From malnutrition to optimal nutrition or Nutrient Security

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May 2012

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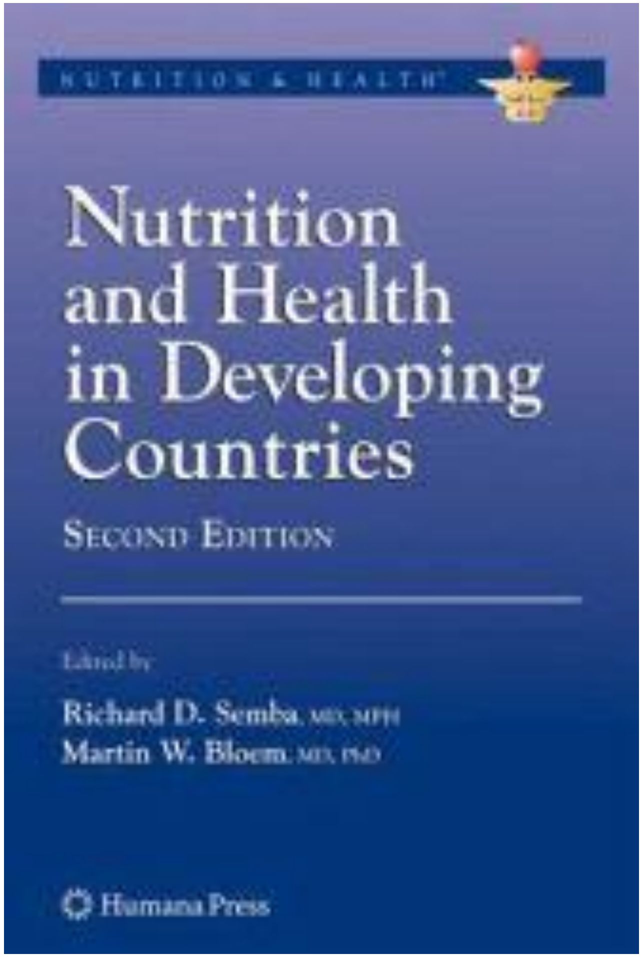
- Definitions
- Indicators of malnutrition
- The role of food security and malnutrition
- The importance of animal products/nutrient dense foods in the first 1000 days.
- Recommendations and other issues

Nutrition

- **Nutrition** is the provision, to cells and organisms, of the materials necessary (in the form of nutrients) to support life.



Nutrients

- are chemicals that an organism needs to live and grow or a substance used in an organism's metabolism which must be taken in from its environment.

Nutrients

- Carbohydrates
- Protein
  - Amino Acids
- Fats
  - Essential Fatty Acids
- Vitamins and Minerals
- Non-nutrients
  - Fibers
  - Water
  - Probiotics
- Anti-nutrients
  - Phytates
- Toxins
  - Aflatoxins

From malnutrition to nutrient security
From RDA to RNI

- **Recommended Dietary Allowance (RDA)**
  - The Recommended Dietary Allowances (RDAs) are quantities of nutrients in the diet that are required to maintain good health in people.
- **Reference Nutrient Intake (RNI)**
  - The amount of a nutrient (mean + 2SD), which is sufficient for almost all individuals. It exceeds the requirement of most people and habitual intakes above RNI are almost certain to be adequate.

Why do we have so many nutrition indicators?

- **Clinical Malnutrition**
- Clinical Signs
- Anthropometric malnutrition
- Biochemical Indicators
- Economic/Demographic indicators

The first half of the 20th century
The clinical period

Why do we have so many nutrition indicators? Clinical Forms

- Clinical forms of malnutrition: **Kwashiorkor**, Wasting, overweight, and obesity

Why do we have so many nutrition indicators? Clinical Forms

- Clinical forms of malnutrition: Kwashiorkor, **Wasting**, overweight, and obesity

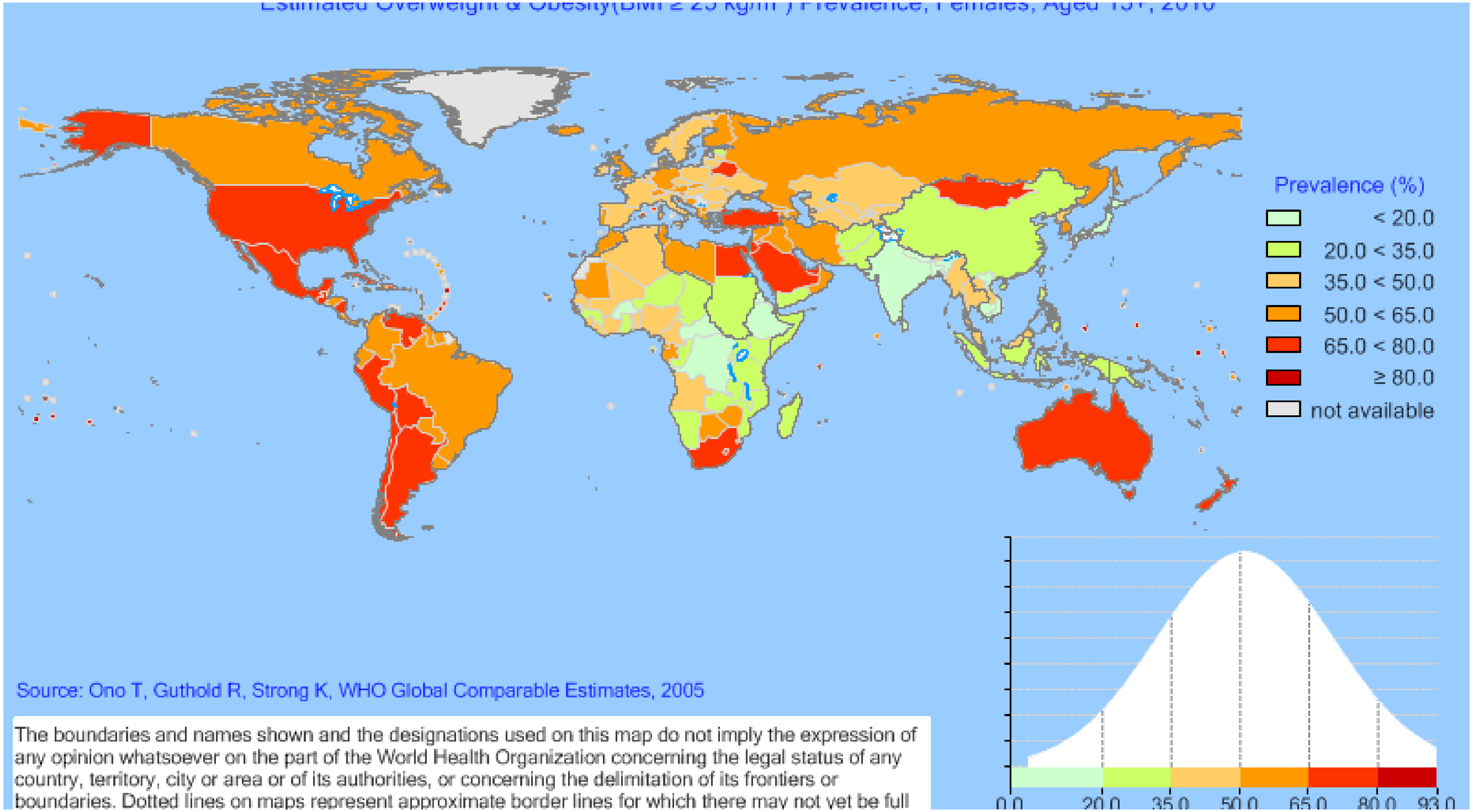
Why do we have so many nutrition indicators? Clinical Forms

- Clinical forms of malnutrition: Kwashiorkor, **Wasting**, overweight, and obesity

Why do we have so many nutrition indicators? Clinical Forms

- 1.5 billion adults, 20 and older, were overweight.
- Of these 1.5 billion overweight adults, over 200 million men and nearly 300 million women were obese.
- Overall, more than one in ten of the world's adult population was obese.

Overweight and Obesity among women >15 years



Why do we have so many nutrition indicators?

- Clinical Malnutrition
- **Clinical Signs**
- Anthropometric malnutrition
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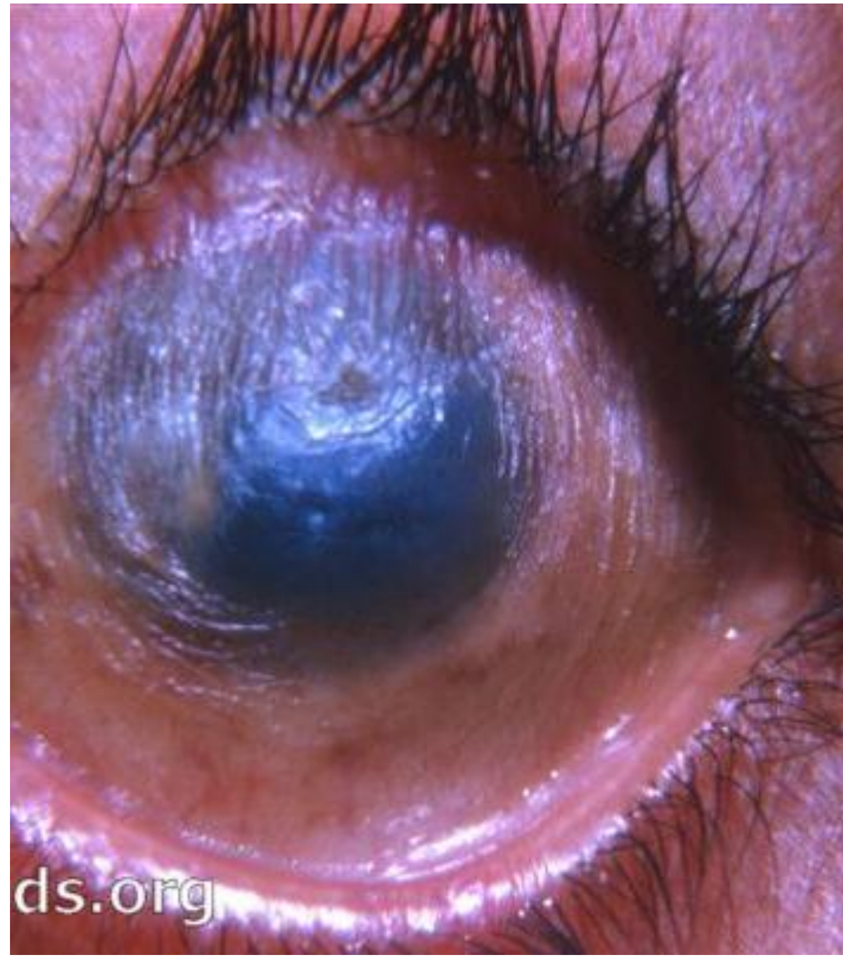
Why do we have so many nutrition indicators? Clinical Signs

- Clinical signs of malnutrition: **xerophthalmia**, scurvy, vitamin B2 deficiency, etc

International Conference on vitamin A and nutritional blindness 1980

- WHO, UNICEF, USAID, HKI, and IVACG
  - Xerophthalmia can be treated with two doses of a vitamin A capsule
  - Large oral dose of vitamin A (200,000 IU) is an effective strategy to prevent xerophthalmia

Xeropthalmia Scars

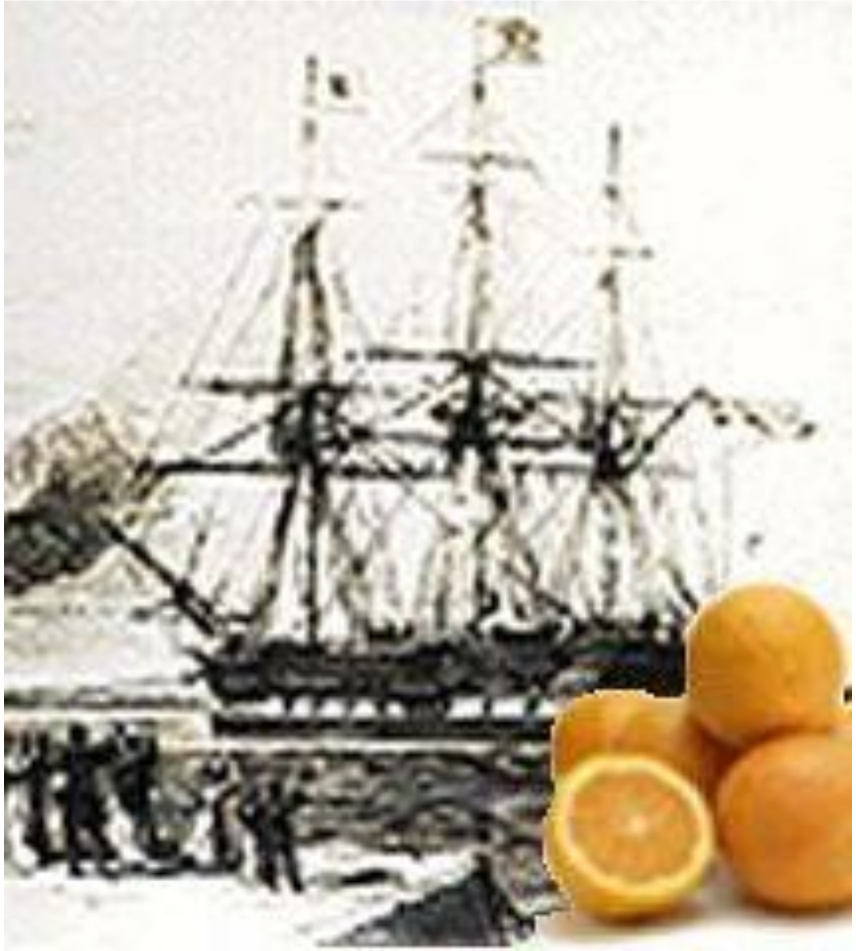


Why do we have so many nutrition indicators?
Clinical Signs

- Clinical signs of malnutrition: xerophthalmia, scurvy, **vitamin B2 (riboflavin) deficiency**, etc

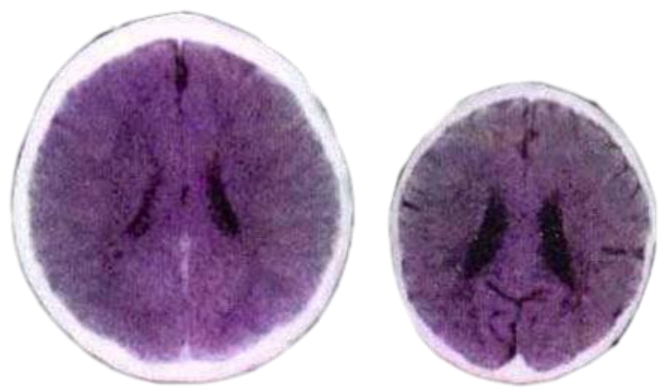
Why do we have so many nutrition indicators? Clinical Signs

- Clinical signs of malnutrition: xerophthalmia, **scurvy**, vitamin B2 (riboflavin) deficiency, etc



Why do we have so many nutrition indicators? Clinical Signs

- During the short period of 9 months, the initial“mother” cell gives rise to more than 100 billion nerve cells and a brain that weighs approximately 400 g when the child is born.



Why do we have so many nutrition indicators? Clinical Signs

- The newborn brain weighs 400 grams. At one year of age the brain weighs 1,000 grams.
- By 2 years of age the brain has reached 80 percent of its adult size.
- By 18 years of age the brain has reached its adult weight of 1400 grams

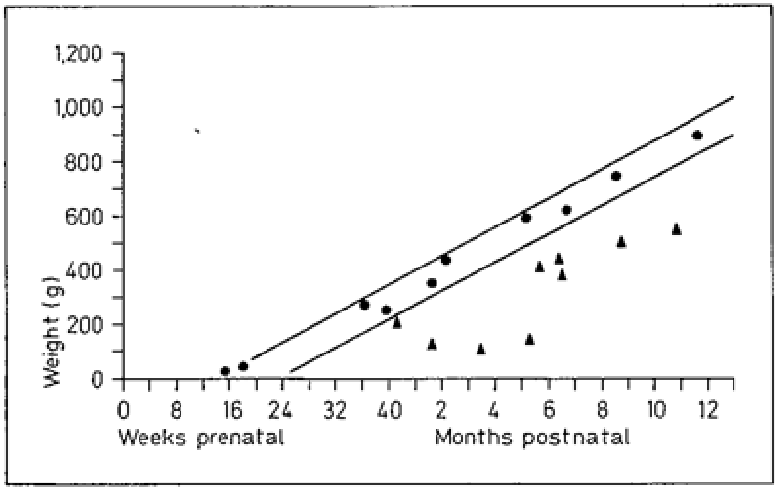


Fig. 1. Lines indicate normal range for US population [11].
● indicates normal Chilean children.
▲ indicates Chilean children who died of severe malnutrition during the first year of life.

