Maternal Under-Nutrition Our Global Disgrace

Advancing Policy Dialogue on Maternal Health
Maternal Undernutrition: Evidence, Links, and Solutions

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Why this talk?

"It was suggested that highly publicized initiatives such as "child survival" and "safe motherhood" have not had the expected effect because ***too little attention*** has been given to the nutritional status of women, including mothers"

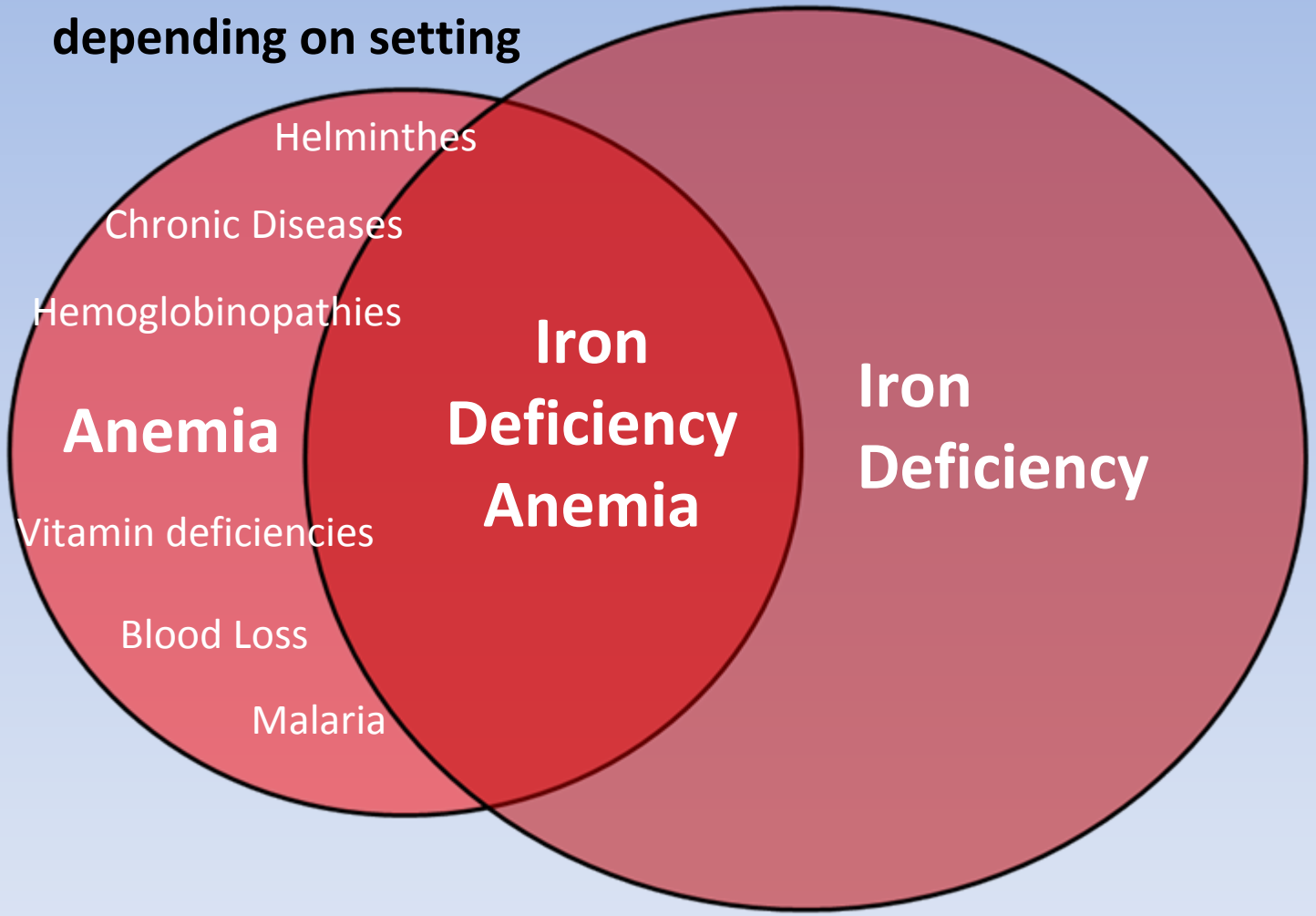
Mora and Nestel 2000 AJCN 71: 1353S-63S

Global Burden

- Underweight (<45 kg) / Low BMI (< 18.5kg/m^2)
  - 10-19% in most countries
  - Bangladesh, India, Eritrea: ~40%
- Low Stature (< 145cm or < 10^{th} percentile for height)
  - Up to 10% in many developing countries
- Iodine deficiency (urinary iodine < 110ug/L)
  - General population: 11% - 52%
- Vit A deficiency
  - 15.3% of pregnant women
- Iron deficiency / Anemia

~1/2 of the anemia burden is due to iron deficiency; estimates vary widely depending on setting

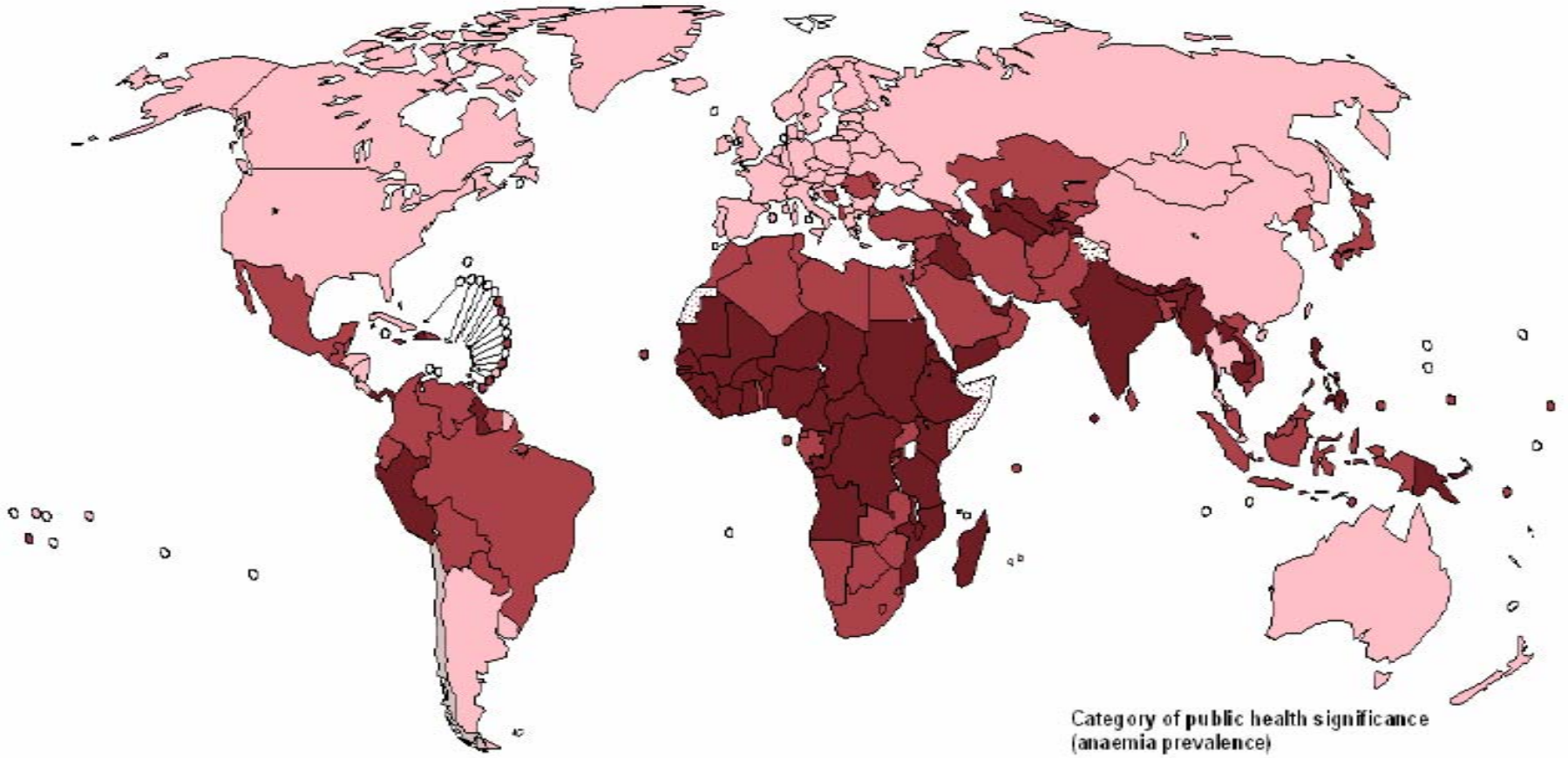
2 billion people globally are iron deficient; majority are women and children



