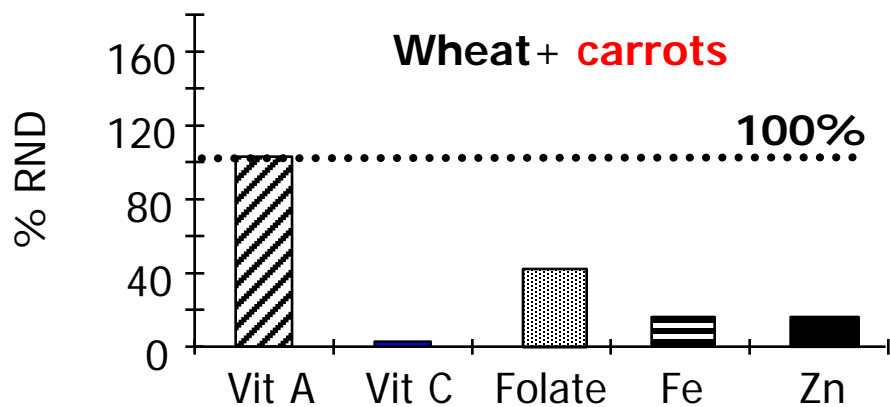


Refined wheat based diet

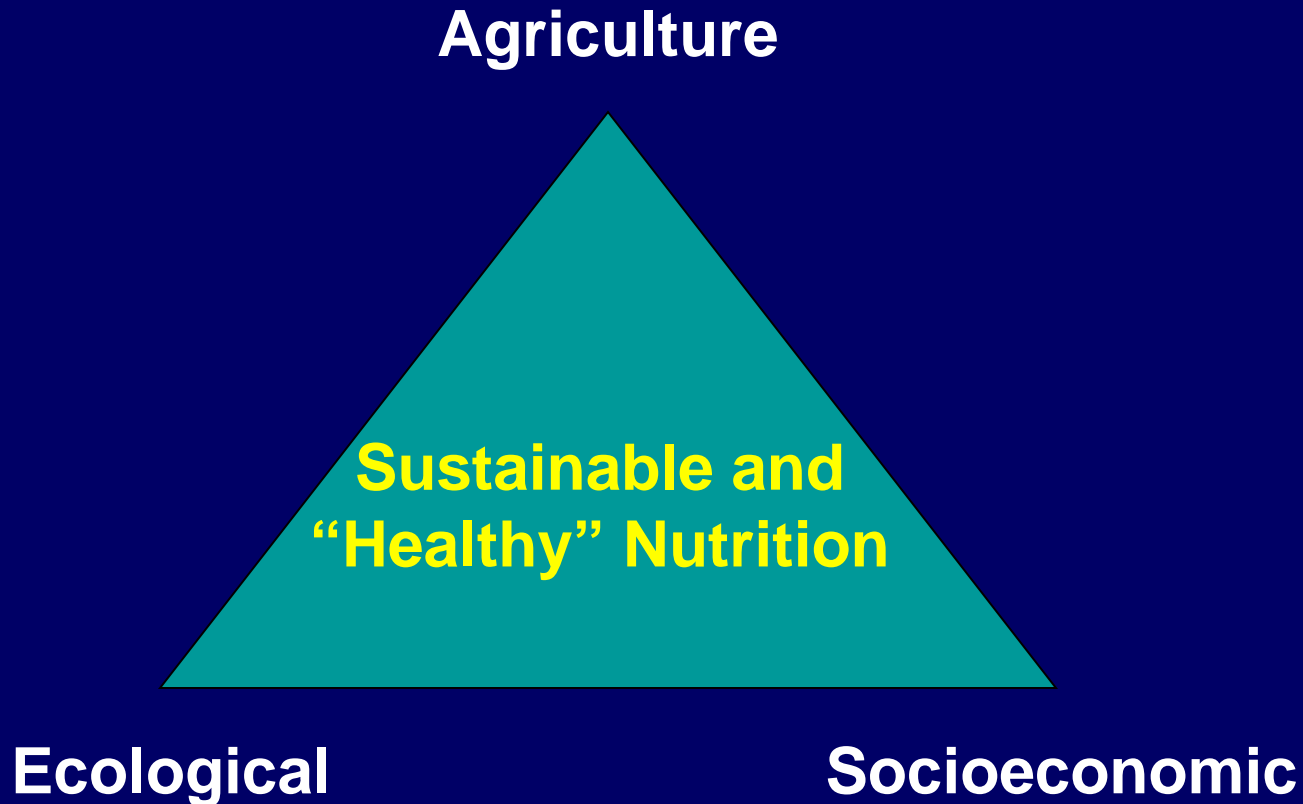