Figure A&B = DAY 0

All figures A-F are of the same child. Figures on the left (A,C,E) are MRI scans at the mid brain level and figures on the right (B,D,F) are scans at a higher level.

These images were taken at the start of nutritional rehabilitation and document cerebral atrophy as seen by widened gaps (dark spaces) among brain matter.

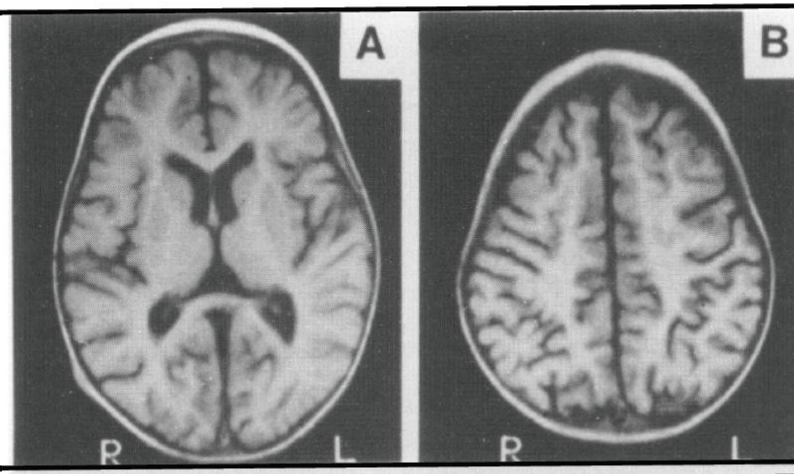


Figure C&D = DAY 30 of nutritional rehabilitation

Improved brain size with fluid shifts (less dark spaces seen). Nutritional rehabilitation consisted of feeding with commercial soya formula and a lactose free diet with micronutrient supplementation for 10 days. A Western diet of cow's milk with micronutrient supplementation was gradually introduced and after discharge from the hospital rehabilitation was continued in a convalescent facility.

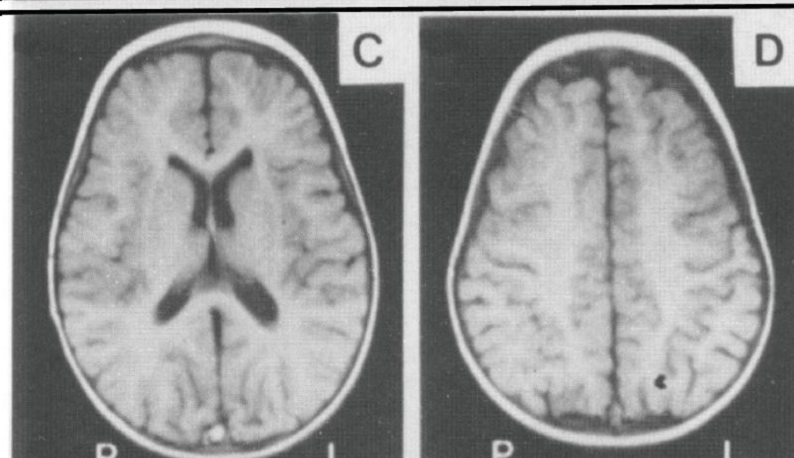
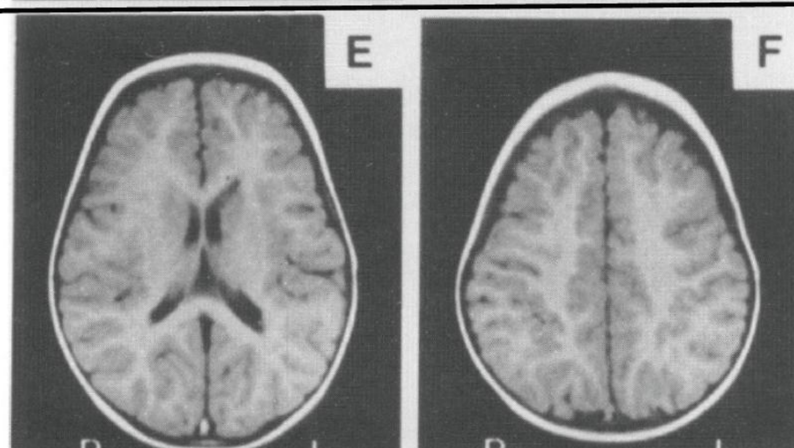


Figure E&F = DAY 90 of nutritional rehabilitation

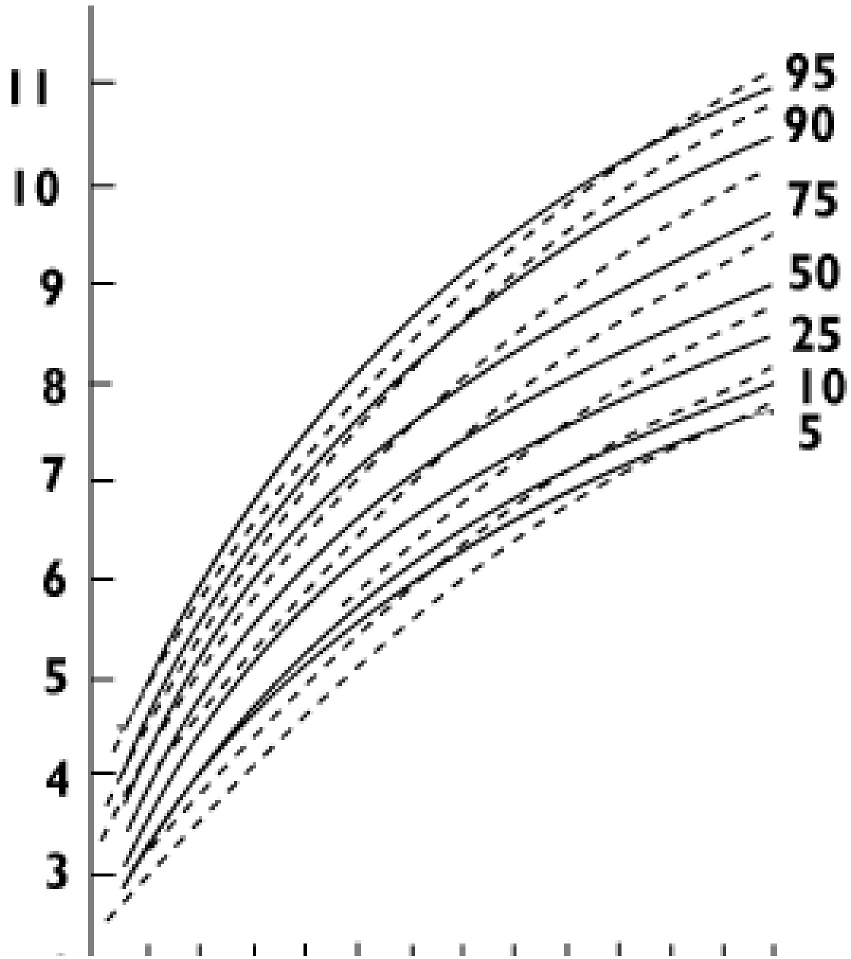
The figure shows the rapid resolution of signs of cerebral atrophy. The brain weighs more and images show increased serum protein presence (grey tissue is more prominent) and myelination (white tissue is more prominent).



Why do we have so many nutrition indicators?

- Clinical Malnutrition
- Clinical Signs
- **Anthropometric malnutrition**
- Biochemical Indicators
- Economic/Demographic indicators

The prevalence of malnutriton



- 1960s: There was a need to establish the magnitude of malnutrition in the world
- NCHS were used as the reference.

Why do we have so many nutrition indicators? Anthropometric Indicators

- Anthropometric indices: underweight, stunting, wasting, and mid-upper arm circumference
- **Underweight is measured by Weight-for-Age**
- **It is a composite indicator and nutrition MDG indicator for MDG1**

Why do we have so many nutrition indicators? Anthropometric indicators

- Anthropometric indices: wasting, underweight, stunting, and mid-upper arm circumference
- Wasting is measured by **Weight-for-Height** or Mid-upper arm circumference (MUAC)

Why do we have so many nutrition indicators? Anthropometric indicators

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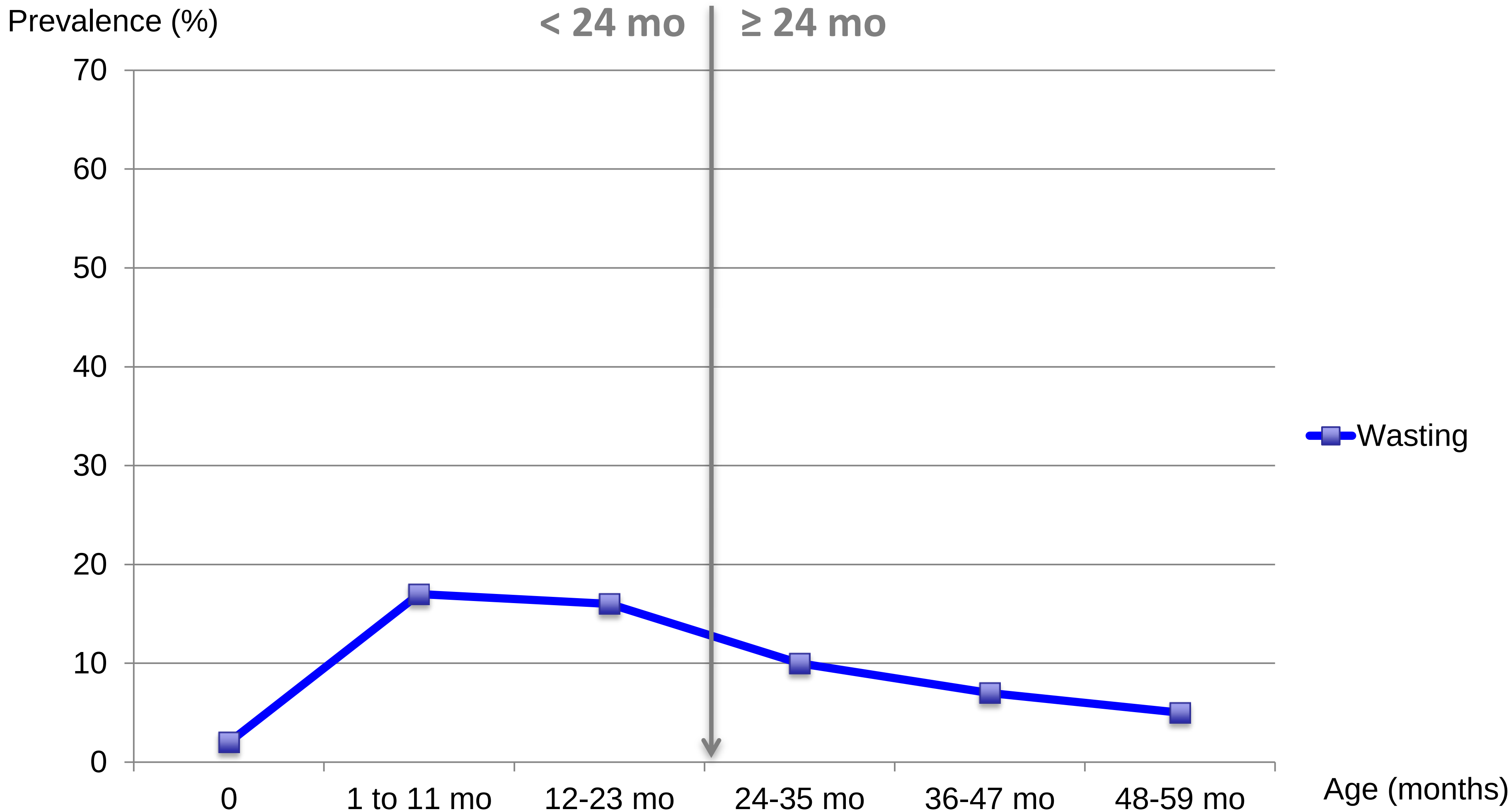
Wasting

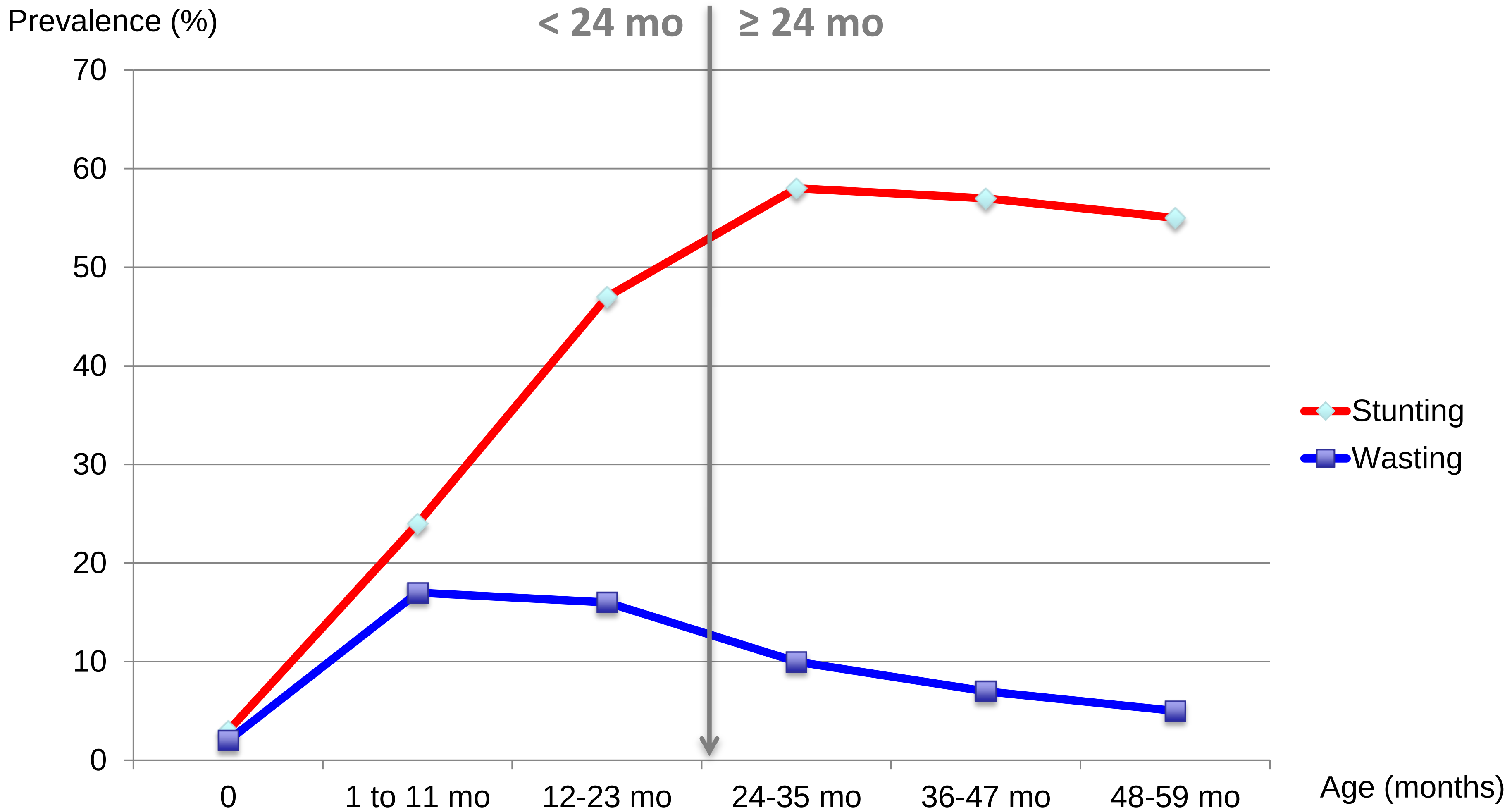


Source: Ethiopia Demographic and Health Survey (2011); Lancet Nutrition Series, 2008