Little progress over the past decade

Micronutrient Malnutrition Unit
Nutrition for Health and Development

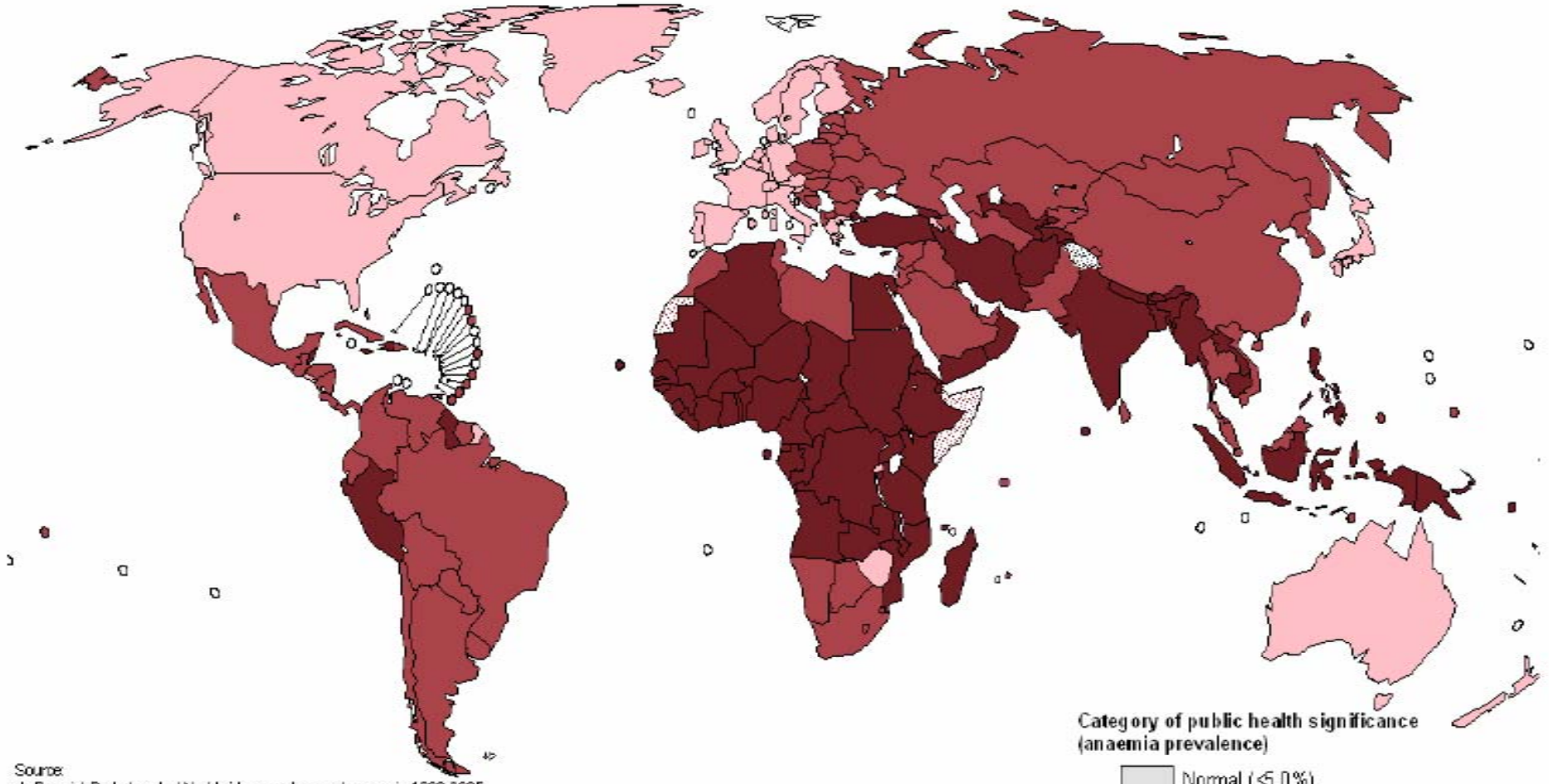
Anaemia as a public health problem by country: Non-pregnant women of reproductive age



Source:
de Benoist B et al., eds. Worldwide prevalence of anaemia 1993-2005.
WHO Global Database on Anaemia. Geneva, World Health Organization, 2008

Micronutrient MalNutrition Unit
Nutrition for Health and Development

Anaemia as a public health problem by country:
Pregnant women



Source:
de Benoist B et al., eds. Worldwide prevalence of anaemia 1993-2005.
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Effects of Maternal Under-nutrition

Maternal Deficiency	Maternal Health Outcomes		Fetal Outcomes	Neonatal, Infant Outcomes		
	Mortality	Morbidity	IUGR, PTD, LBW	Mortality	Morbidity	Growth/ Development
Underweight; Low BMI	I	++	IUGR: OR 1.8 (1.7–2.0) PTD : OR 1.3 (1.1–1.4)	Attr. Fraction: 0.8%-17%	+	++
Poor weight gain	I	I	14% of IUGR	++	I	++
Low Stature	I	++; 60% increase in risk of assisted delivery	18.5% of IUGR	++	I	++

I: insufficient evidence / research conducted
-- : likely no effect
+ - +++: association evident based on consistency and strength of research

Effects of Maternal Under-nutrition

Maternal Deficiency	Maternal Health Outcomes		Fetal Outcomes	Neonatal, Infant Outcomes		
	Mortality	Morbidity	IUGR, PTD, LBW	Mortality	Morbidity	Growth Development
Vit A	RR (clinical VAD) 4.51 (2.91–6.94)	+++	--	--	I	I
Iodine	I	Goiter+++	+++	++	++	++
Calcium	--	+++	IUGR: -- PTD: ++	++	I	I
Zinc	I	I	MIxed	I	I	I

Effects of Maternal Under-nutrition

Maternal Deficiency	Maternal Health Outcomes		Poor Pregnancy Outcomes	Neonatal, Infant Outcomes		
	Mortality	Morbidity	IUGR, PTD, LBW	Mortality	Morbidity	Growth Development
Iron / IDA	Severe anemia+++ RR (1g/dL Hb) 0.75 (0.62-89);	+++ +PPH; + sepsis	+++	mixed	I	++

Mechanisms

- Severe anemia directly contributes to mortality (Hb <5 g/L)
- Moderate anemia increases risk of hemorrhage (less evidence for mild)
  - Uterine atony
  - Greater blood loss in moderately compared to nonanemic women
- Moderate anemia may increase risk of sepsis
- Anemia increases risk of dying from hemorrhage
  - Inability to tolerate blood loss

Estimates of odds ratio of maternal mortality associated with a 1g/dl increase in hemoglobin level

Study ID	Stoltzfus 2003 (OR, 95%CI)	Murray-Kolb et al, Unpublished (OR, 95% CI)	
		DSL, 1986 Method	Mixed Model
India 80	0.61(0.57-0.64)	0.61(0.57-0.64)	0.61(0.57-0.64)
India 95	0.84(0.81-0.88)	0.84(0.81-0.88)	0.84(0.81-0.88)
Malaysia 65	0.74(0.69-0.80)	0.74(0.69-0.80)	0.74(0.69-0.80)
Nigeria 75	0.46(0.15-1.42)	0.49(0.18-1.38)	0.49(0.18-1.38)
Nigeria 82	0.38(0.14-1.03)	0.45(0.20-1.03)*	-**
Nigeria 85	0.95(0.83-1.09)	0.95(0.83-1.09)	0.95(0.83-1.09)
Indonesia 08		0.80(0.67-0.96)	0.80(0.67-0.96)
Ghana 06		0.46(0.13-1.60)*	-**
Nigeria 03		0.41(0.04-3.72)*	-**
India 02		0.76(0.15-3.91)*	-**
Combined Estimates:			
6-study	0.746 ± 0.088 (0.623-0.892)	0.747 ± 0.088 (0.628-0.887)	0.725 ± 0.086 (0.582-0.904)
10-study		0.749 ± 0.076 (0.645-0.870)	0.724 ± 0.076 (0.610-0.861)

Note: * set value of 0.1 for zero death; ** zerodeath

Murray-Kolb L, Caulfield LE, Chen L, Chen P. Unpublished CHERG review

Effects of Maternal Under-nutrition

Maternal Deficiency	Maternal Health Outcomes		Poor Pregnancy Outcomes	Neonatal, Infant Outcomes		
	Mortality	Morbidity	IUGR, PTD, LBW	Mortality	Morbidity	Growth Development
Iron / IDA	Severe anemia+++ RR (1g/dL Hb) 0.75 (0.62-89); ID/IDA contributes to 115000 deaths	+++ +PPH; + sepsis	+++	mixed	I	++