Potato based diet

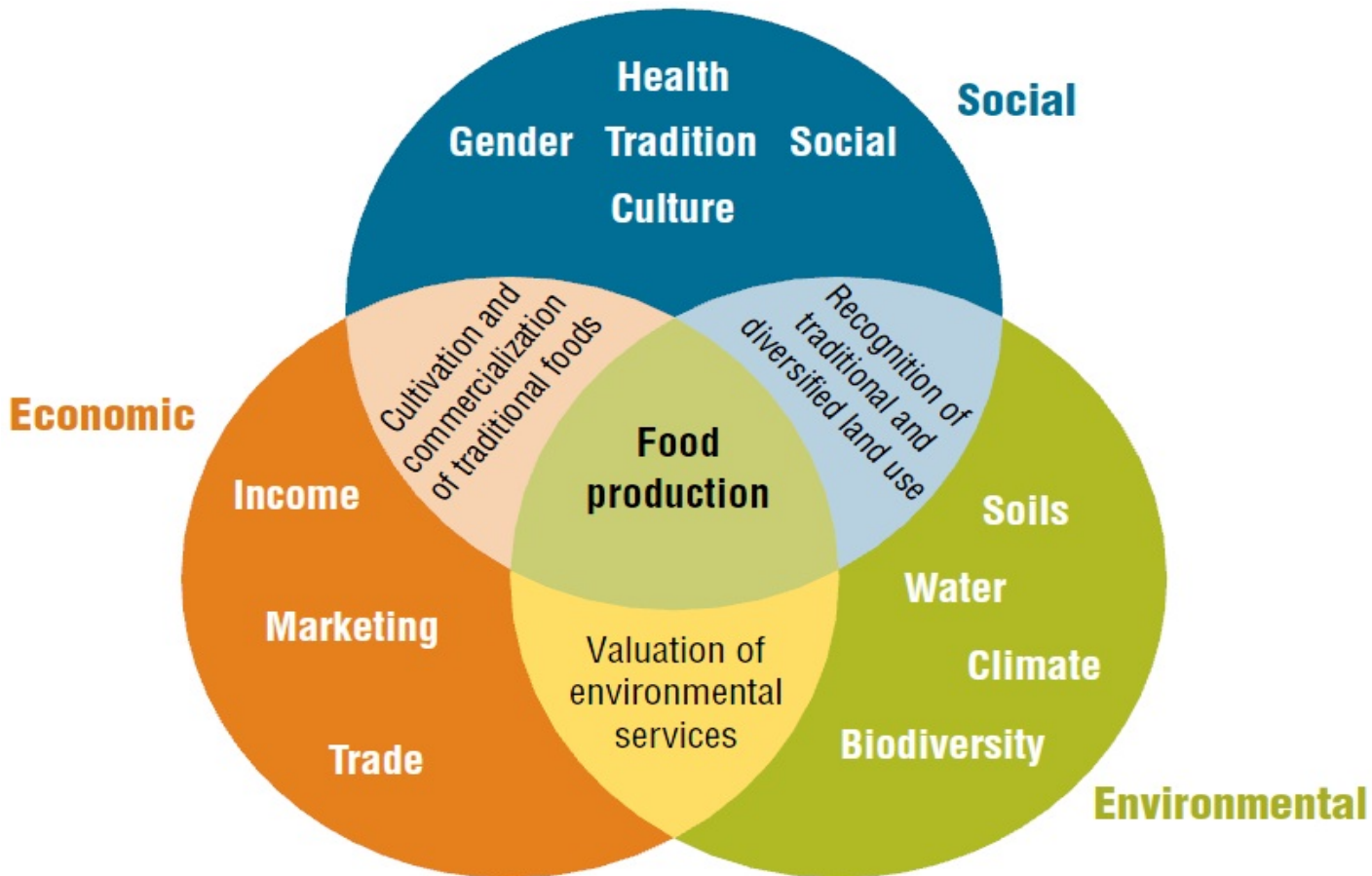




Intersectoral Approaches Needed!!