Why do we have so many nutrition indicators? Anthropometric indicators

- Anthropometric indices: underweight, stunting, wasting, and mid-upper arm circumference
- **Stunting is measured by Height-for-age**
- **Although stunting is happening in the first two years, it is also called chronic undernutrition**

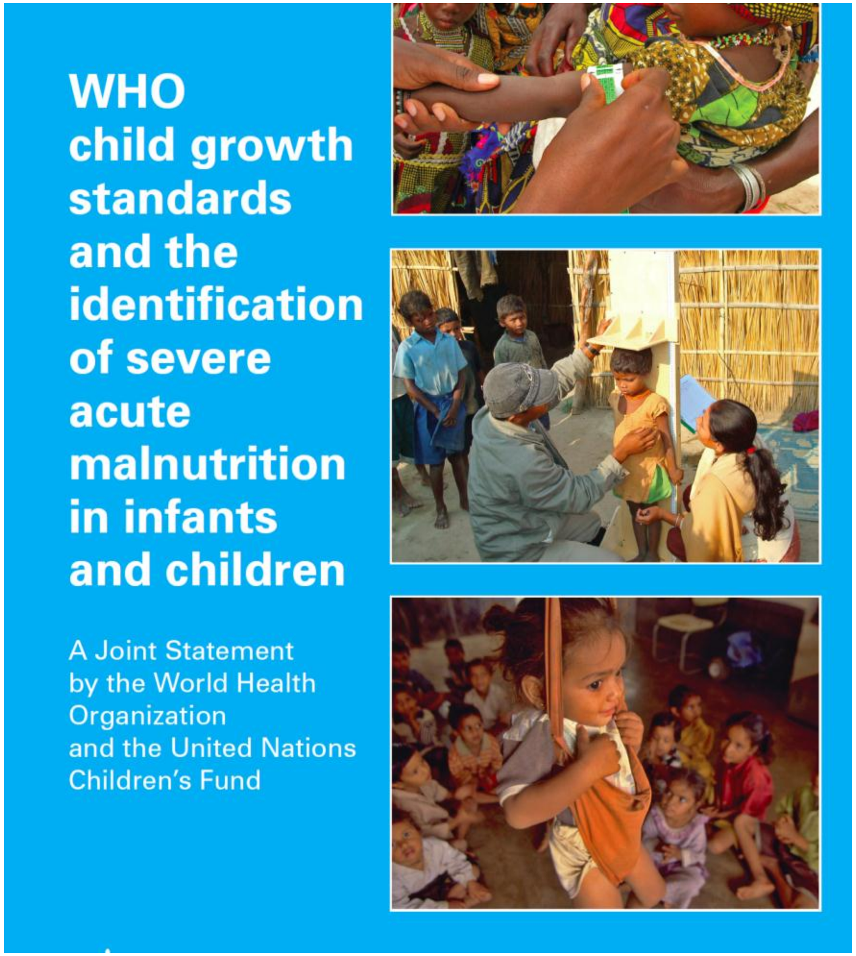
Stunting



Source: Ethiopia Demographic and Health Survey (2011); Lancet Nutrition Series, 2008

NCHS vs WHO standards

- The new WHO growth standards confirm earlier observations that the **effect of ethnic differences** on the growth of infants and young children in populations is small compared with the effects of the environment.



Why do we have so many nutrition indicators?

- Clinical Malnutrition
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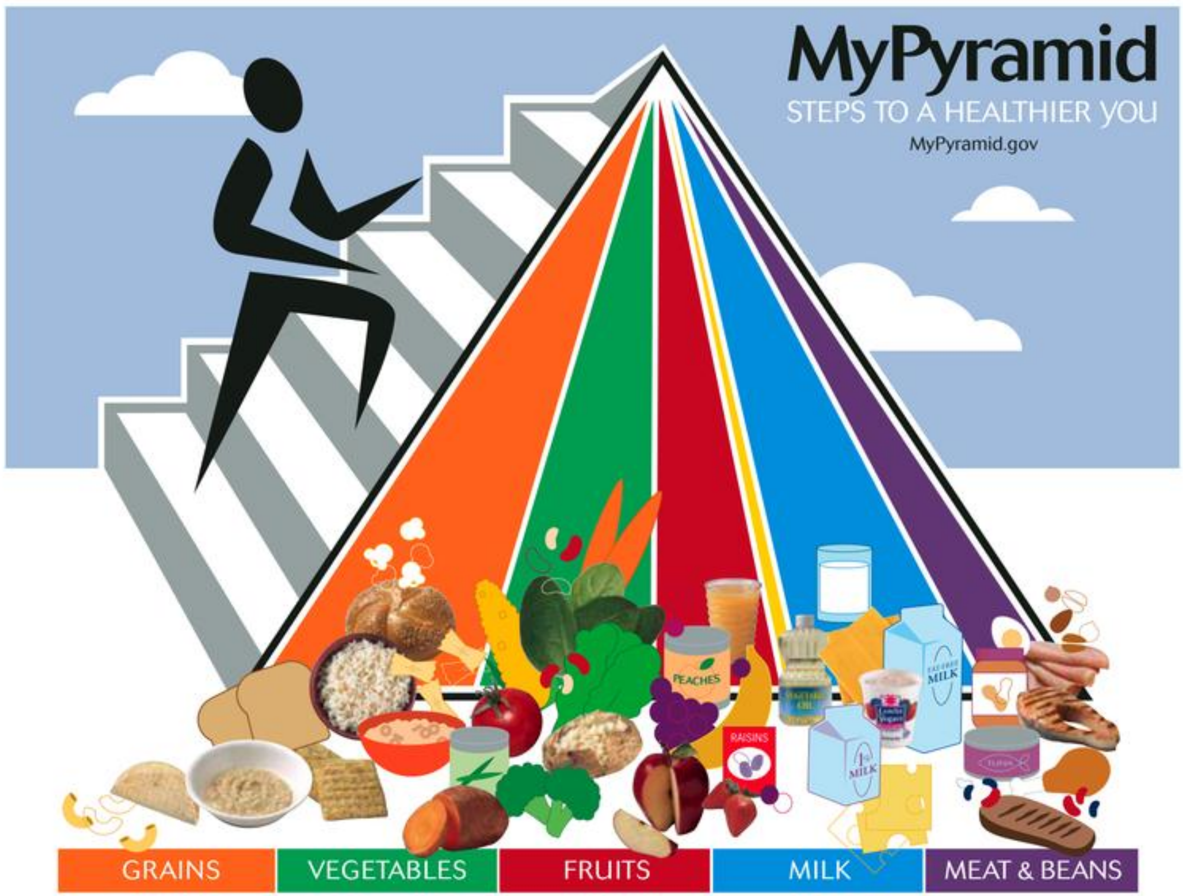
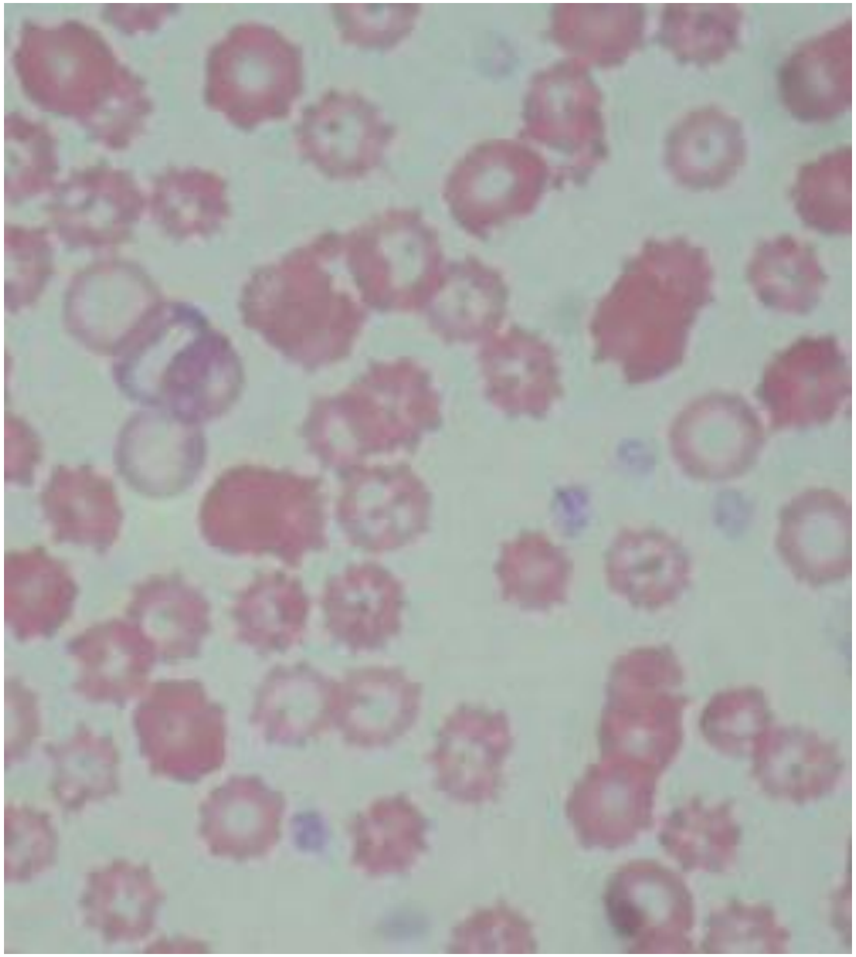
- Anthropometric malnutrition
- **Biochemical Indicators**
- Economic/Demographic indicators

Ideal Food availability



Why do we have so many nutrition indicators? Biochemical Indicators

- Biochemical indices: **iron-deficiency anemia**, vitamin A deficiency, zinc deficiency, Folic Acid, etc.



Why do we have so many nutrition indicators? Biochemical Indicators

- Biochemical indices: **iron-deficiency anemia**, vitamin A deficiency, zinc deficiency, Folic Acid, etc.

WHO region	Preschool-age children[a]	
	Prevalence (%)	# affected (millions)
Africa	67.6 (64.3–71.0)[b]	83.5 (79.4–87.6)
Americas	29.3 (26.8–31.9)	23.1 (21.1–25.1)
South-East Asia	65.5 (61.0–70.0)	115.3 (107.3–123.2)
Europe	21.7 (15.4–28.0)	11.1 (7.9–14.4)
Eastern Mediterranean	46.7 (42.2–51.2)	0.8 (0.4–1.1)
Western Pacific	23.1 (21.9–24.4)	27.4 (25.9–28.9)
Global	**47.4 (45.7–49.1)**	**293.1 (282.8–303.5)**

Why do we have so many nutrition indicators? Biochemical Indicators

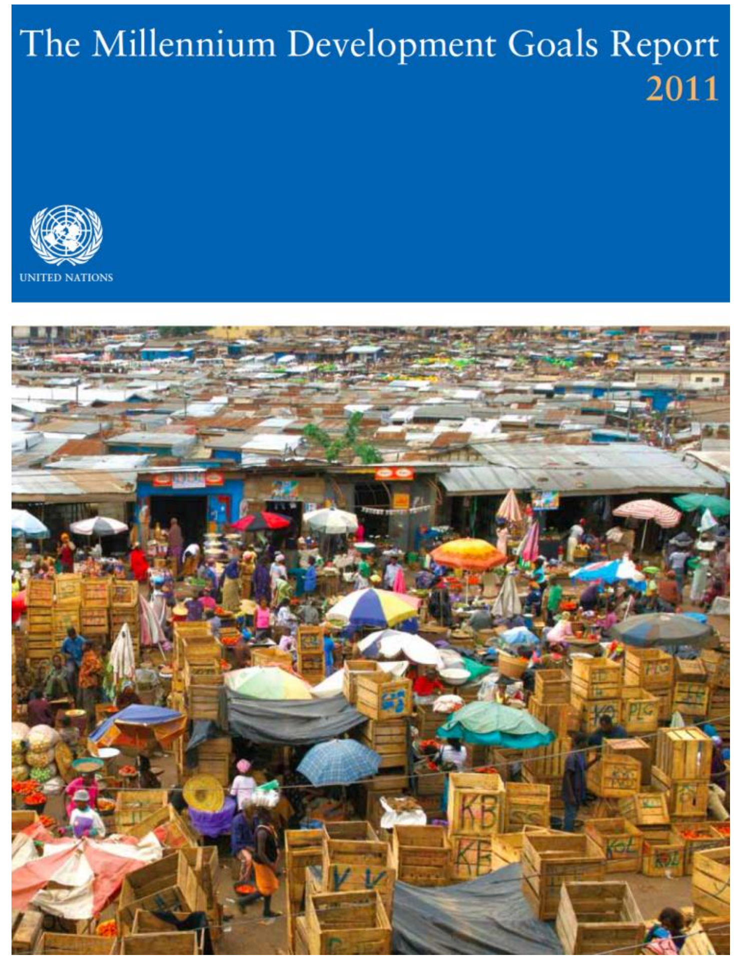
- Biochemical indices: iron-deficiency anemia, vitamin A deficiency, zinc deficiency, **Folic Acid**, etc.
- Folic Acid deficiency may lead to neural tube defects.

Malnutrition

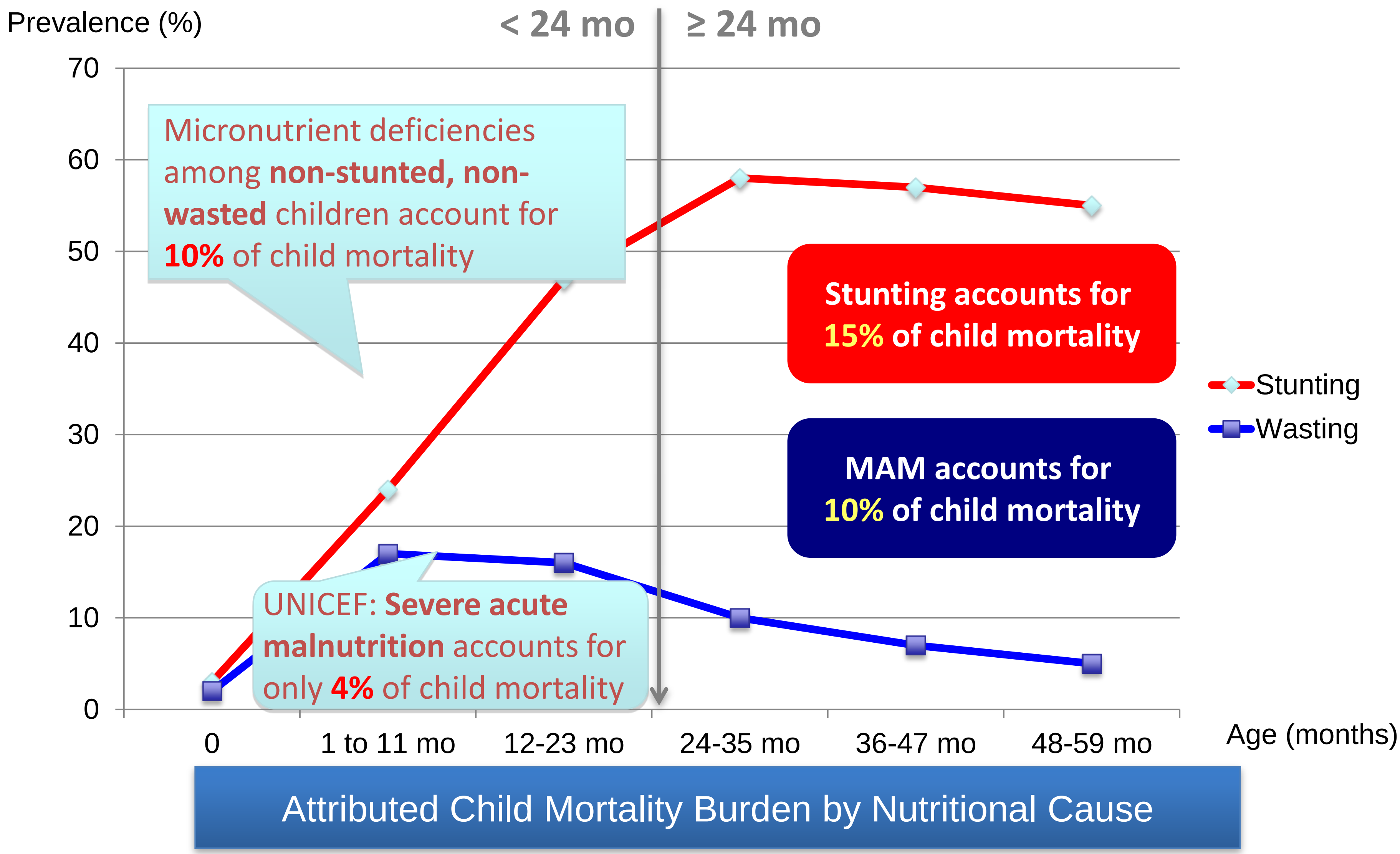
Nutrition indicator	Measurement indicator	Clinical Indicator
Acute Malnutrition (SAM & MAM)	Weight-for-Height	Wasting, kwashiorkor
	Mid-upper arm circumference	Wasting, Kwashiorkor
Chronic Undernutrition	Height-for-Age	Stunting
Underweight (composite indicator)	Weight-for-Age	Underweight
Overnutrition	Body Mass Index (weight/Height^2	Overweight/Obesity
Micronutrient Deficiencies	Biochemical indicators	Xerophthalmia, stomatitis, etc.