Other Maternal Health Outcomes

Increased Infection

Depression

Fatigue, Low work productivity

Poor pregnancy outcomes

In girl children / adolescents – impaired cognitive development

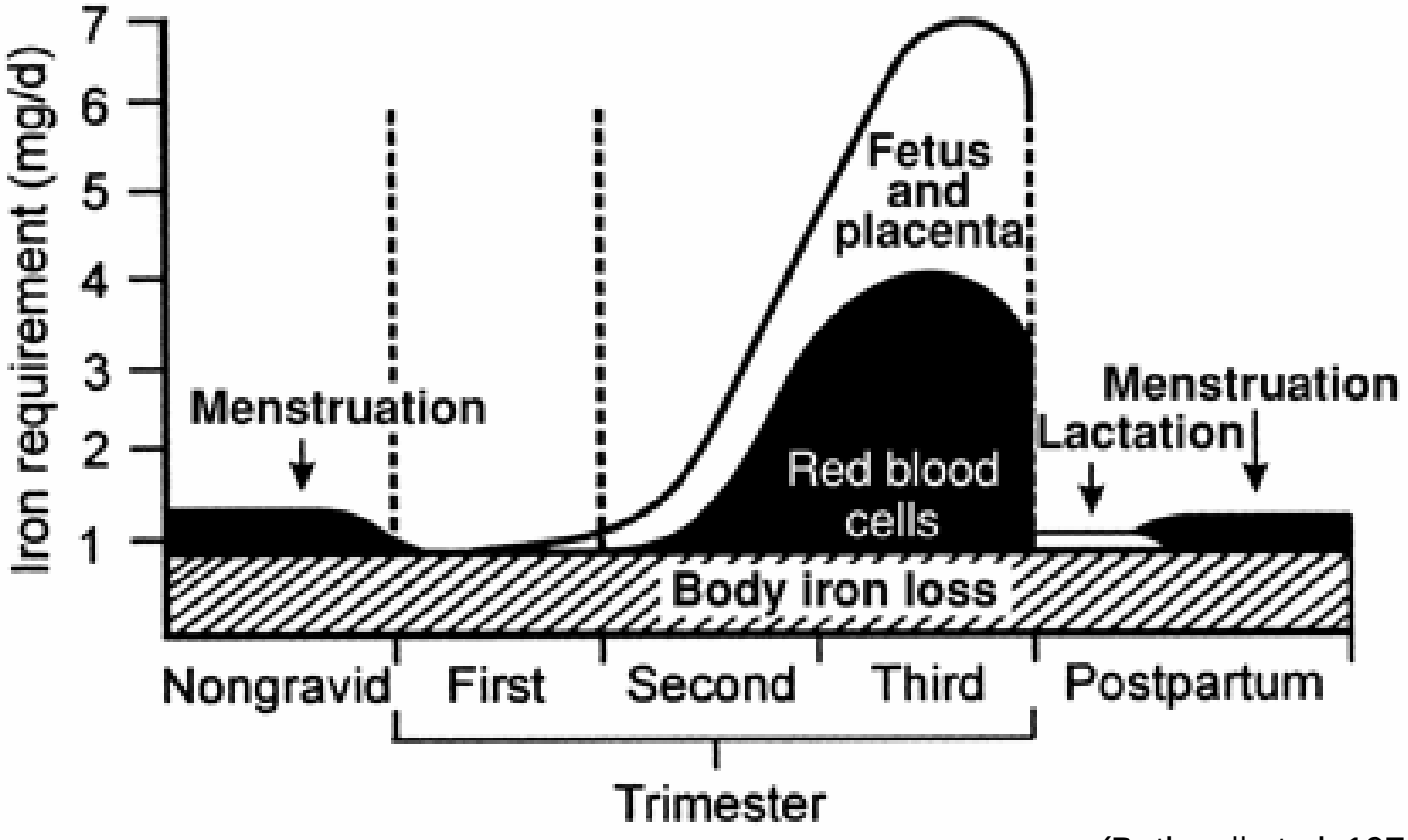
Why is the burden so high in women?

DIETARY INTAKES ≠ **DIETARY NEEDS**

DIETARY NEEDS

- Illness / Infection
- Menstruation
- Pregnancy / Growth
- Physical Activity
- Lactation

Requirements during pregnancy



(Bothwell et al, 1979)

Why is the burden so high in women?

Medscape® www.medscape.com

Age/condition	Nutrient: Vitamin B12 (μg/d)	Vitamin D (μg/d)	Calcium (mg/d)	Iron (mg/d)	Zinc (mg/d)	Protein (g/d)	Omega-3 fatty acids (g/d)
Infants							
0–0.5 y	0.4	5	210	0.27	2	9.1 (0–6 mo)	0.5 (0–6 mo)
0.5–1 y	0.5	5	270	11	3	13.5 (7–12 mo)	0.5 (7–12 mo)
Children							
1–3 y	0.9	5	500	7	3	13	0.7
4–8 y	1.2	5	800	10	5	19	0.9
Male							
9–13 y	1.8	5	1300	8	8	34	1.2
14–18 y	2.4	5	1300	11	11	52	1.6
19–30 y	2.4	5	1000	8	11	56	1.6
Female							
9–13 y	1.8	5	1300	8	8	34	1
14–18 y	2.4	5	1300	15	9	46	1.1
19–30 y	2.4	5	1000	18	8	46	1.1
Pregnancy							
≤18 y	2.6	5	1300	27	13	71	1.4
19–30 y	2.6	5	1000	27	11	71	1.4
Lactation							
<18 y	2.8	5	1300	10	14	71	1.3
19–30 y	2.8	5	1000	9	12	71	1.4

Adapted from Dietary Reference Intakes: Vitamins, Food and Nutrition Board; Dietary Reference Intakes: Elements, Food and Nutrition Board, 2001; Dietary Reference Intakes: Macronutrients, Institute of Medicine. These reports can be accessed via www.nal.usda.gov/fnic/etext/000105.html.

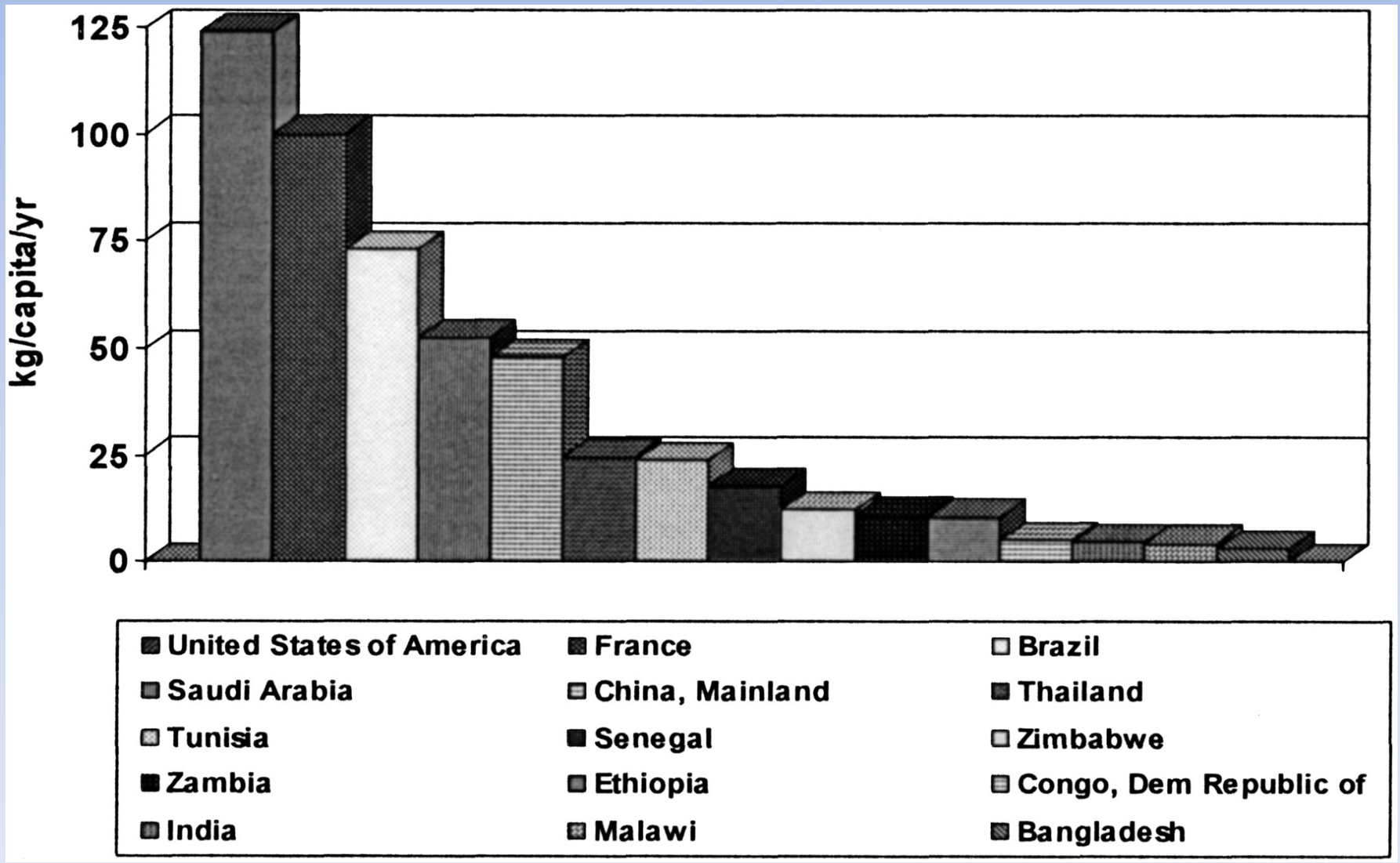
Source: J Pediatr Health Care @ 2006 Mosby, Inc.