Agriculture's roles have benefits beyond just food production



FDA Fortification “Guidelines”

- Start with a demonstrated need**
- Consider the unintended consequences**
- Determine the proper fortification vehicle or vehicles and technical feasibility issues**
- Study the potential impact on intakes/status for all age/sex groups**
- Carry out monitoring post-fortification**

Multiple Micronutrient Supplementation

Infants	↓ anemia
	↑ weight gain
Children	↓ anemia
	↑ growth
Women	↑ birth length
	↓ low birth weight
	↓ congenital birth defects

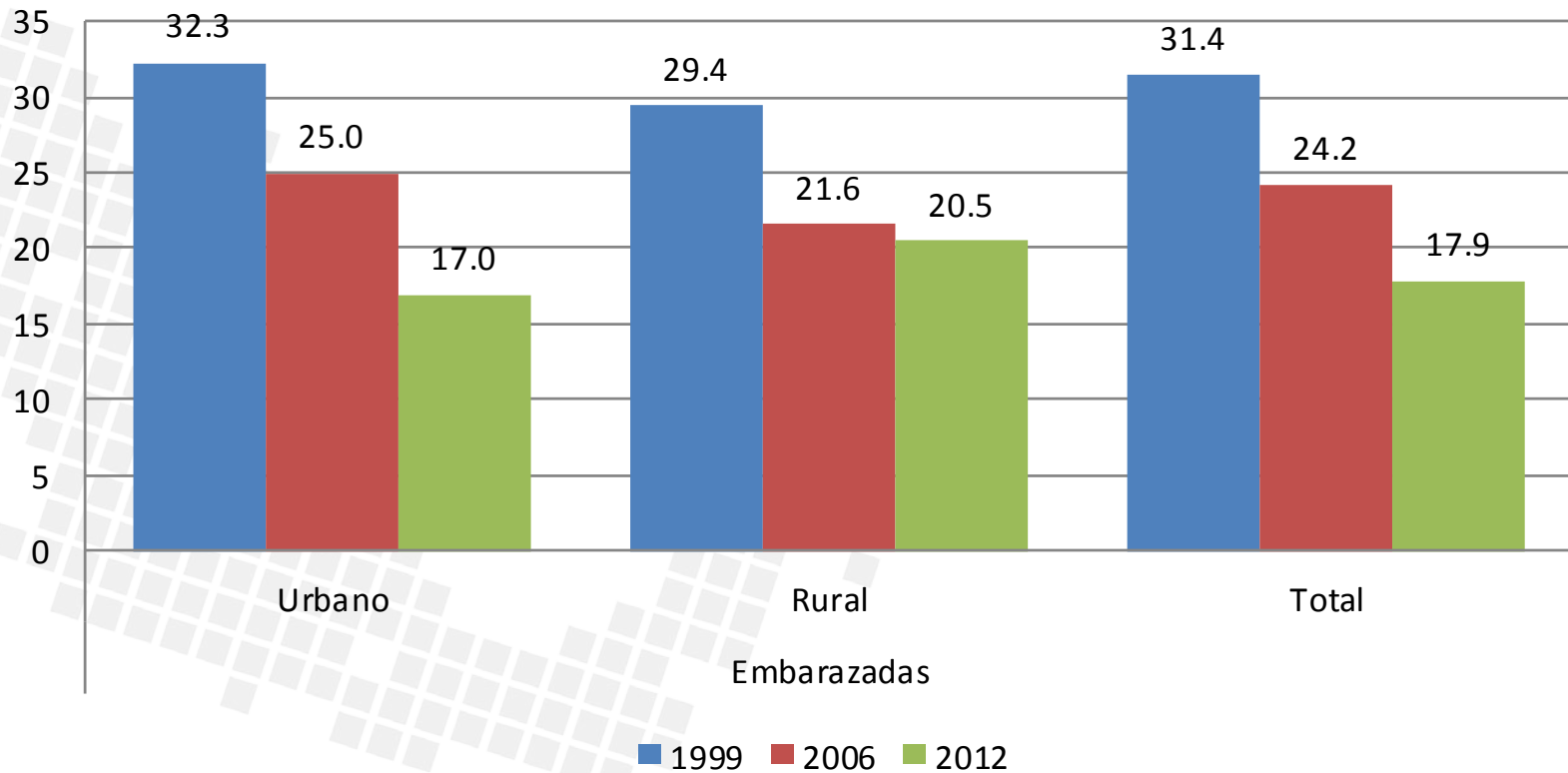
The benefit-cost ratios for nutrition programs