Why is underweight the MDG 1 indicator and not stunting or wasting?

- Height measurements were very difficult in the primary health care settings
- Countries had data on underweight but not on stunting.
- The prevalence of underweight was very similar as the prevalence of stunting in areas where acute malnutrition was below 5%.



Saving lives: Wasting, Stunting, Micronutrient Deficiencies and Risk of Dying



Source: Ethiopia Demographic and Health Survey (2011); Lancet Nutrition Series, 2008

The chronic malnutrition misconception

- Chronic Malnutrition or stunting (height-for-age) develops in a very short time frame (from conception to 24 months = first 1000 days) but is called chronic because you can’t treat stunting effectively after 2 years!;
- Prevention of stunting does not have to take a long time if the right interventions are used in the window of children’s first 1000 days.

Damage Suffered in Early Life Leads to Permanent Impairment

- Undernourished children are more likely to become short adults and to give birth to smaller babies
- Evidence links stunting to cognitive development, school performance and educational achievement
- Poor fetal growth or stunting in the first 2 years of life leads to reduced economic productivity in adulthood
- Child's height for age is best predictor of human capital

The Consequences of Stunting (Lancet 2008)

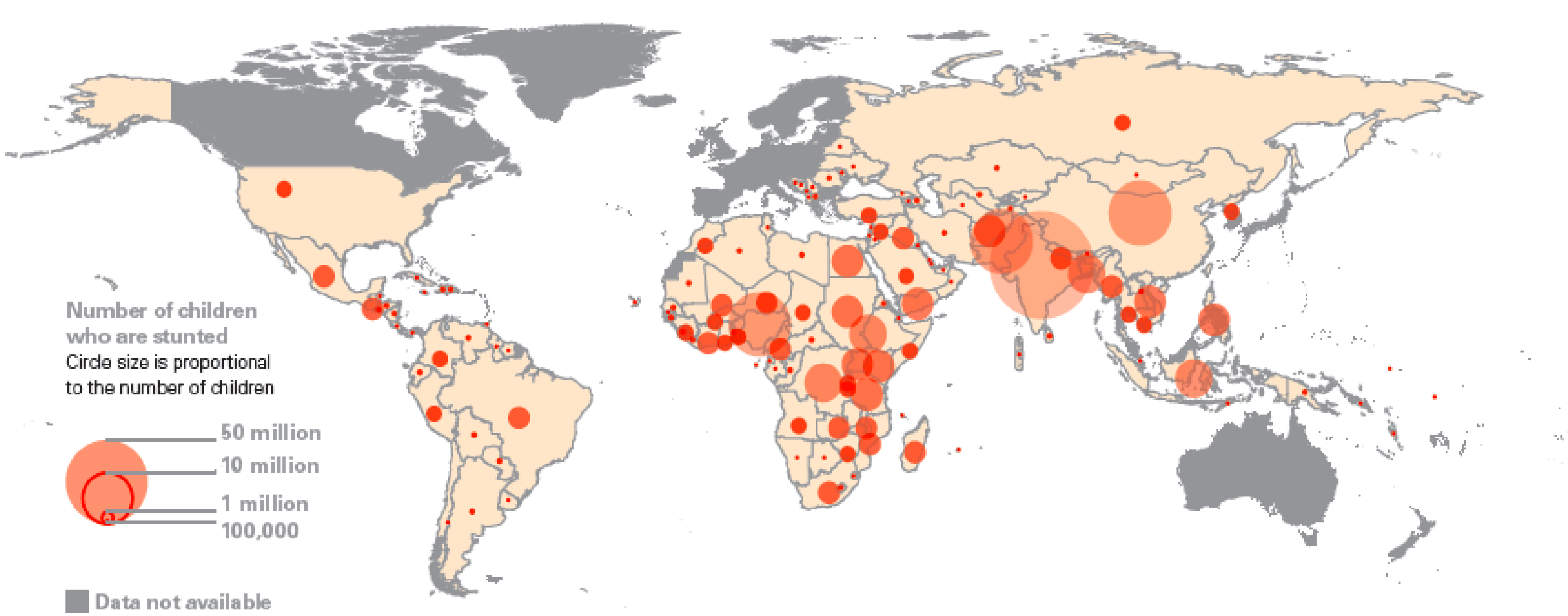
- Chronic Diseases: Children who are undernourished in the first 2 years of life and who put on weight rapidly later in childhood and in adolescence are at high risk of **chronic diseases** related to nutrition

- The window of prevention = the first 1000 days = from conception to 24 months

80 per cent of the developing world's stunted children live in 24 countries

195 million children in the developing world are stunted

Number of children under 5 years old who are moderately or severely stunted (2008)



80 per cent of the developing world's stunted children live in 24 countries

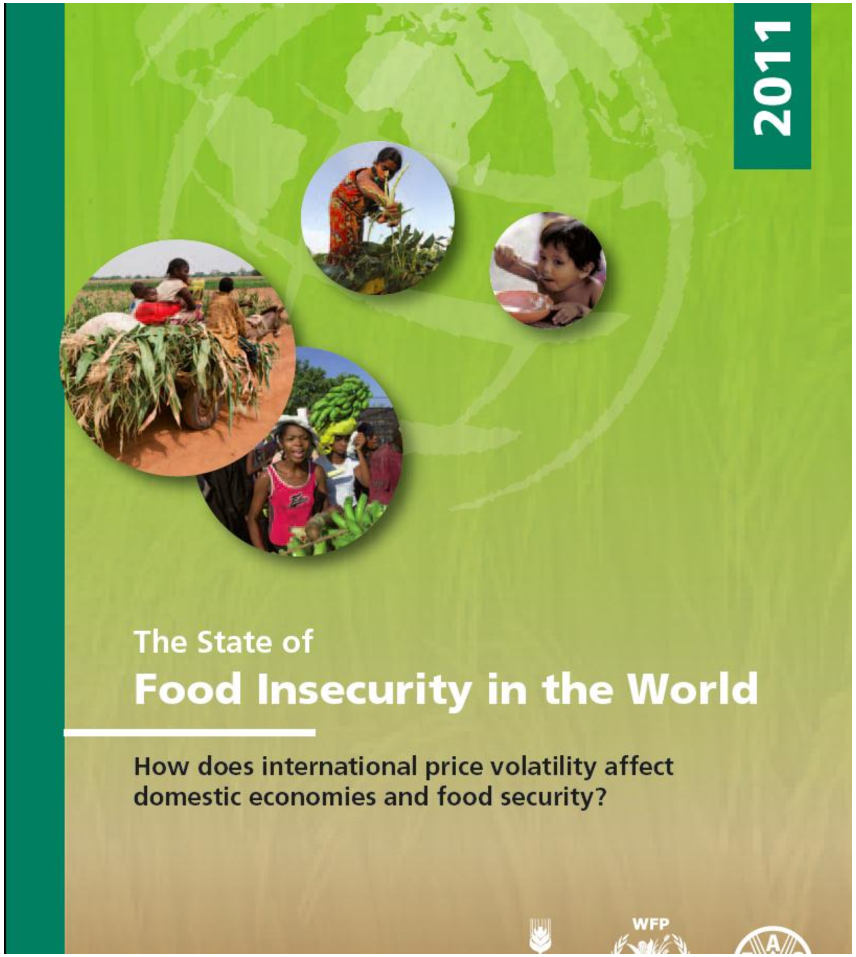
Ranking	Country	Stunting prevalence (%)	Number of children who are stunted (thousands, 2008)	Percentage of developing world total (195.1 million)
1	India	48	60,788	31.2%
2	China	15	12,685	6.5%
3	Nigeria	41	10,158	5.2%
4	Pakistan	42	9,868	5.1%
5	Indonesia	37	7,688	3.9%
6	Bangladesh	43	7,219	3.7%
7	Ethiopia	51	6,768	3.5%
8	Democratic Republic of the Congo	46	5,382	2.8%
9	Philippines	34	3,617	1.9%
10	United Republic of Tanzania	44	3,359	1.7%
11	Afghanistan	59	2,910	1.5%
12	Egypt	29	2,730	1.4%
13	Viet Nam	36	2,619	1.3%
14	Uganda	38	2,355	1.2%
15	Sudan	40	2,305	1.2%
16	Kenya	35	2,269	1.2%
17	Yemen	58	2,154	1.1%
18	Myanmar	41	1,880	1.0%
19	Nepal	49	1,743	<1%
20	Mozambique	44	1,670	<1%
21	Madagascar	53	1,622	<1%
22	Mexico	16	1,594	<1%
23	Niger	47	1,473	<1%
24	South Africa	27	1,425	<1%
				Total: 80%

Why do we have so many nutrition indicators?

- Clinical Malnutrition
- Clinical Signs
- Anthropometric malnutrition
- Biochemical Indicators
- **Economic/Demographic indicators**

Why do we have so many nutrition indicators? Food Security/Economic Indicators

- Undernourishment exists when caloric intake is below the minimum dietary energy requirement (MDER).



Why do we have so many nutrition indicators? Food Security/Economic Indicators

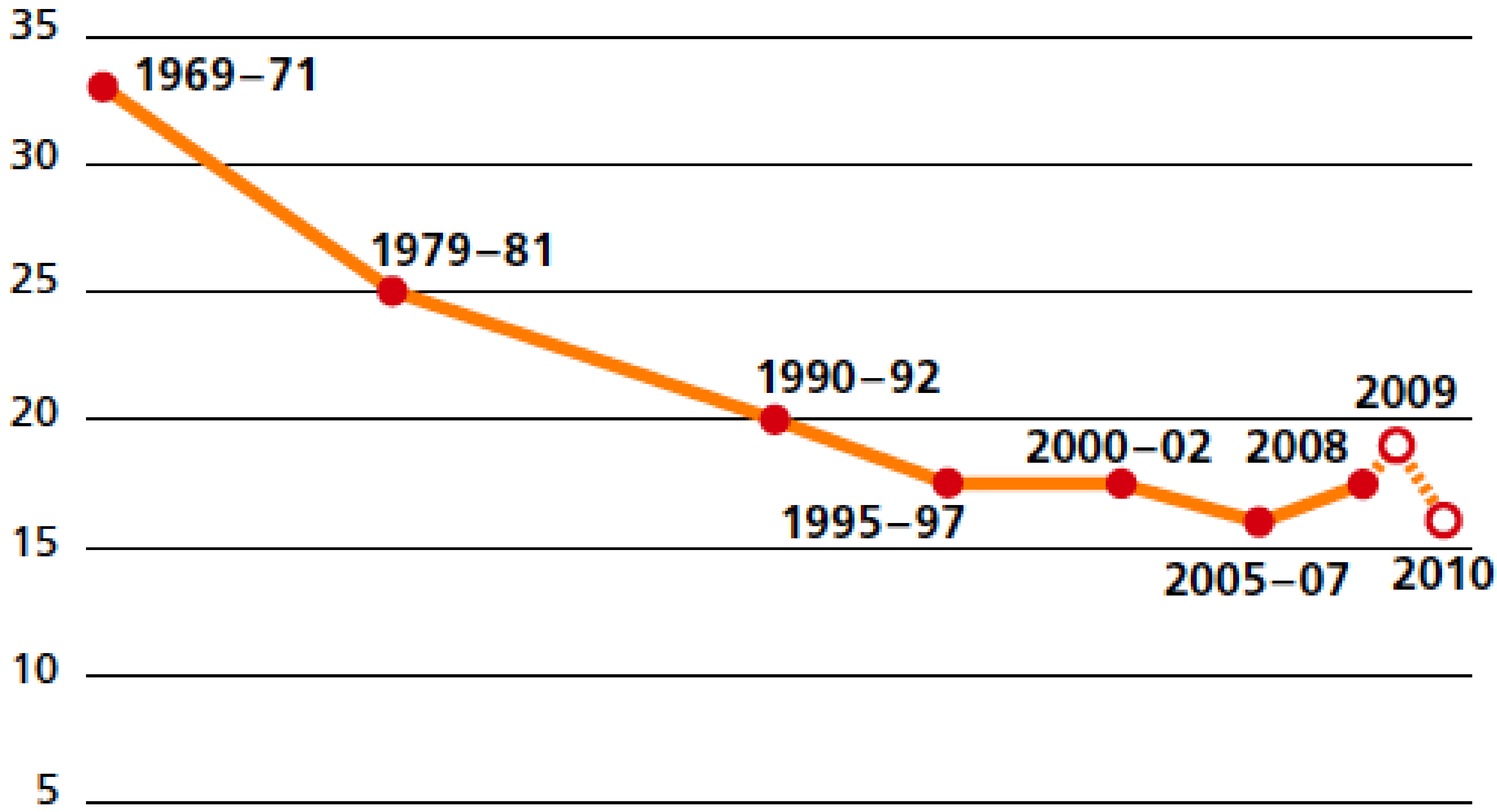
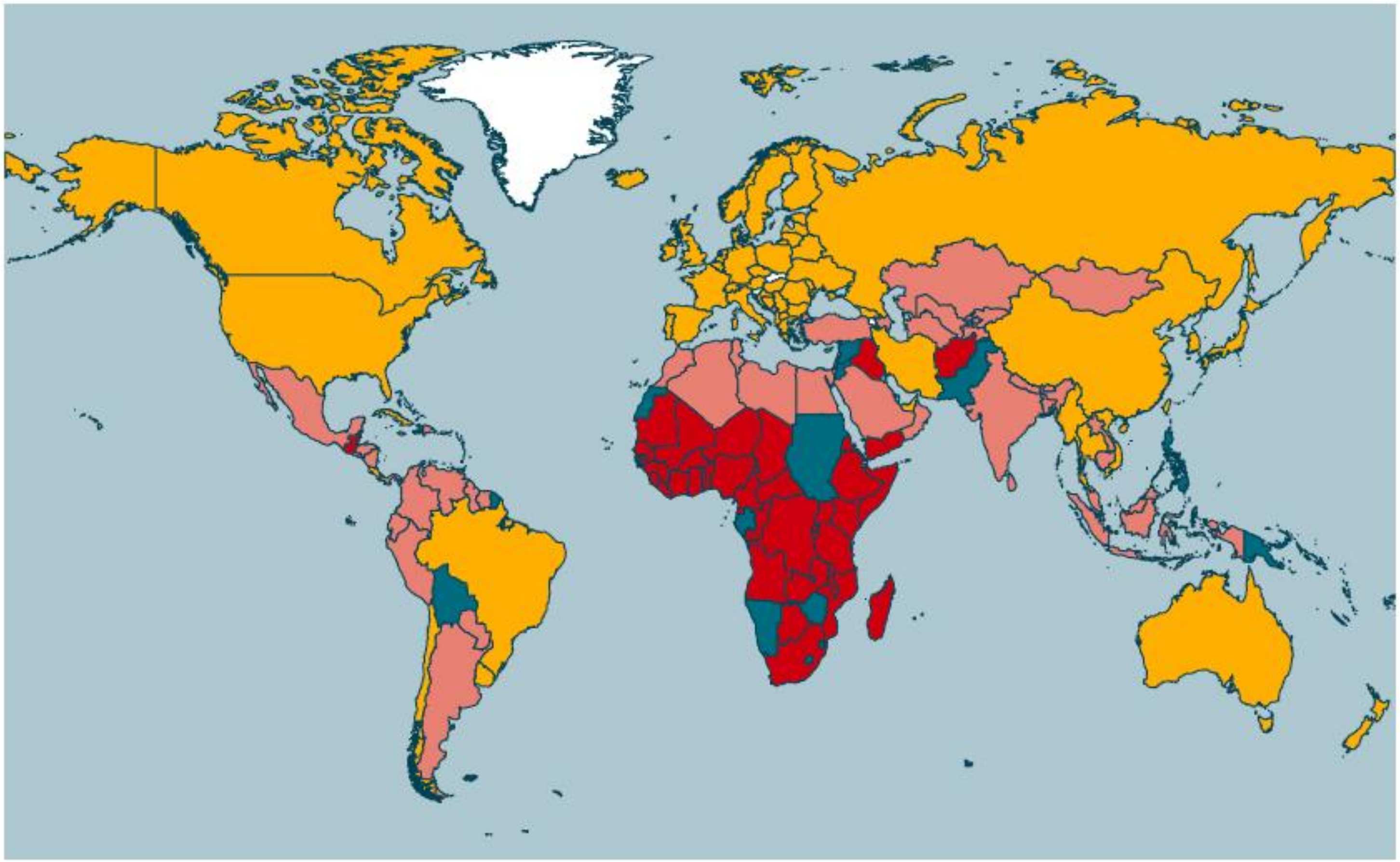