Top Food Sources of Key Micronutrients*

- Vitamin A,
  - Animal Liver, >500%
  - Carrot, 474%
  - Pumpkin: 269%
- Vitamin C
  - Guava, 275%
  - Red bell peppers, 158%
  - Oranges, 116%
- Vitamin B12
  - Animal Liver, > 1000%
  - Fish /seafood, >700%
  - Beef, >125%
- Iron
  - Clams, 252%
  - Liver, 65-150%
  - Beef, 30%
- Zinc
  - Oysters, 509%
  - Beef, 60%
  - Liver, 45%
- Iodine
  - Seaweed, 100%
  - Cod fish, 70%
  - Milk, 20%

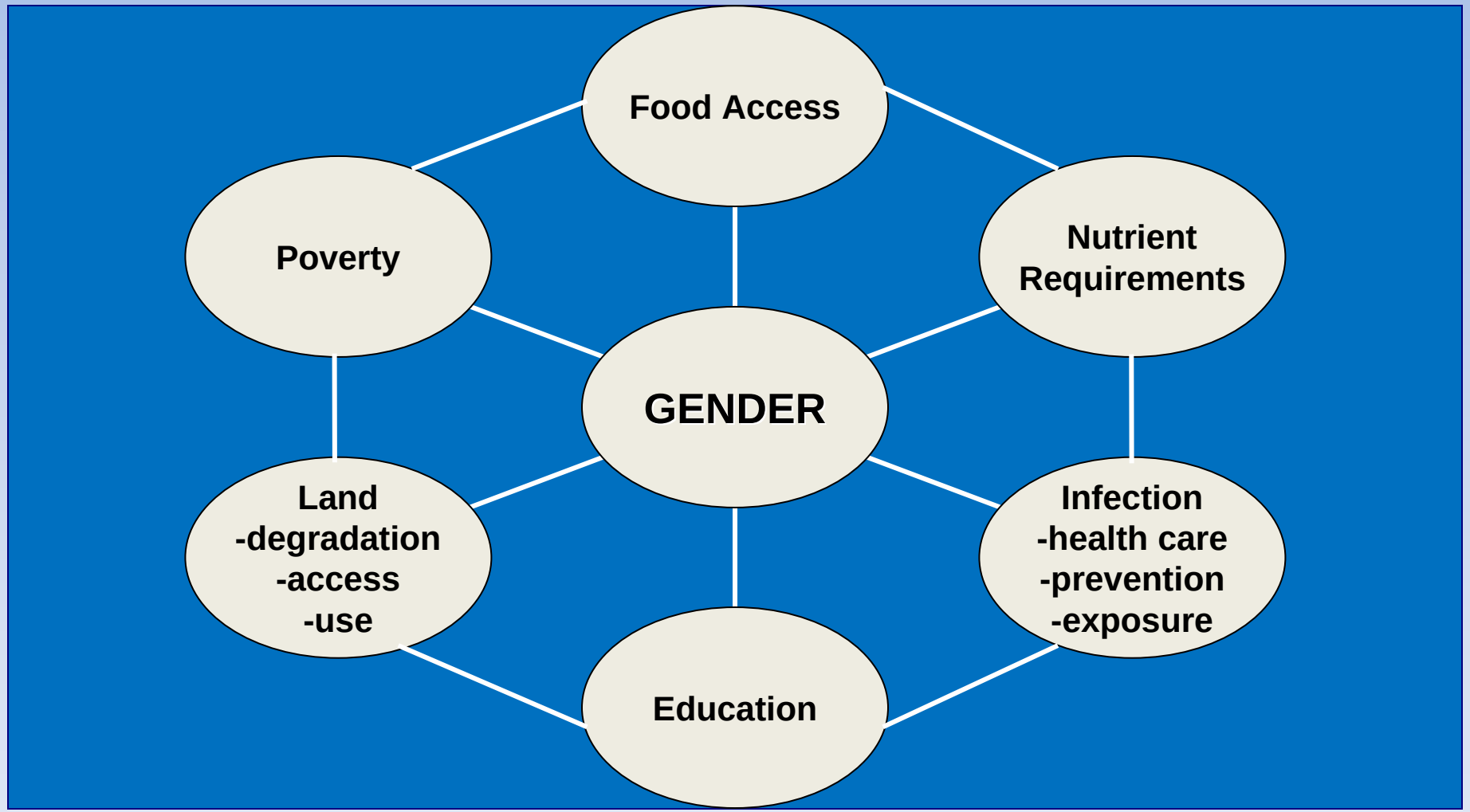
* Naturally occurring, non-fortified foods

Global Meat Consumption



Speedy A W J. Nutr. 2003;133:4048S-4053S

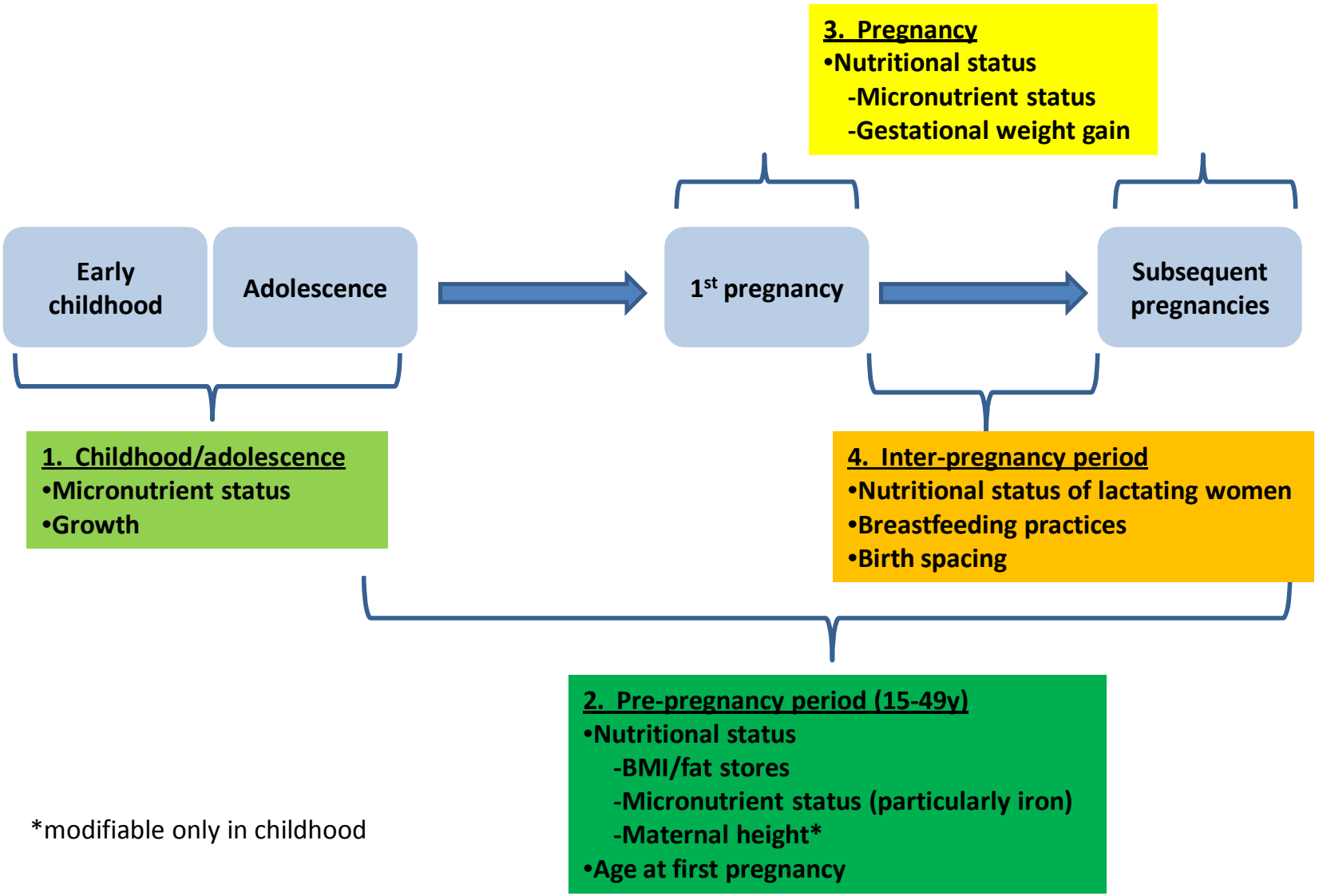
Why is the burden so high in women?