<u>Intervention programs</u>	<u>Benefit-cost</u>
Breastfeeding promotion in hospitals	5-67
Integrated child care programs	9-16
Iodine supplementation (women)	15-520
Vitamin A supplementation (< 6 years)	4-43
Iron fortification (per capita)	176-200

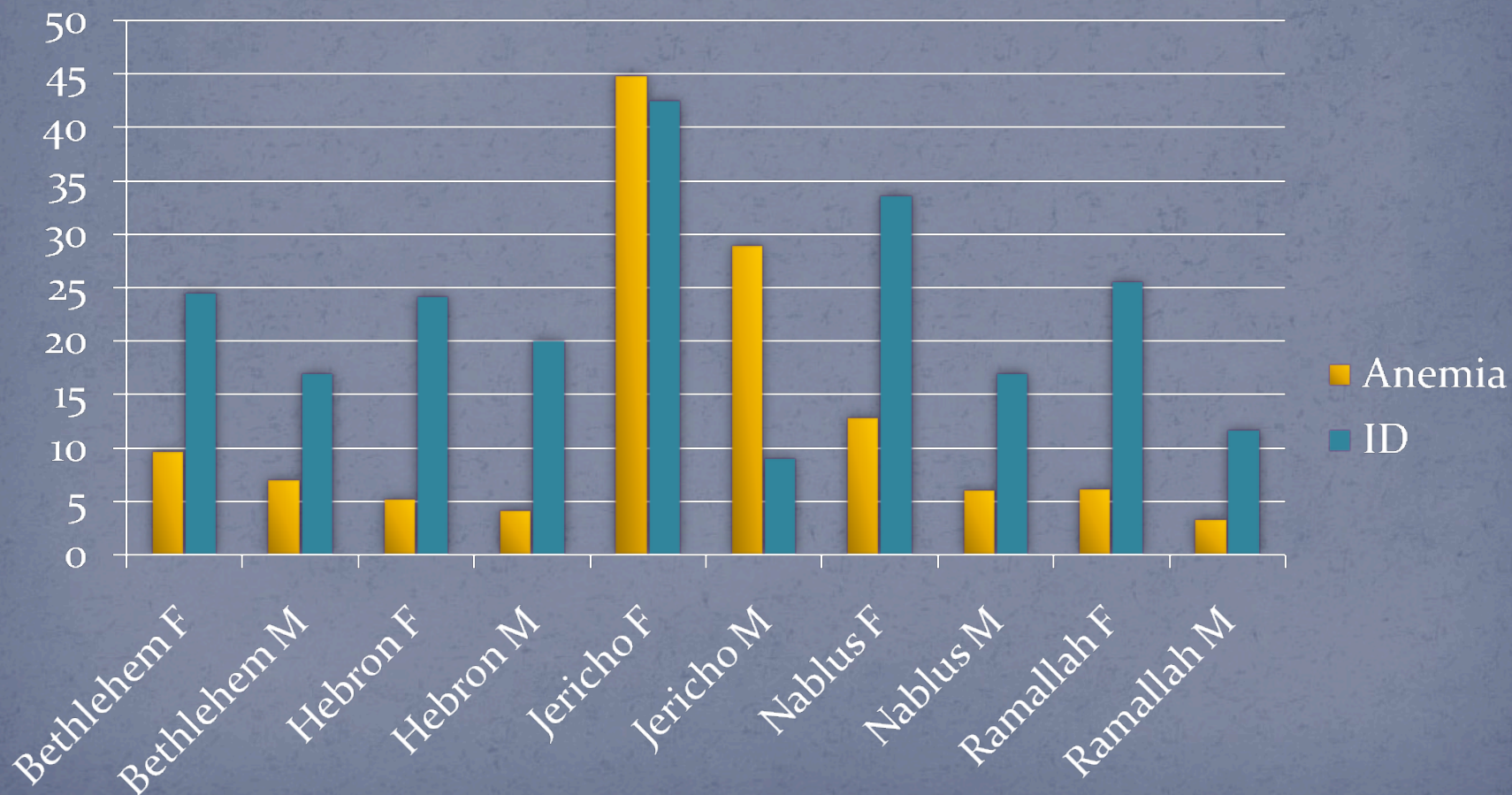
Behrman, Alderman, and Hoddinott (2004)