Figure 2.8 Total fertility rate 2005 – 2010

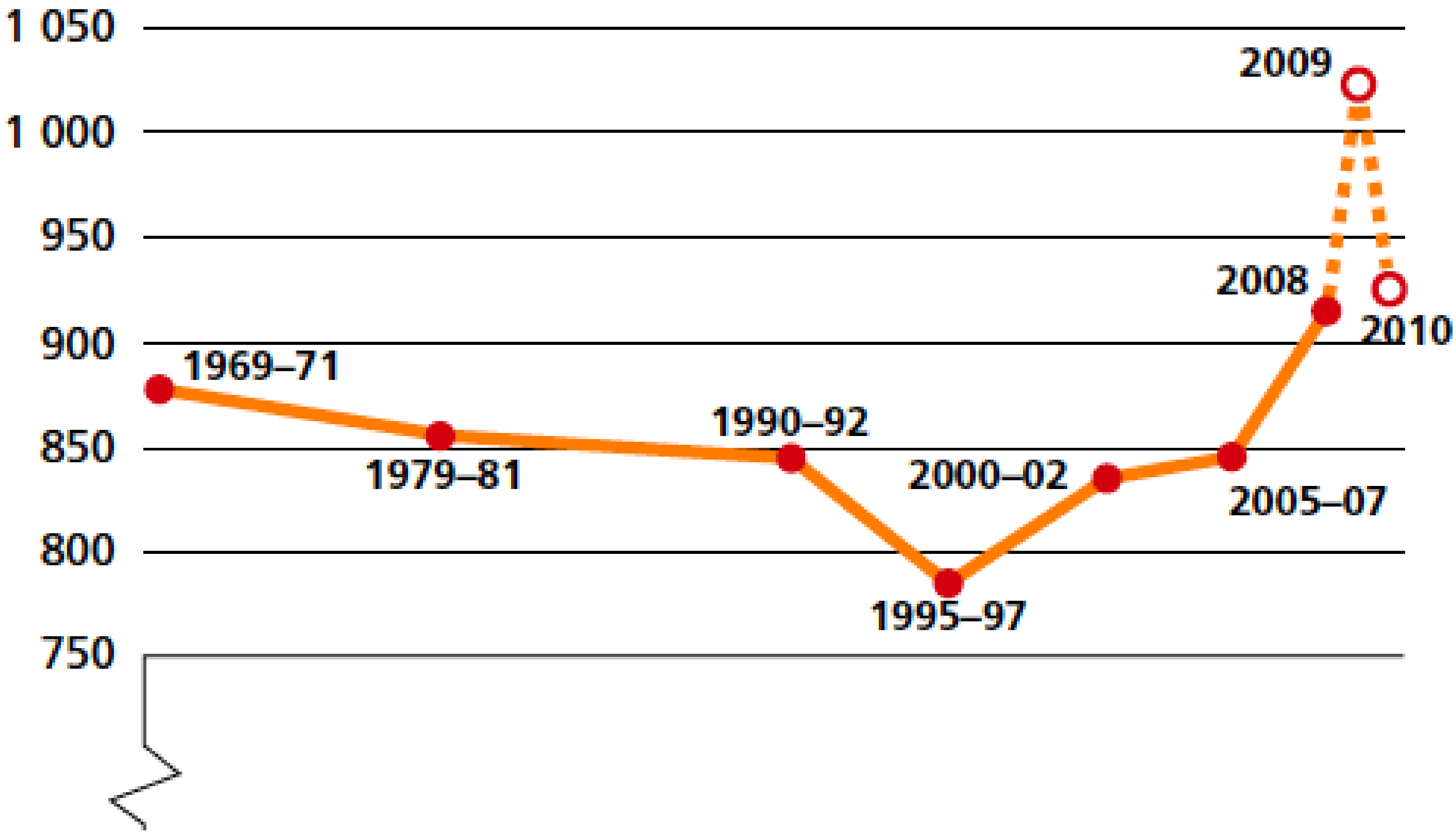


Total fertility rate 2005 – 2010

- 2.1 and under
- 2.2 – 3.1
- 3.2 – 4.1
- 4.2 and over
- N/A

Source: Harper 2012; UNPD 2011a

Why do we have so many nutrition indicators? Food Security/Economic Indicators



What is the link between food security and nutrition security?

Malnutrition rates and Rice prices

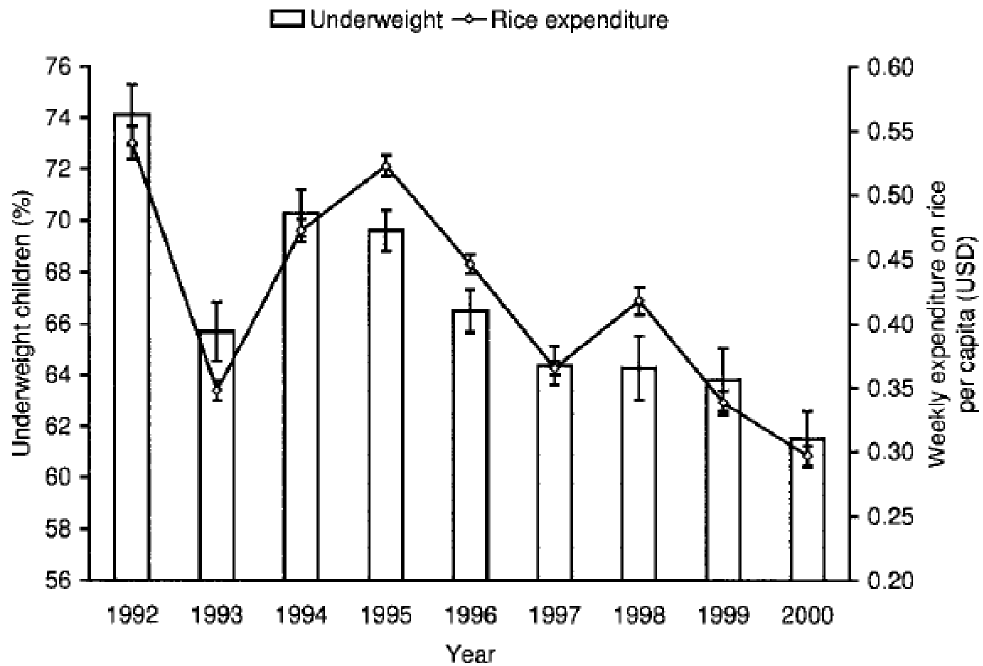


FIGURE 3 The percentage of underweight children (Z-score weight-for-age less than −2 SD) aged 6–59 mo and the weekly expenditure on rice per capita in US$ (USD) in rural Bangladesh during the month of June, 1992–2000. Values for underweight are percentage ± 95% CI and values for expenditure on rice are means ± 95% CI (r = 0.91, P = 0.001, n = 9).

Rice consumption and rice prices

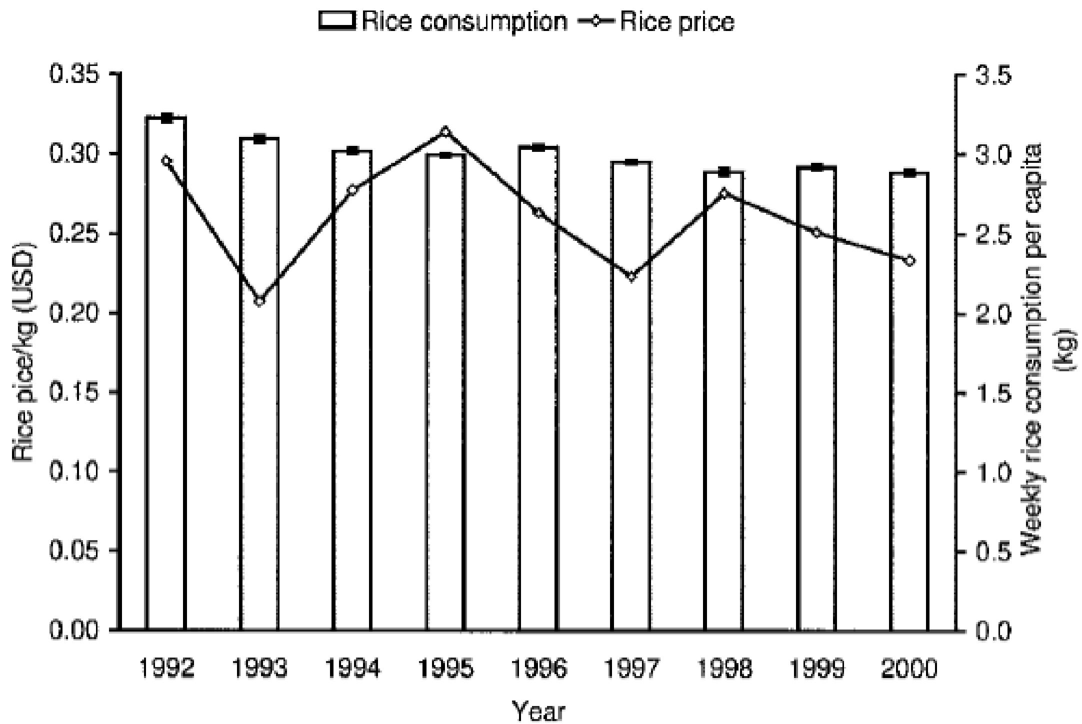
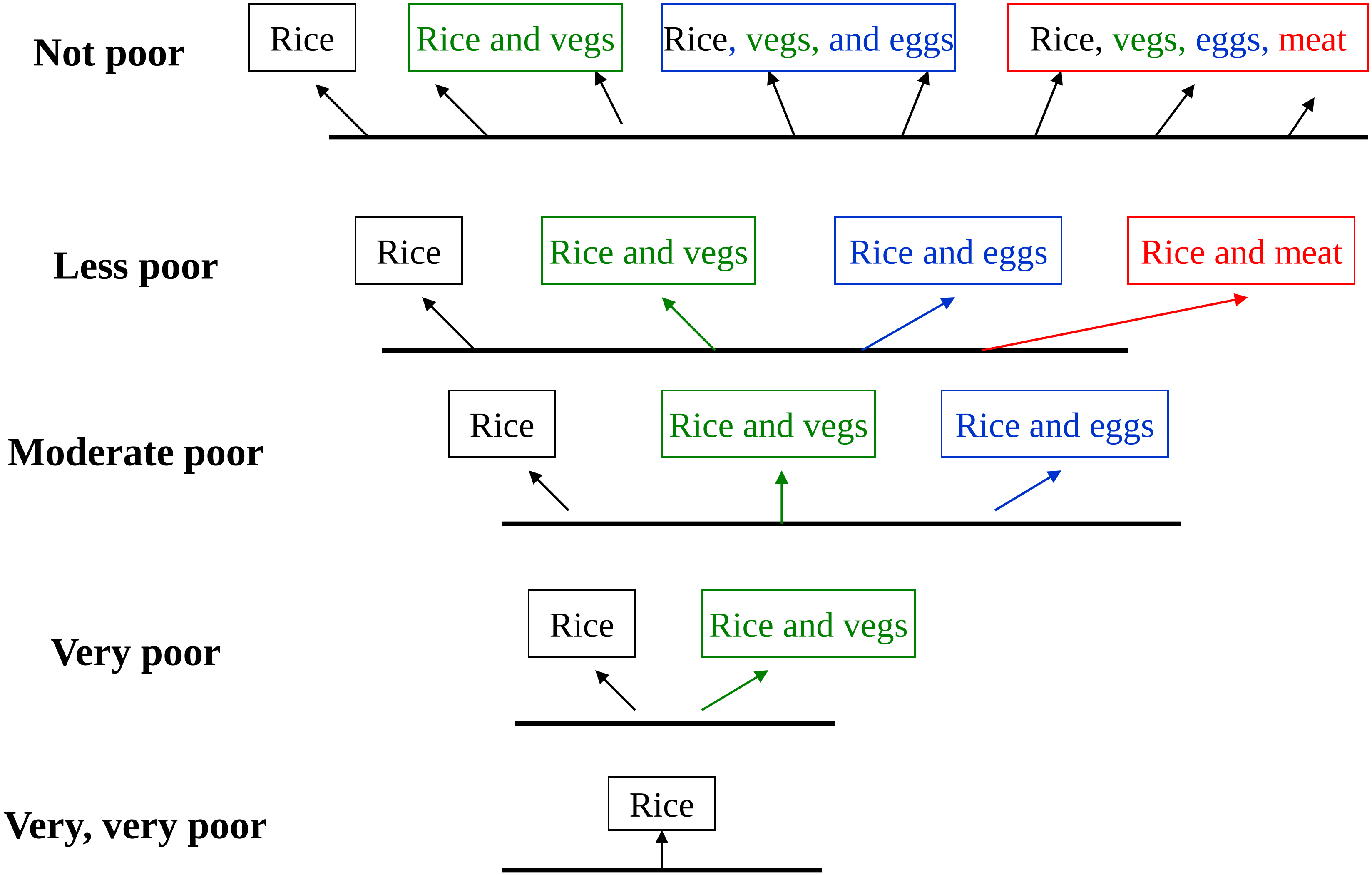


FIGURE 2 The price of rice in US$ (USD) and the weekly rice consumption per capita in rural Bangladesh during the month of June, 1992–2000. Values are means ± 95% CI (r = 0.23, P = 0.55, n = 9). The CI for the price of rice are very small and therefore not visible.