Evidence of Impact for Nutritional Interventions

Windows of opportunity for nutritional interventions during the life course to improve conditions that influence MNCH outcomes

(Boxes 1-4 highlight select determinants)



*modifiable only in childhood

Interventions: Nutritional

- Micronutrient supplementation
- Fortification
  - Large scale, Industrial
  - Point of use
  - Small / medium scale
- Behavior Change Communication
  - Use of supplements / fortified foods
  - Nutrition education
  - Dietary Modification / Diversification
    - Food pairings – vitamin C rich foods
    - Food modifications – fermentation, soaking
- Increase Access to High Quality Diets
  - Bio-fortification of Crops
  - Kitchen gardens, animal production
  - BCC on access of foods to women

Interventions: Non-nutritional

- Malaria treatment and prevention
- Management of chronic diseases / inflammation
- Prevention and treatment for parasites
- Reduced work load / increased rest
- Increasing age at first pregnancy
- Increasing birth intervals (>= 2 years)

Supplementation during Pregnancy

2009-10 Cochrane Reviews: Summary of Research Findings			
Balanced Protein / Energy (13 studies)	Iron / IFA (49 trials)	Vitamin A (16 trials)	Multiple Micronutrients (9 trials)
1. Stillbirth 2. Birth weight 3. SGA 4. Neonatal death 5. No effect on preterm 6. No data reported for maternal mortality / morbidity	1. infant iron status 2. birth weight / length; SGA 3. anemia at term 4. IDA at term 5. moderate /severe anemia at any time 6. Diarrhea 7. Risk of transfusion 8. More side effects 9. Weekly as efficacious as daily	Maternal mortality in VAD populations Maternal anemia No impact on other maternal / infant health outcomes	LBW and anemia; Effect not significant when compared to IFA Insufficient data on most outcomes Trials of MMNS during pregnancy report improved child growth up to 2 years compared to IFA alone (Food Nutr Bull 2009, supp 1)

IFA supplementation during pregnancy

Klemm R, et al. Unpublished

Industrial Fortification

Efficacy / Effectiveness

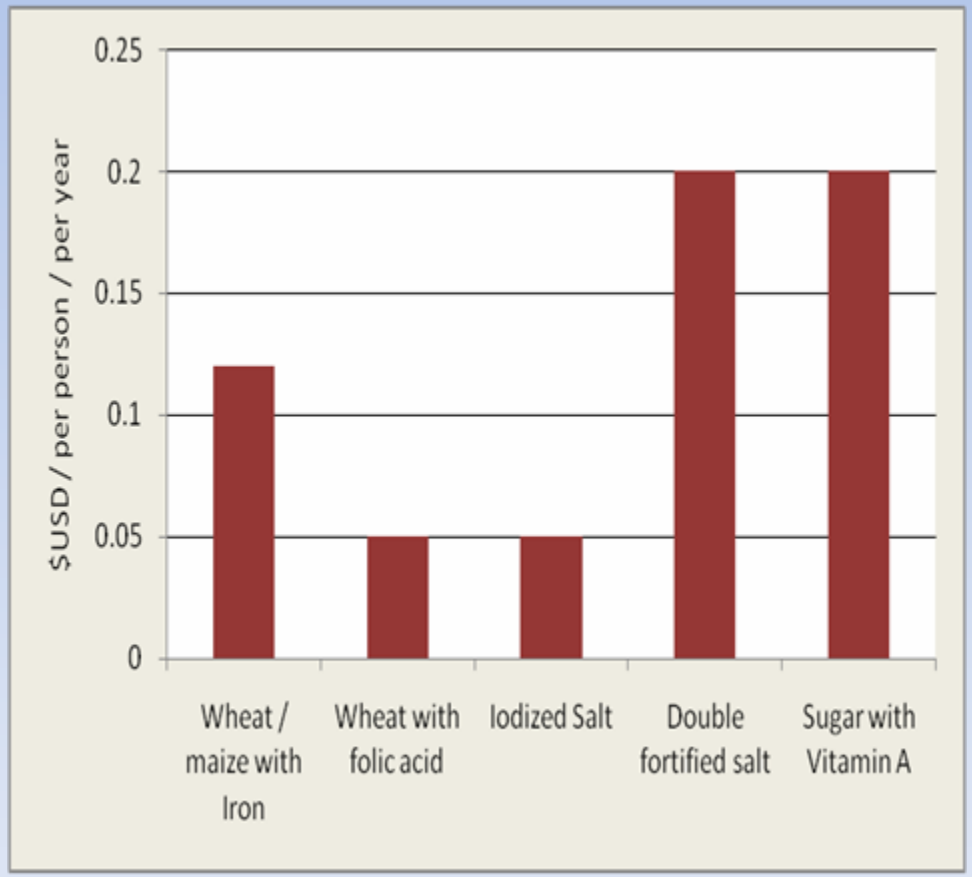
Sugar: Vitamin A -- efficacious and effective; Double fortified to include iron – limited efficacy / effectiveness

Wheat flour: moderate to high efficacy with certain forms of iron at appropriate doses; high efficacy and effectiveness with folic acid

Maize: less developed technologies; higher phytate, lower iron content; rarely fermented

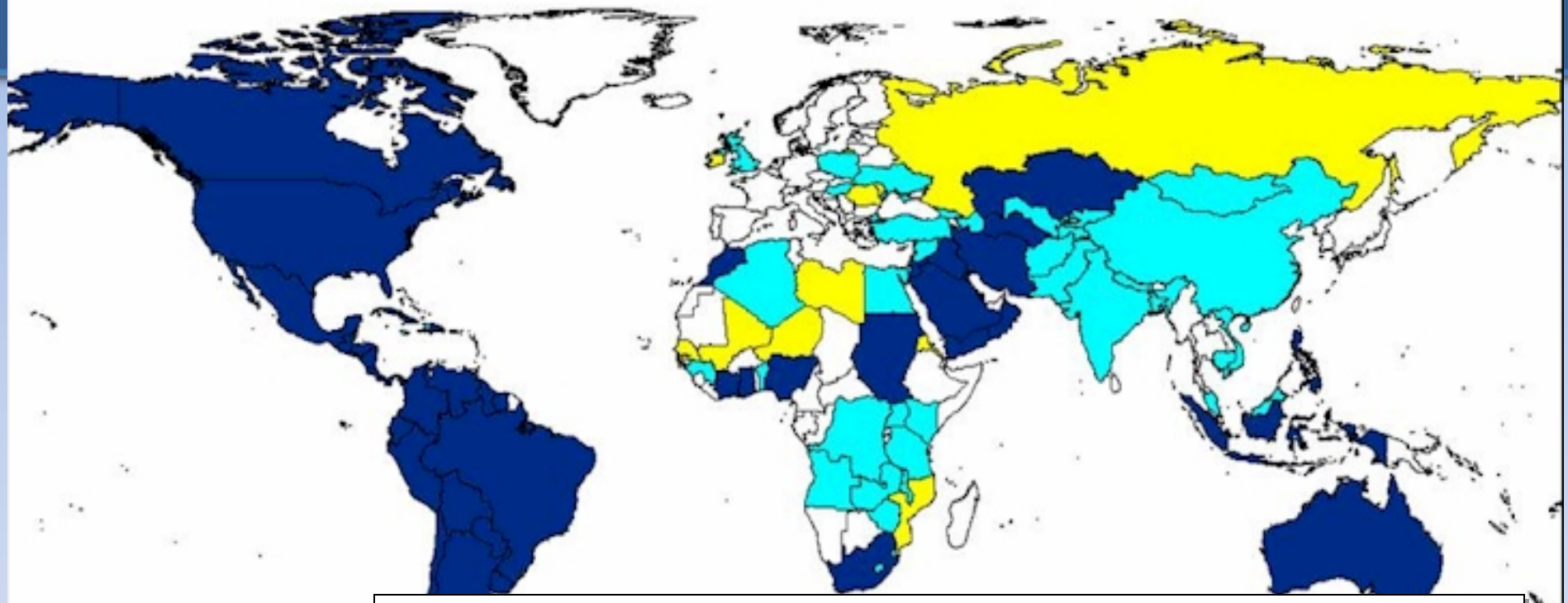
Salt: iodine efficacious and effective; doubly fortified with iron also efficacious in children , limited data for women