Prevalence of anemia in children 12 to 49 months of age in urban and rural areas in Mexico from 1999 to 2012



Prevalence of Anemia and Iron Deficiency in the West Bank after Flour Fortification



Serum Folate Levels in Palestinian Children

Effects of Flour Fortification (2009)

There is essentially no folate deficiency!!

- Median folate: 16.1 ng/ml
- 0.1% : <3.1 µg/L (Very low)
- 2.3% : <7.0 µg/L (Low)
- 72.3%: 7-20 µg/L (Normal)
- 25.1% : >20 µg/L (High)
- 8.5% : >30 µg/L (High)

n = 1890

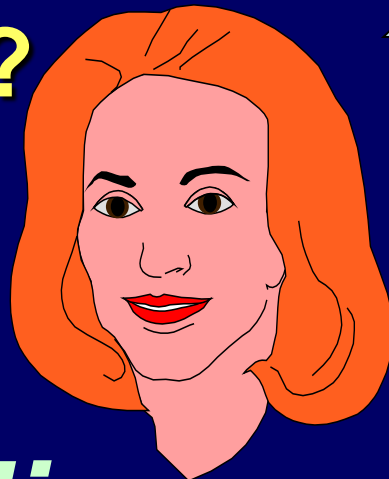
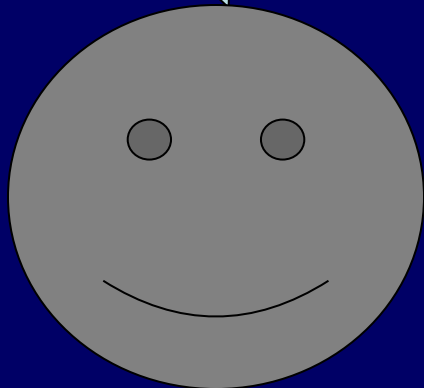
Screening for “Treatable” Causes of Undernutrition in Armenia

- Poor breastfeeding practices
- Poor post weaning and childhood feeding practices

- Celiac disease
- Cow milk protein allergy
- Intestinal parasites
- Lead, arsenic, other toxicities
- **BASELINE MICRONUTRIENT SURVEYS**

Intervention strategies--how to decide in Armenia?

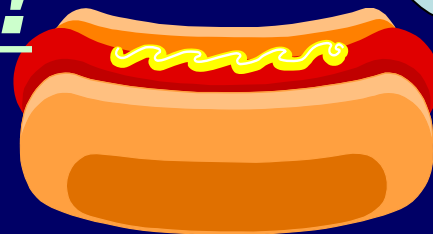
'Pop a Pill'



Eat your green leafy vegetables

Baseline
data
needed!!

Just put it in the flour





What are the costs of doing nothing?



Annual Cost of Fortification: A Pack of Chewing Gum!

Vitamin			1/3 RDA	Cost/Person/Year
A (250 CWS)	1111	IU	\$	0.073
D (100 CWS)	133	IU	\$	0.016
E (50% CWS)	5	IU	\$	0.139
B1	0.47	mg	\$	0.004
B2	0.57	mg	\$	0.013
B6	0.73	mg	\$	0.006
Niacin	6.3	mg	\$	0.019
Folic Acid	66.7	mcg	\$	0.001
B12	1	mcg	\$	0.014
C	20	mg	\$	0.055
Fe			\$	0.09
I			\$	0.05
Total			\$	0.48

Cochrane Database Syst Rev. 2016 Feb 18;2:CD010647. doi:
10.1002/14651858.CD010647.pub2.

Supplementation with multiple micronutrients for breastfeeding women for improving outcomes for the mother and baby.

Abe SK1, Balogun OO, Ota E, Takahashi K, Mori R.

“. We found no evidence to quantitatively assess the effectiveness of multiple-micronutrient supplementation in improving health outcomes in mother and baby.”