Choices and economic status



Non-rice food expenditure and malnutrition

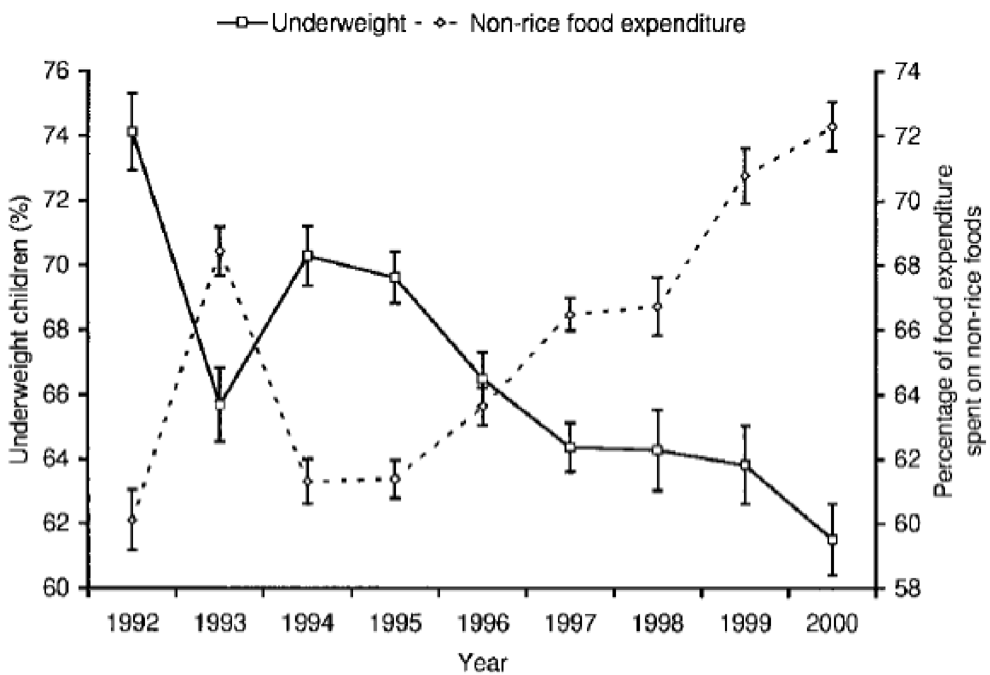
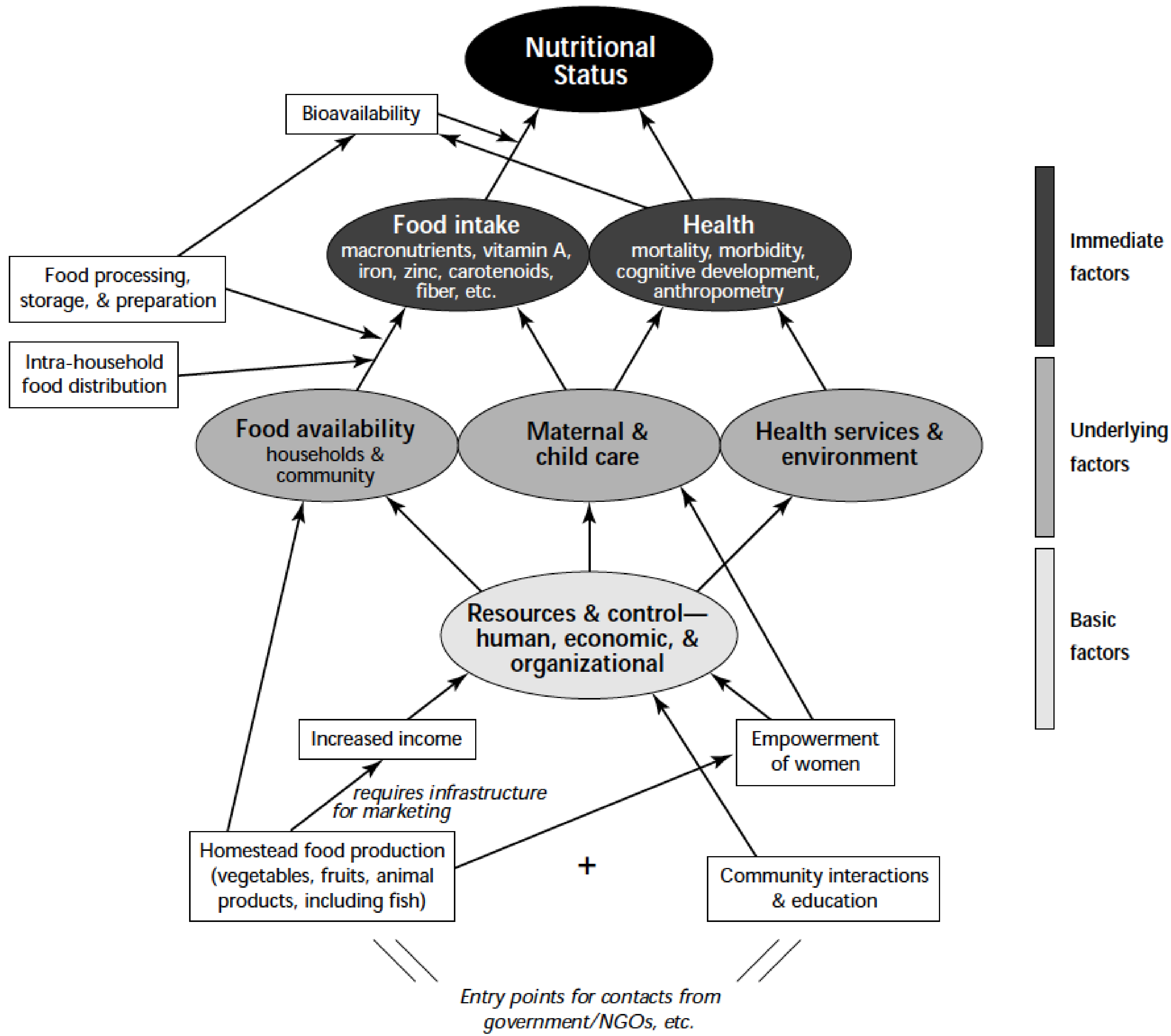
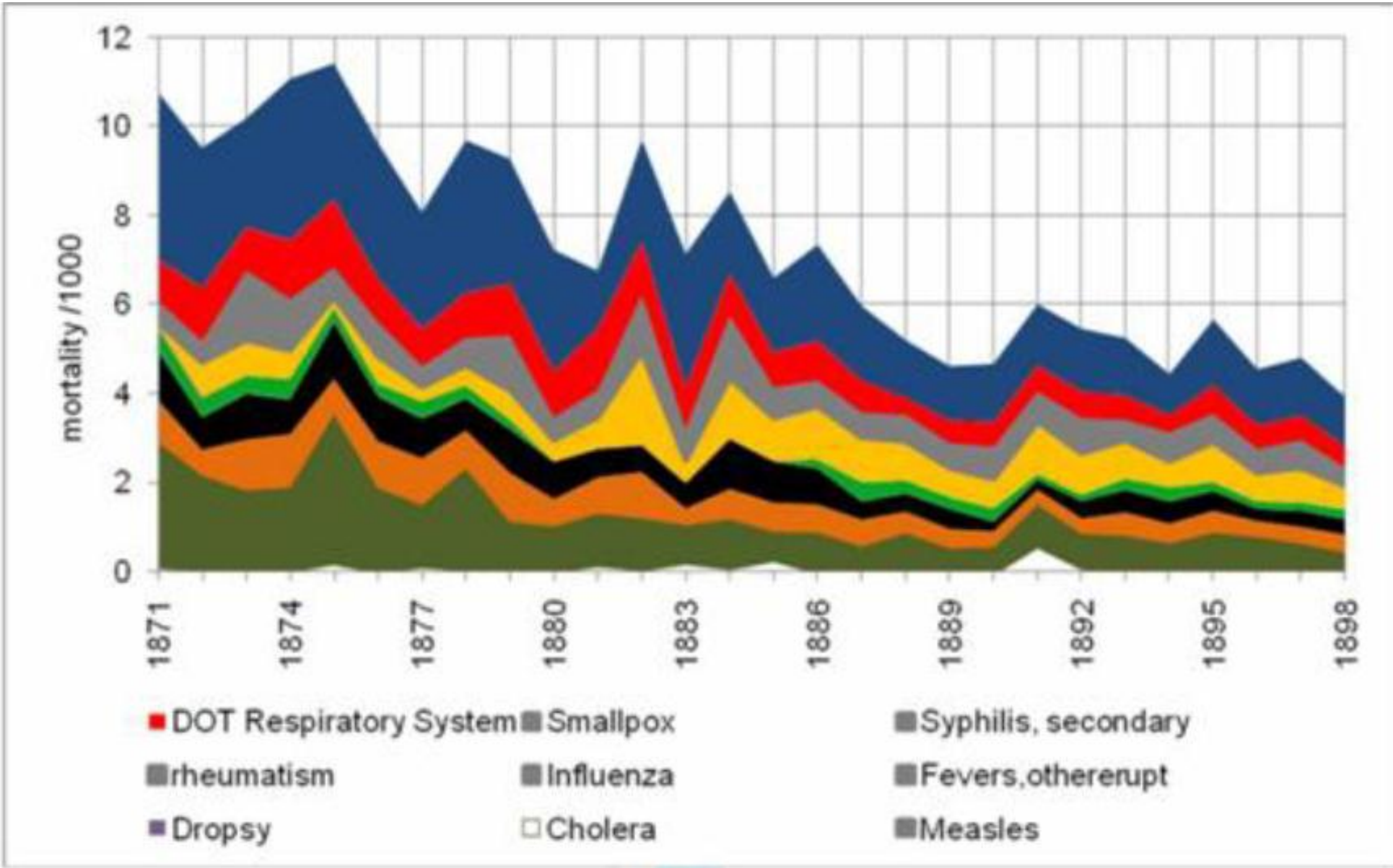


FIGURE 4 The percentage of underweight children (Z-score weight-for-age <-2 SD) aged 6–59 mo and the percentage of food expenditure spent on nonrice foods in rural Bangladesh during the month of June, 1992–2000. Values for underweight are percentage ± 95% CI and values for expenditure on nonrice foods are means ± 95% CI ($r = -0.91$, $P = 0.001$, $n = 9$).



Nutritional Status
Bioavailability
Food intake
macronutrients, vitamin A, iron, zinc, carotenoids, fiber, etc.
Health
mortality, morbidity, cognitive development, anthropometry
Food processing, storage, & preparation
Intra-household food distribution
Food availability
households & community
Maternal & child care
Health services & environment
Resources & control—human, economic, & organizational
Increased income
Empowerment of women
requires infrastructure for marketing
Homestead food production (vegetables, fruits, animal products, including fish)
+
Community interactions & education
Entry points for contacts from government/NGOs, etc.
Immediate factors
Underlying factors
Basic factors

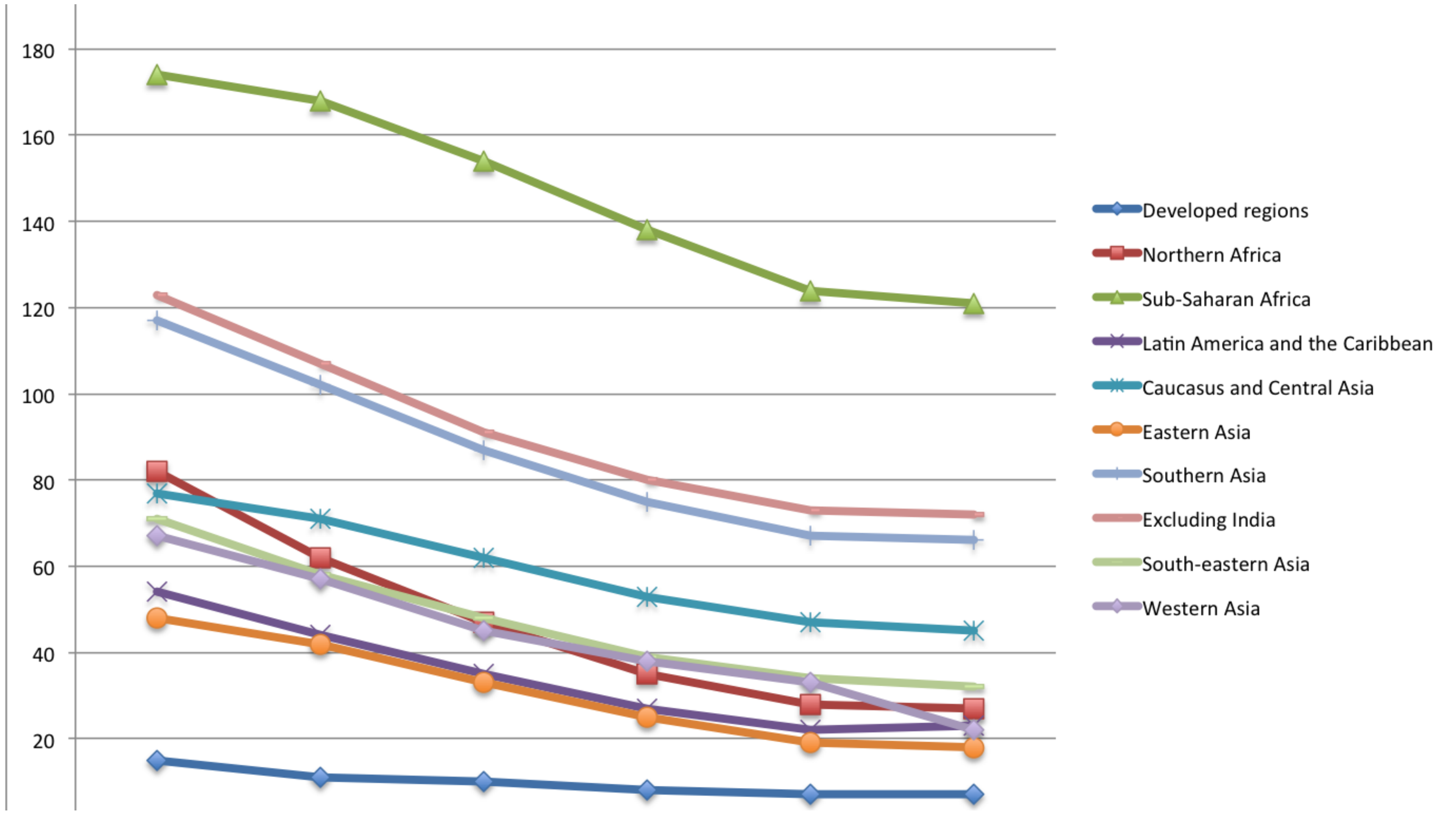


12
10
8
6
4
2
0
mortality /1000
1871
1874
1877
1880
1883
1886
1889
1892
1895
1898
DOT Respiratory System
Smallpox
Syphilis, secondary
rheumatism
Influenza
Fevers,othererupt
Dropsy
Cholera
Measles

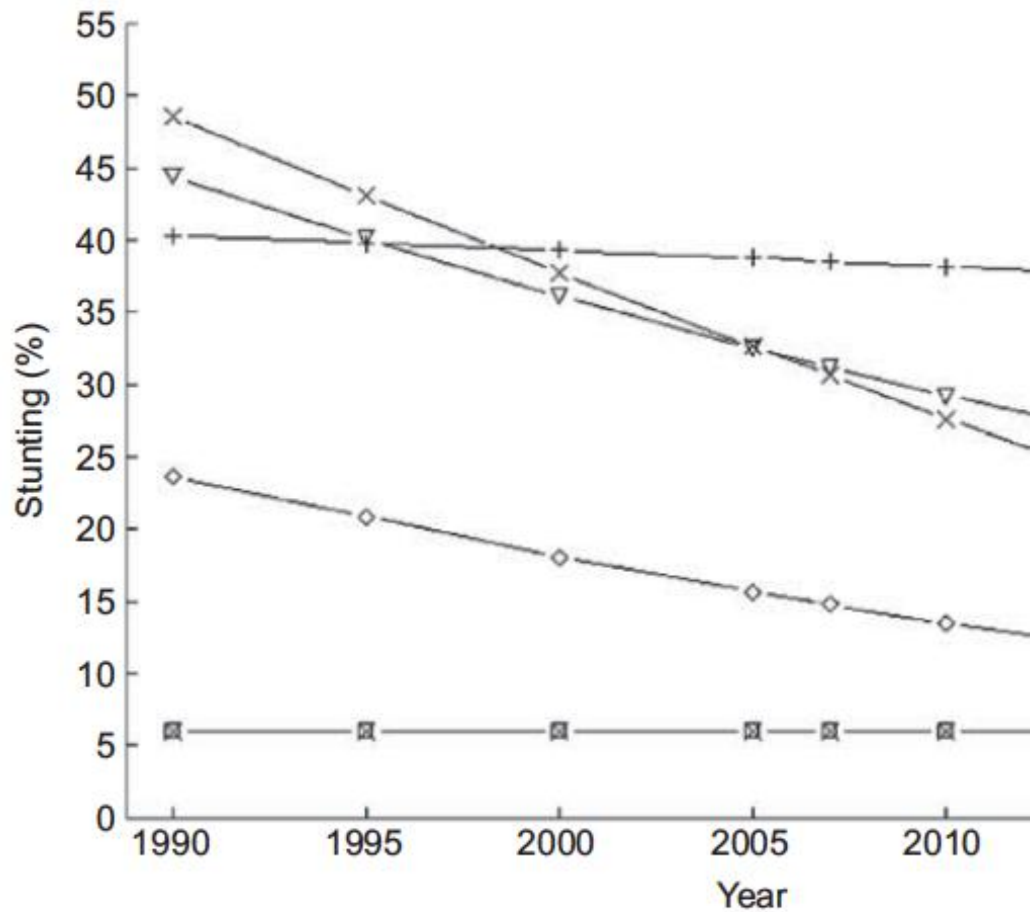
Male Height in the Netherlands

Place	Year	Height (cm)
Leiden	1880-1930	166
Country	1955	175.5
Country	1965	178
Country	1980	182
Country	1997	184

Levels and trends in underfive mortality rate, by Millennium Development Goal region, 1990–2010 Overall reduction of 35%



Levels and trends in the number of deaths of children under age five, by Millennium Development Goal region, 1990–2010 (thousands) Overall reduction of 37%



The nutritional needs of infants

- The right food at the right time
- Nutrient Dense
- Micronutrients
- Fatty Acids

Lindsay H. Allen

Research Professor, Department of Nutrition

Director, USDA ARS Western Human Nutrition Research Center

- Professor Allen argued that **animal source foods** have some nutrients not found anywhere else and that
- pregnant women on vegan diets could be damaging their child while it was growing in the womb.