Cost Effectiveness



Flour Fortification Initiative: Map of Global Progress

Fortification Status: September 2007



-- May not be accessible or acceptable in target populations

-- Only 9/78 countries with active or planned wheat fortification activities will achieve impact on iron deficiency and anemia (Hurrell 2010)

- **Wrong iron form**
- **Iron dose too low**
- **Population intakes of wheat flour too low**

Other fortification strategies

- Small and medium scale fortification
  - Can be effective for difficult to reach populations
  - Quality Assurance and control
- Micronutrient powders (sprinkles)
  - Acceptable, efficacious and effective in children; limited research with women

Other Food Based Strategies

- Behavior change communication to alter diet patterns can enhance bioavailability of vitamin A, iron, zinc and calcium and dietary diversity
- Home processing of foods to reduce phytates can improve bioavailability but ASF still required to meet requirements (mostly children)
- Agricultural strategies to increase production can improve intakes and nutrition of women and children (Gibson, 2009; Berti 2008; Faber 2008)
  - Vitamin A rich vegetables and ASF

Integrated Approaches: MICAH

Project Goal: Improve the micronutrient status of women and children in Ethiopia, Ghana, Malawi, Tanzania, and Senegal

Activities

- Disease prevention /control
- Health systems strengthening
- Food Based Approaches: kitchen gardens, small animal rotating funds
- Community-based weekly IFA supplementation of nonpregnant women and children;
- Community based daily supplementation of pregnant women
- Small and medium scale fortification (selected sites)
- Intensive nutrition education

Outcomes

- IFA coverage in pregnant women
  - Ethiopia: 20% → 43%
  - Ghana: 41% → 98%
  - Malawi: 49% → 50%
  - Senegal: 5%→ 72%
  - Tanzania: 78%→ 89%
- Anemia in pregnant women
  - Ghana: 63% → 25%
  - Malawi: 59%→ 48%
  - Senegal: 81% → 65%
  - Tanzania: 87% → 73%

Achieving Impact

- Include women as the beneficiaries of not just the targets of interventions
- Move beyond facility based micronutrient supplementation of pregnant women as sole strategy
  - The entire life cycle
  - Alternative strategies
- Recognize and address the role of gender bias, low community and individual knowledge and awareness
- Integrate
  - Integrate health and nutrition strategies
  - Integrate facility and community based strategies
- Integrate maternal nutrition into community-based food security / agricultural strategies
- Move beyond only child-level indicators

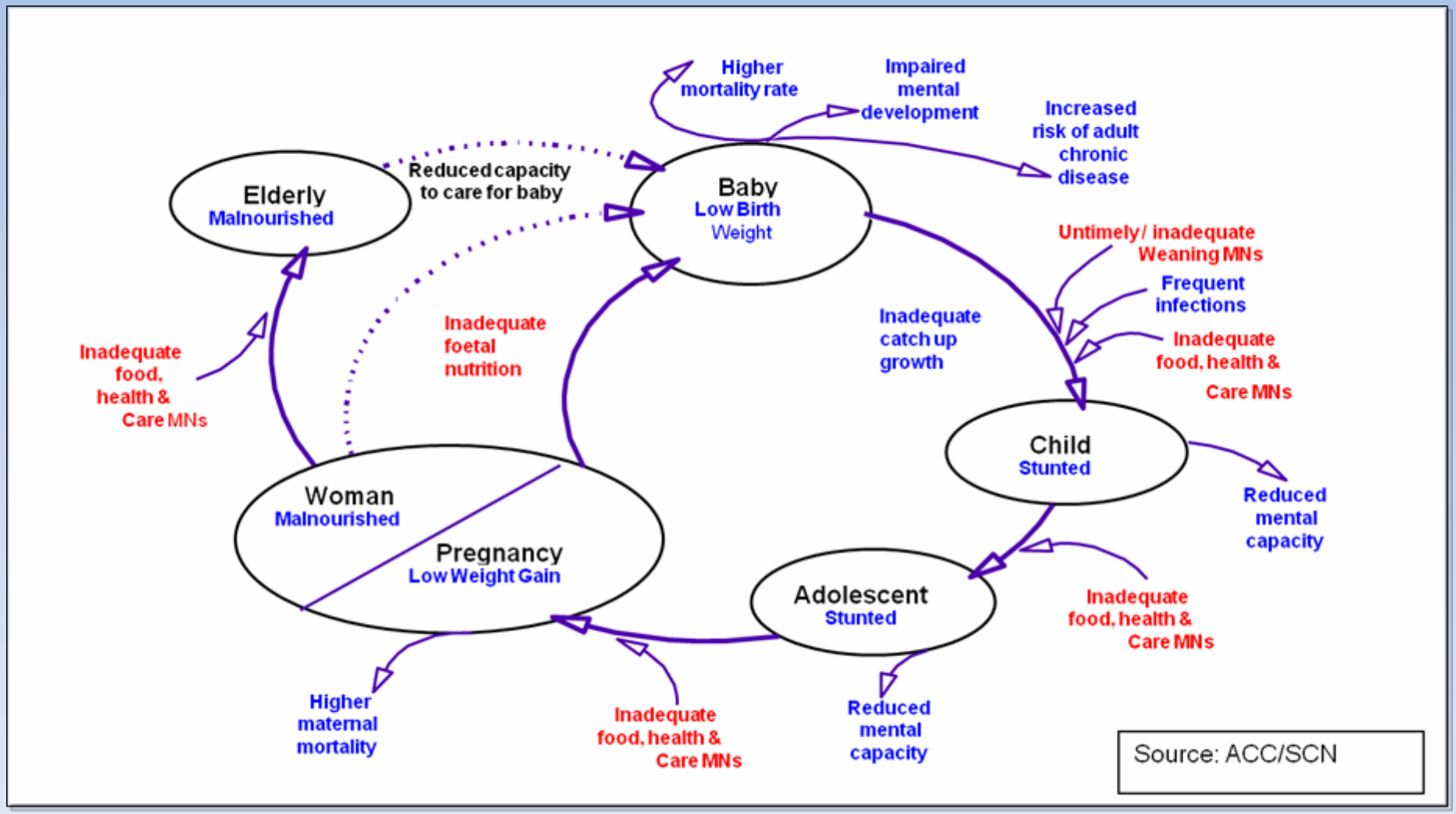
Achieving Impact

- Improve nutrition through the life cycle
- Improve access to nutrition and health services
- Improve access to nutritionally adequate food

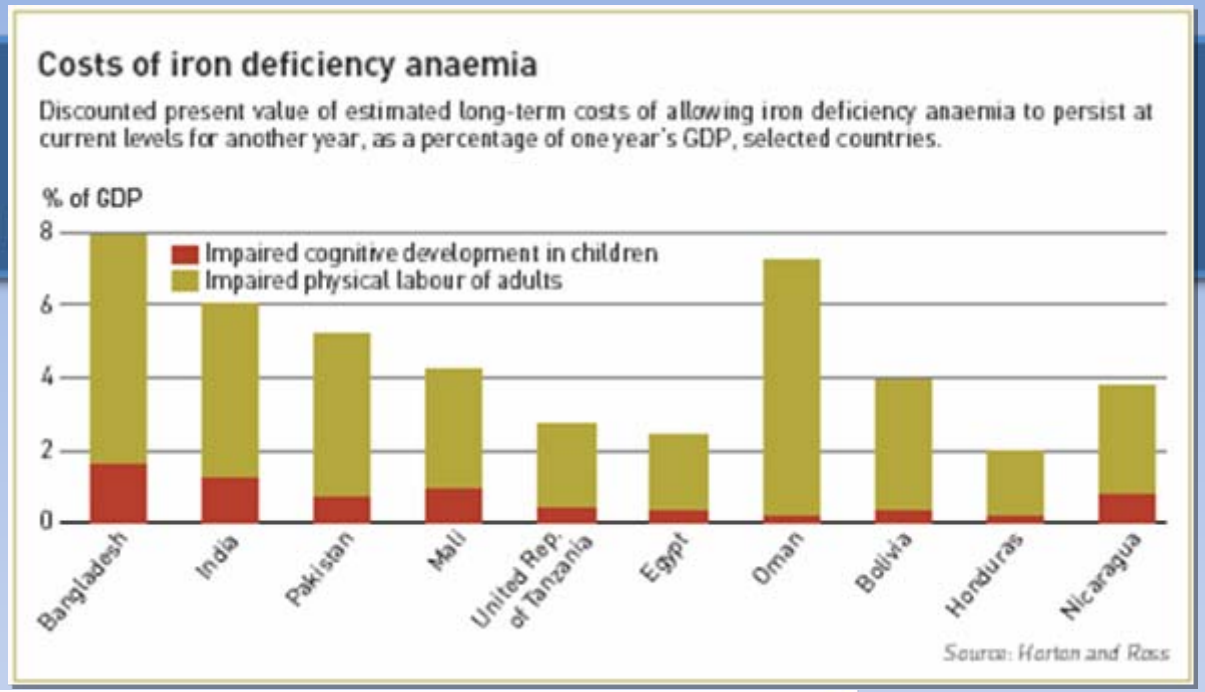
→ Improvements in the health and well being of women

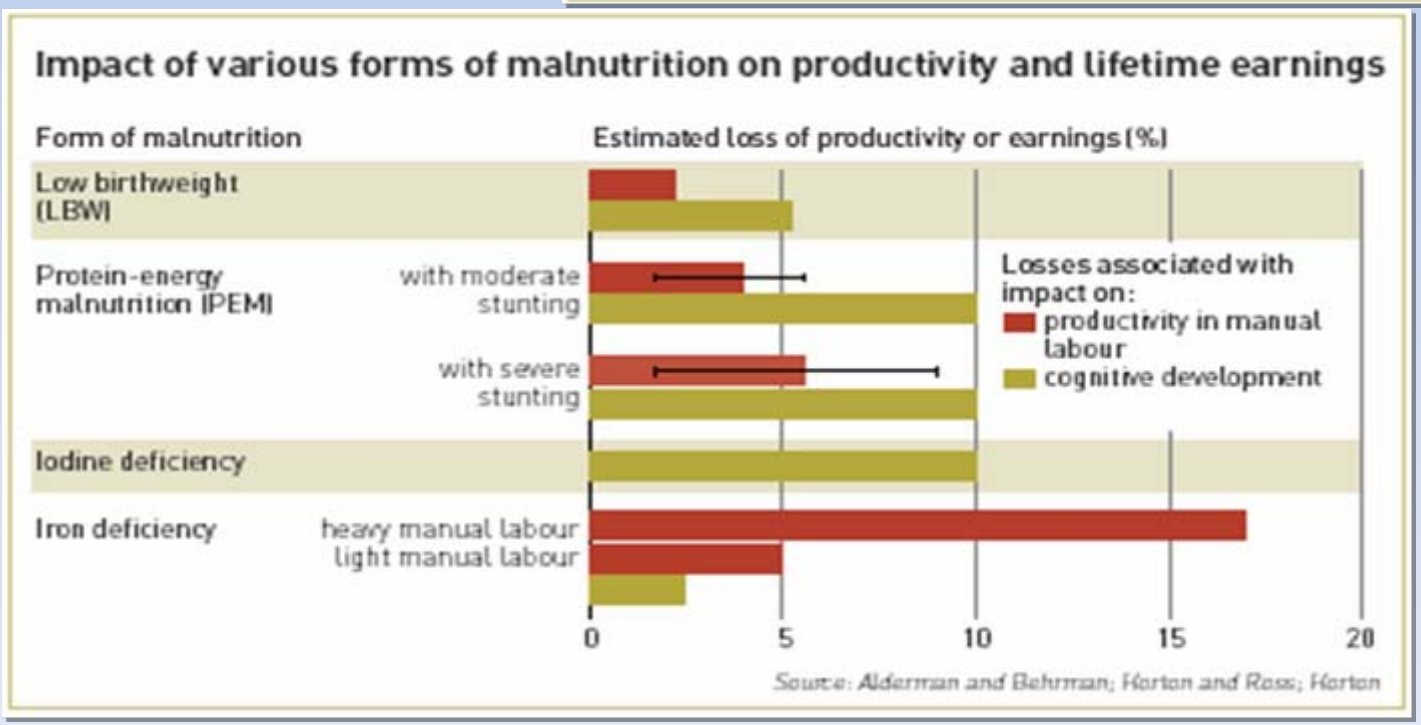
Thank you

Intergenerational Effects



Economic Costs of Under-nutrition





FAO

So what is anemia exactly?

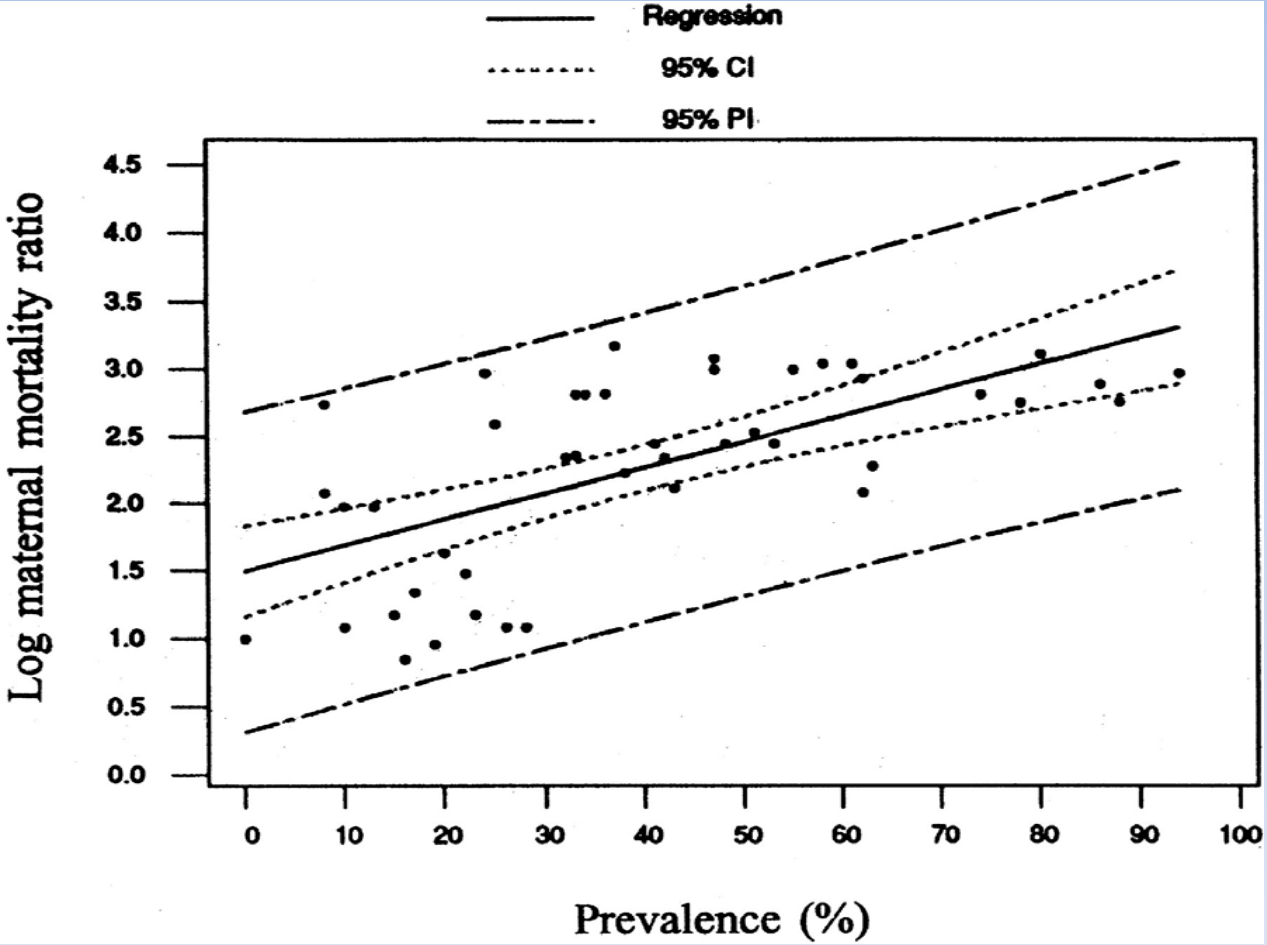
Considered anemic when the Hemoglobin (Hb) concentration <2 standard deviations of the age- and sex specific normal population reference

	Women		Children	Men
	Non pregnant	**Pregnant women**	**6 mo - 5 y**	
Nonanemic	>12	>11	>11	> 13.0
Mild	9.5-12	9.5-11	9.5-11	
Moderate	8-9.5	7-9.5	8-9.5	
Severe	<8	<7	<8	

Need for thinking outside the box –

- Maternal and child anemia should be the GOAL of our log-frames
- Objectives should focus on determinants of anemia
  - Reduced prevalence of diseases
  - Increased dietary diversity and adequacy
  - Increased compliance to IFA
  - Improved status of women in the community
  - Behavior change education, social marketing, community mobilzation