Ancient Egyptians

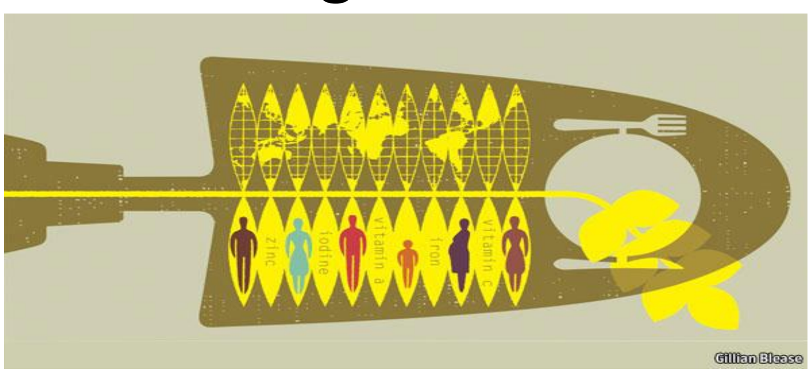
The ancient Egyptians described the symptoms of nightblindness and used liver as therapy

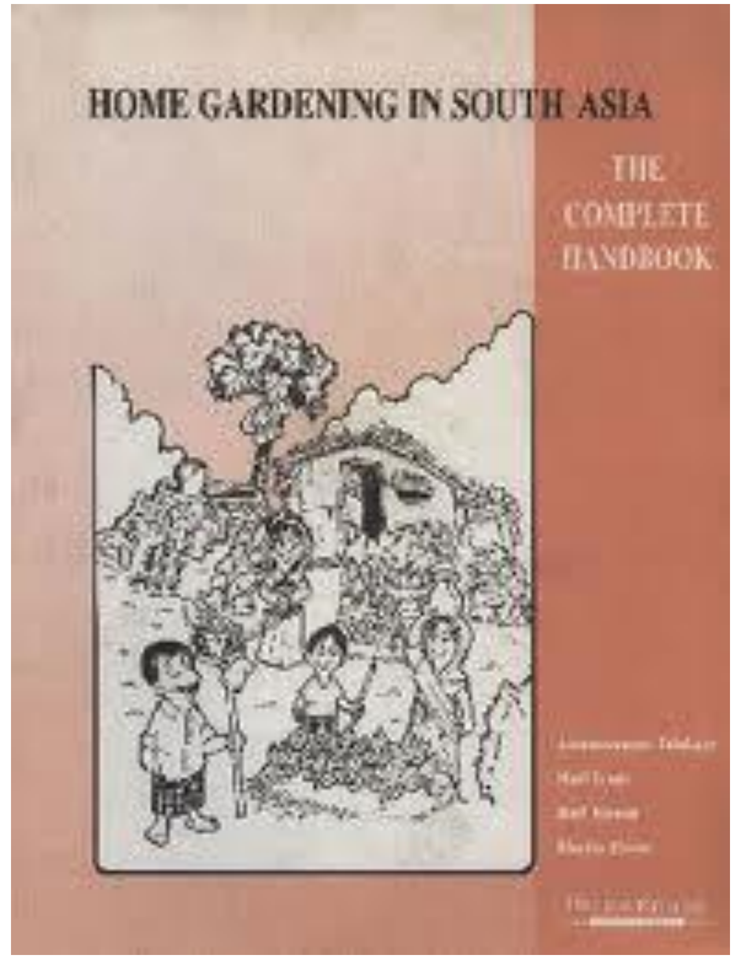
Sources of vitamin A

- Plant foods: fruits and vegetables (carotenoids)
- Animal foods (retinol)
- Carotenoids need to be converted to retinol to be effective as vitamin A; The scientific world always assumed a 1:6 conversion rate.

Homegardening: long-term strategy to prevent vitamin A deficiency

- 1980s: promotion of vegetables consumption/homegardening
- Not effective in eradicating vitamin A





Lack of improvement in vitamin A status with increased consumption of dark-green leafy vegetables Lancet 1995

Saskia de Pee, Clive E West, Muhilal, Darwin Karyadi, Joseph G A J Hautvast

Summary

There is little evidence to support the general assumption that dietary carotenoids can improve vitamin A status. We investigated in Bogor District, West Java, Indonesia, the effect of an additional daily portion of dark-green leafy vegetables on vitamin A and iron status in women with low haemoglobin concentrations (<130 g/L) who were breastfeeding a child of 3–17 months.

Every day for 12 weeks one group (n=57) received stir-fried vegetables, a second (n=62) received a wafer enriched with β-carotene, iron, vitamin C, and folic acid, and a third (n=56) received a non-enriched wafer to control for additional energy intake. The vegetable supplement and the enriched wafer contained 3·5 mg β-carotene, 5·2 mg and 4·8 mg iron, and 7·8 g and 4·4 g fat, respectively. Assignment to vegetable or wafer groups was by village. Wafers were distributed double-masked. In the enriched-wafer group there were increases in serum retinol (mean increase 0·32 [95% CI 0·23–0·40] µmol/L), breastmilk retinol (0·59 [0·35–0·84] µmol/L), and serum β-carotene (0·73 [0·59–0·88] µmol/L). These changes differed significantly from those in the other two groups, in which the only significant changes were small increases in breastmilk retinol in the control-wafer group (0·16 [0·02–0·30] µmol/L) and in serum β-carotene in the vegetable group (0·03 [0–0·06] µmol/L). Changes in iron status were similar in all three groups.

An additional daily portion of dark-green leafy vegetables did not improve vitamin A status, whereas a similar amount of β-carotene from a simpler matrix produced a strong improvement. These results suggest that the approach to combating vitamin A deficiency by increases in the consumption of provitamin A carotenoids from vegetables should be re-examined.

Lancet 1995; **346:** 75–81

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Introduction

Vitamin A supplementation and food fortification have beneficial effects on child mortality and morbidity.[1,2] Supplementation of children and pregnant women with anaemia and vitamin A deficiency increases not only serum retinol but also haemoglobin concentrations.[3,4] Vitamin A supplements given to women shortly after delivery increase serum and breastmilk retinol concentrations.[5]

Of the strategies to reduce vitamin A deficiency, the dietary approach is increasingly being emphasised because it is sustainable, provides nutrients other than vitamin A, and adds variety to the diet. In developing countries, fruit and vegetables provide 70–90% of total vitamin A intake from their high content of provitamin A carotenoids.[6] However, studies on the effectiveness of vegetables and fruits to prevent vitamin A deficiency are scarce.[7] One well-controlled study[8] showed an increase in serum retinol after consumption of red sweet potato and dark-green leafy vegetables[8] but other intervention studies that have shown positive results were controlled poorly or not at all, while cross-sectional and case-control studies had weak designs.[7]

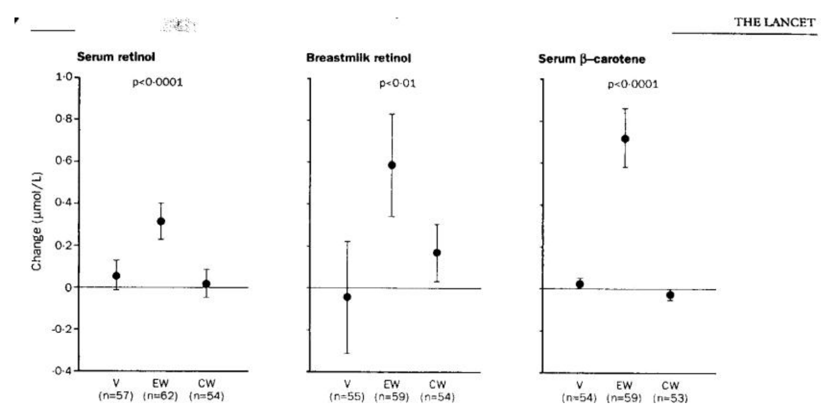
We examined the extent to which an additional daily portion of local dark-green leafy vegetables can improve vitamin A status in anaemic breastfeeding women in a rural area in West Java, Indonesia. The effect on iron status was also examined. The women receiving vegetables were compared with others given a wafer enriched with β-carotene, iron, vitamin C, and folic acid, so that we could examine the effect of a similar amount of micronutrients in a simpler matrix with better bioavailability. A third group received a non-enriched (control) wafer to allow for effects of additional energy intake.

Subjects and methods

Subjects

The study was carried out from September, 1993, to January, 1994, in two neighbouring villages in Bogor district, West Java. Most inhabitants are of middle or low socioeconomic class. The area is free of malaria. A large variety of fruits, vegetables, and staples are available all year. The usual daily diet consists of two to three rice-based meals with vegetables and dried salted fish, soya products, or meat, and one or more snacks (fried banana, noodles, and cookies). Many breastfeeding women do not eat fruits for 6 months after delivery, believing them to be harmful to their health.

Power calculations, based on within-individual changes from a previous study of pregnant women,[4] showed that the number of subjects per group required to detect a 0·12 µmol/L difference



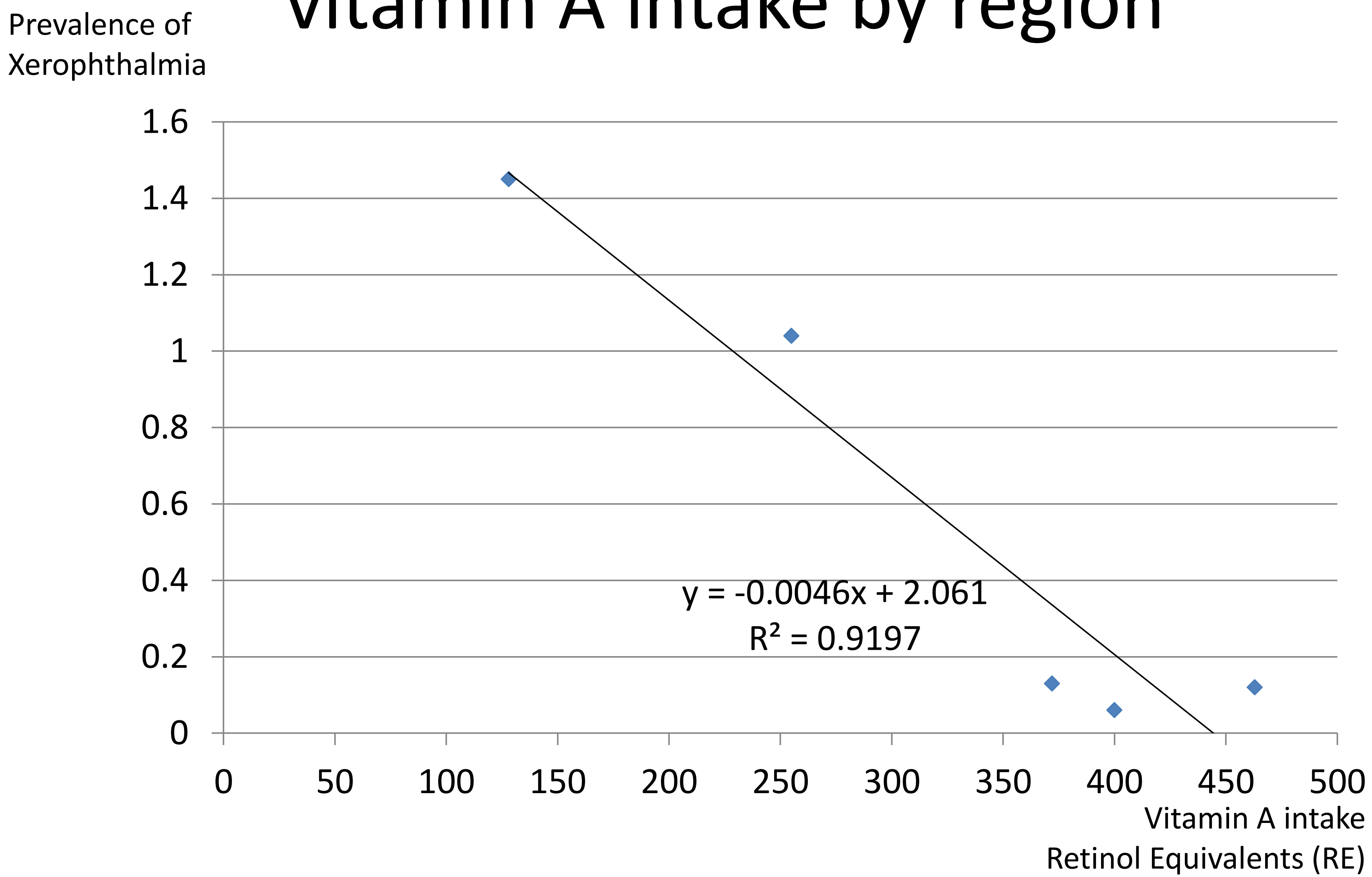
Vegetables are not a good source for vitamin A

TABLE 3. Available supply of vitamin A according to WHO region

Region	Vitamin A (mg RE/day)[a]			Incidence of xerophthalmia
	Vegetable	Animal	Total	
South-East Asia	378 (75)	53	431 (128)	1.45
Africa	654 (130)	122	776 (255)	1.04
Western Pacific	781 (156)	216	997 (372)	0.13
Eastern Mediterranean	591 (118)	345	936 (463)	0.12
Americas	519 (104)	295	814 (400)	0.06

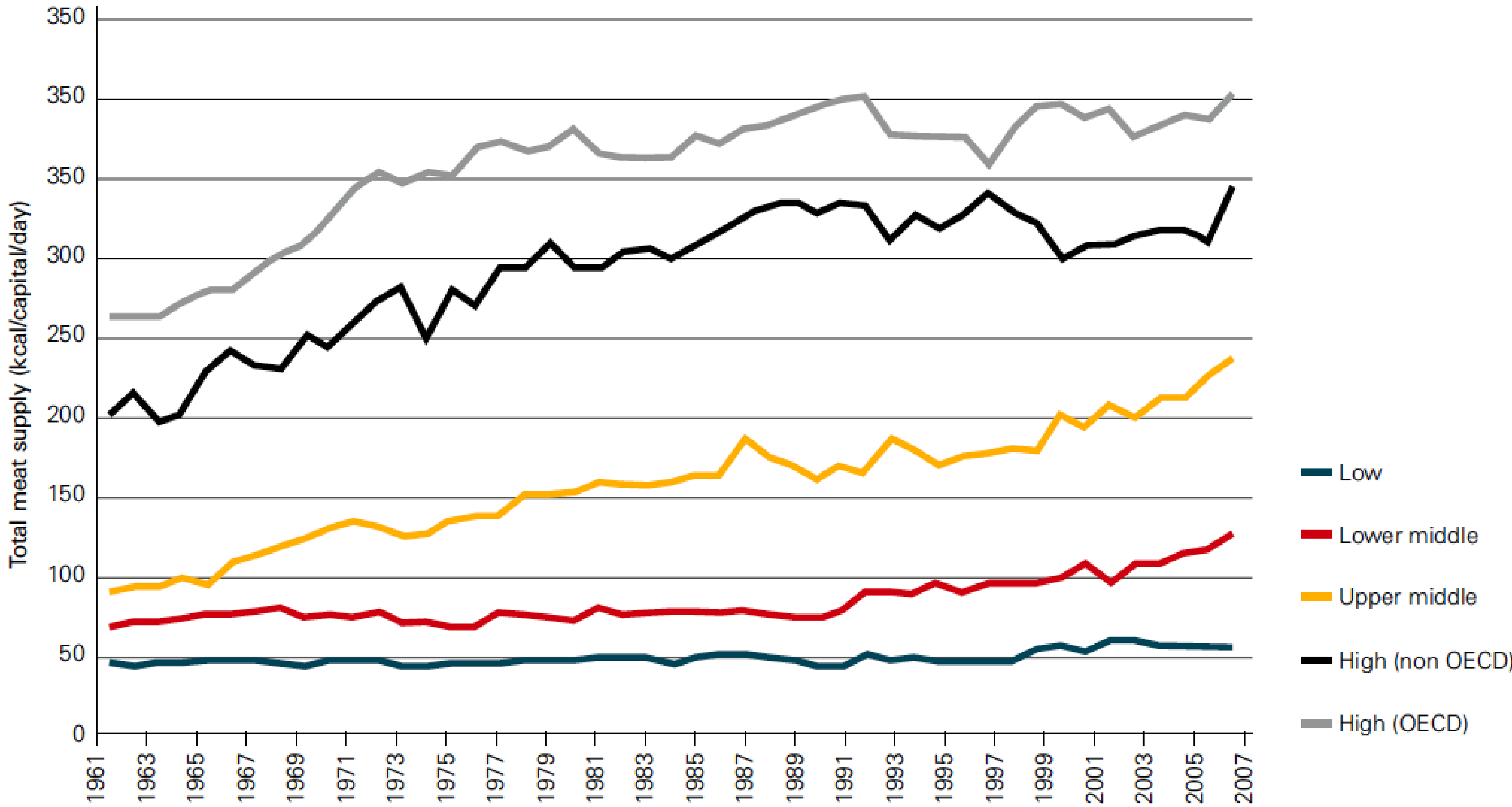
Source: ref. 6.
a. Numbers in parentheses are adjusted for bioavailability.