Associations between anemia and maternal mortality

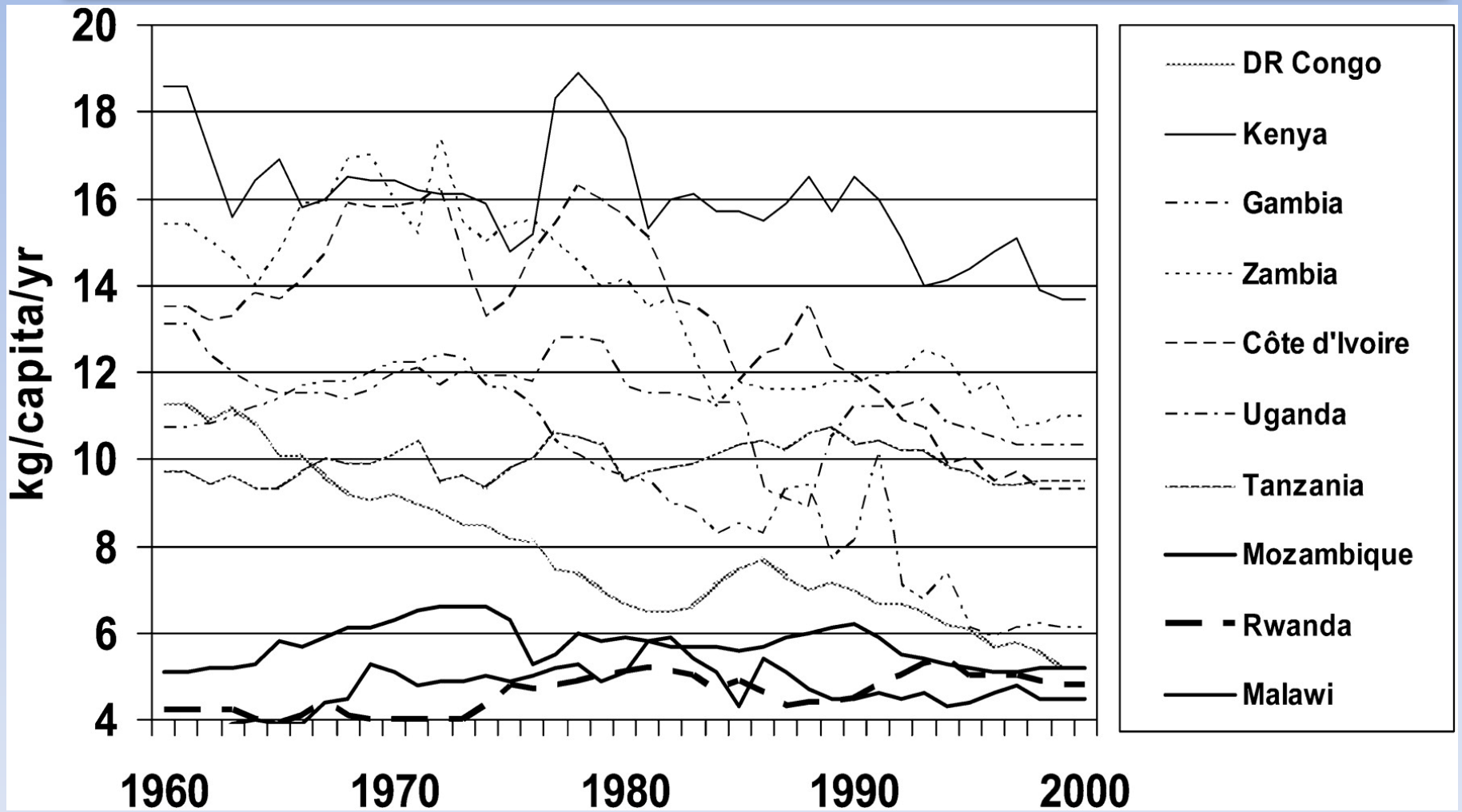


Brabin B J et al. J. Nutr. 2001;131:604S-615S

Summary of Impact on Maternal Mortality

- Severe but not mild-moderate contribute to maternal mortality (Brabin 2001)
- Reductions in iron deficiency anemia reduce maternal deaths (Stolzfus, 2004)
- 1 g/dL increase in Hb is associated with a 25%-28% reduction in risk of maternal mortality [Murray-Kolb L, Presentation on CHERG analysis, 2010 (to be published)]

Global Meat Consumption



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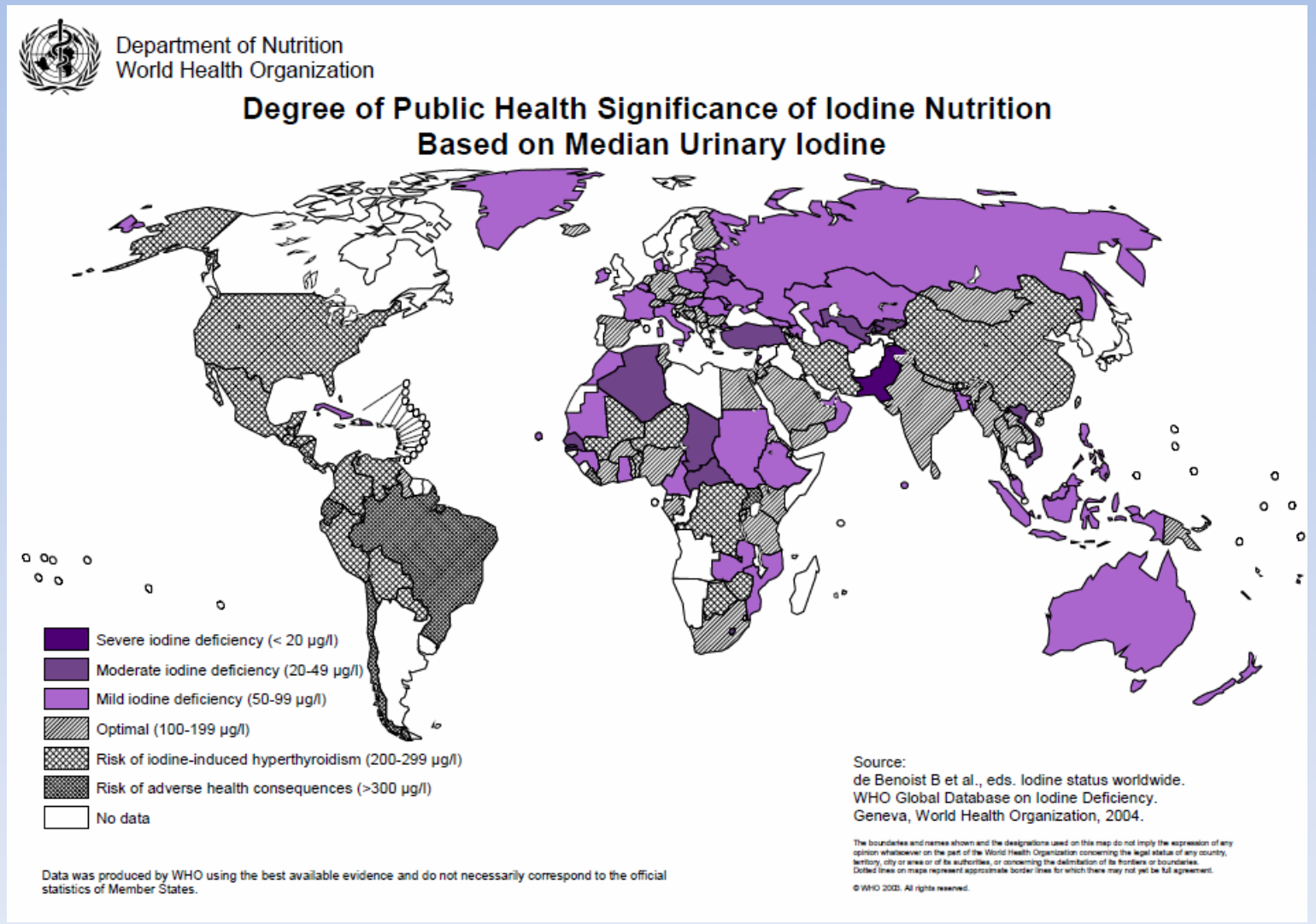
Iodine


Department of Nutrition
World Health Organization
Degree of Public Health Significance of Iodine Nutrition
Based on Median Urinary Iodine
Severe iodine deficiency (< 20 µg/l)
Moderate iodine deficiency (20-49 µg/l)
Mild iodine deficiency (50-99 µg/l)
Optimal (100-199 µg/l)
Risk of iodine-induced hyperthyroidism (200-299 µg/l)
Risk of adverse health consequences (>300 µg/l)
No data
Source:
de Benoist B et al., eds. Iodine status worldwide.
WHO Global Database on Iodine Deficiency.
Geneva, World Health Organization, 2004.
Data was produced by WHO using the best available evidence and do not necessarily correspond to the official statistics of Member States.
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Countries and areas with survey data and regression-based estimates: Pregnant women