Prevalence of xerophthalmia by vitamin A intake by region



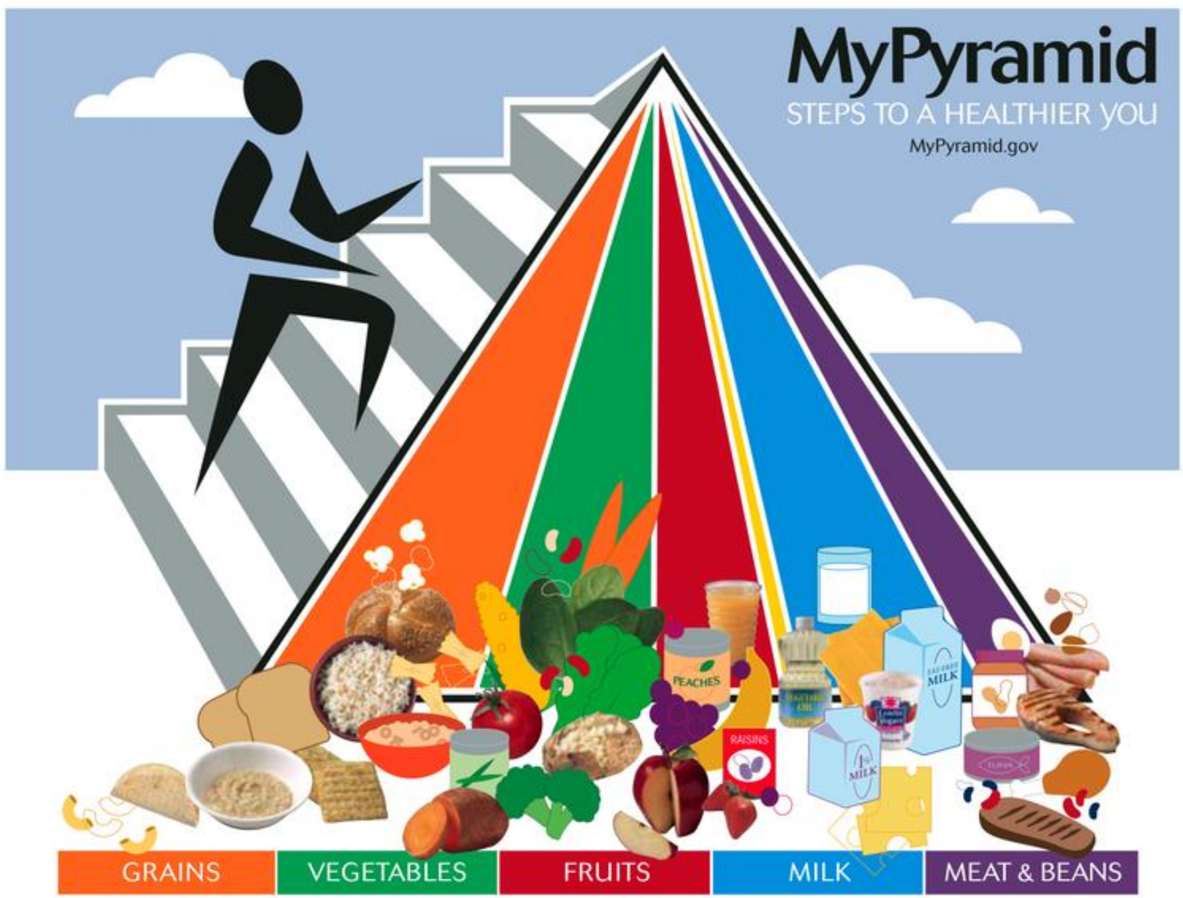
Source:

Median total meat supply (kcal / capita / day) for each income category

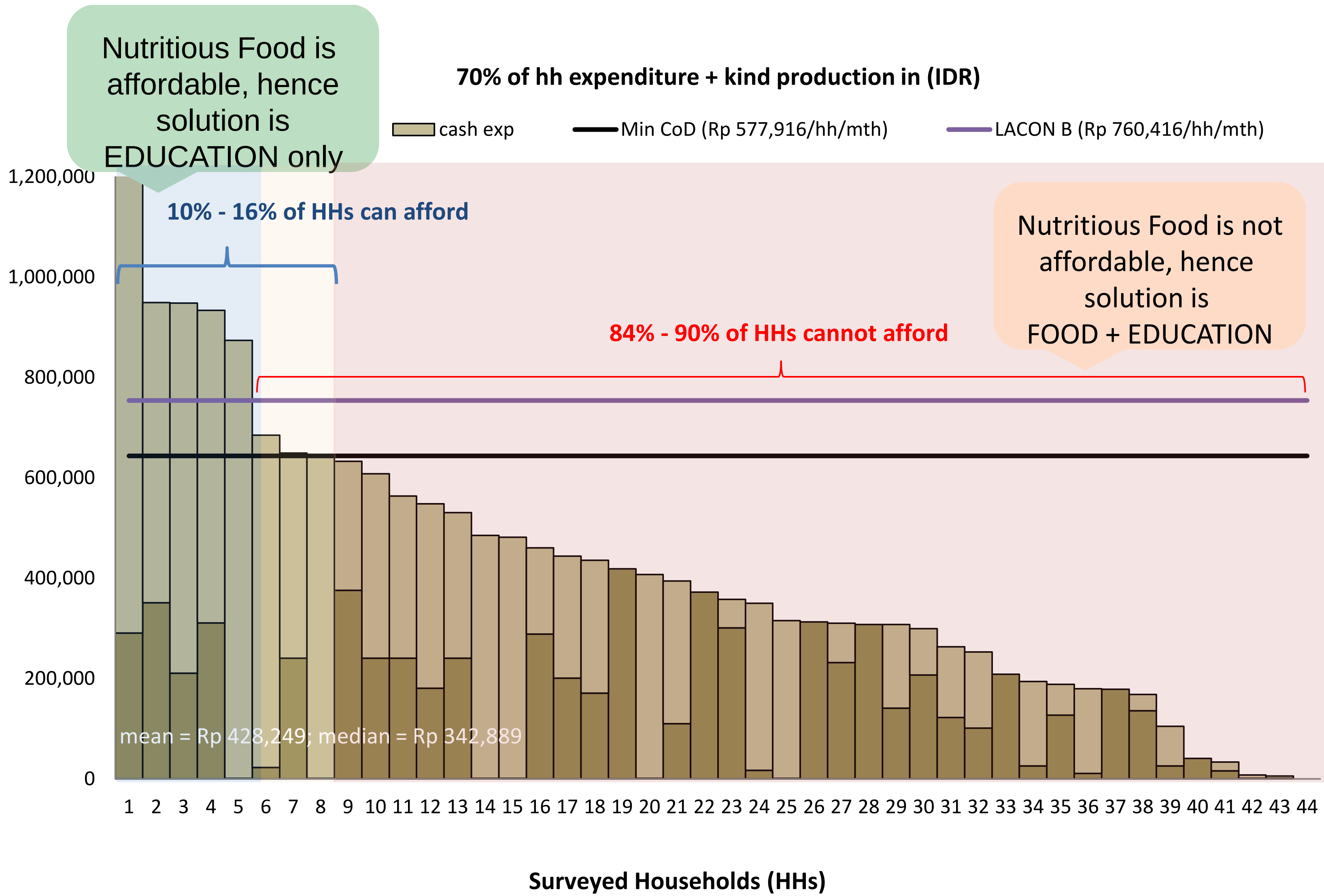


Source: FAOstat 'Food supply' database (see http://faostat.fao.org/default.aspx)

Poor Complementary Feeding
Lack of knowledge/behavior or Poverty?



First results indicate that in TTS between 84% and 90% of all HHs are not able to afford a Minimum Cost Nutritious Diet



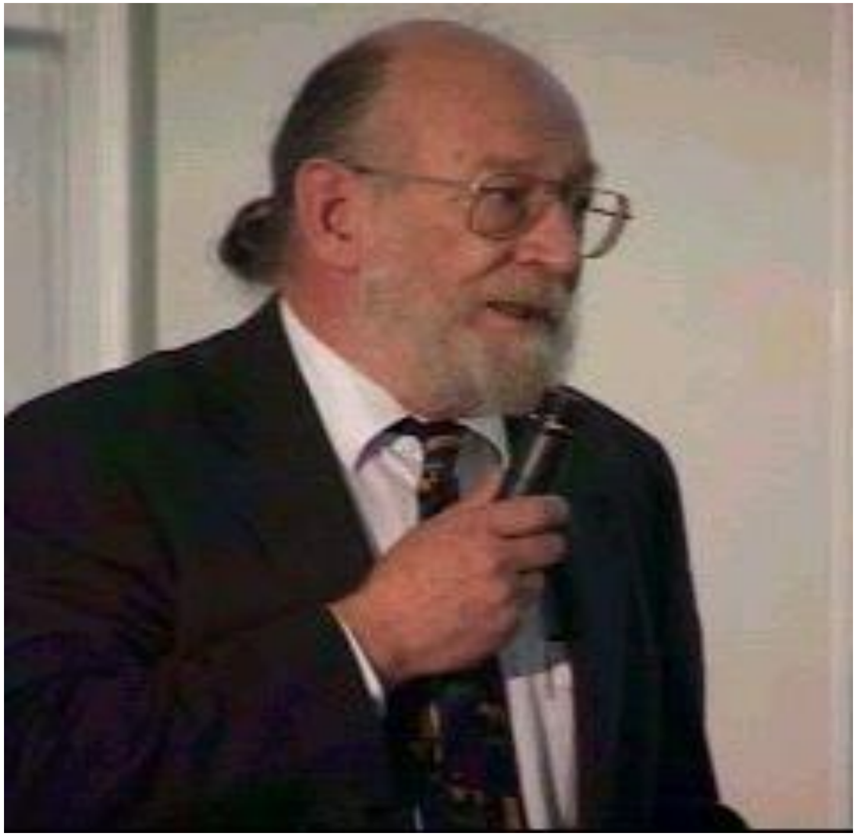
Source: Pilot Food Security and Nutrition Monitoring System in Indonesia, TTS, April, 2011, n=50; WFP CoD Analysis in TTS, 2011.
Note: Household Size: 5 members, including 1 child 12-23 months

Poverty or Lack of Knowledge

Andre Briend & Michael Golden
Treatment of SAM based on nutrient needs

Plumpy nut: community based

F100: clinics



Management of severe acute malnutrition in children

Management of severe acute malnutrition in children

Steve Collins, Nicky Dent, Paul Binns, Paluku Bahwere, Kate Sadler, Alistair Hallam

Lancet 2006; 368: 1992–2000

Published Online September 26, 2006 DOI:10.1016/S0140-6736(06)69443-9

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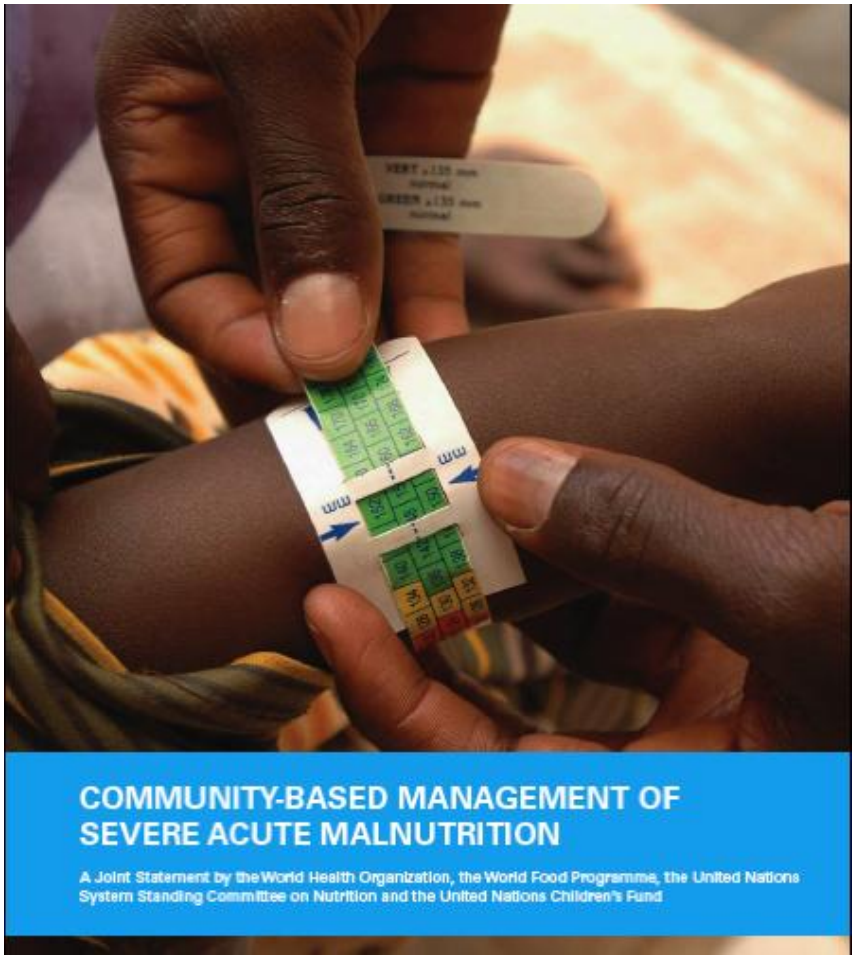
Correspondence to: Dr Steve Collins, Valid

Severe acute malnutrition (SAM) is defined as a weight-for-height measurement of 70% or less below the median, or three SD or more below the mean National Centre for Health Statistics reference values, the presence of bilateral pitting oedema of nutritional origin, or a mid-upper-arm circumference of less than 110 mm in children age 1–5 years. 13 million children under age 5 years have SAM, and the disorder is associated with 1 million to 2 million preventable child deaths each year. Despite this global importance, child-survival programmes have ignored SAM, and WHO does not recognise the term “acute malnutrition”. Inpatient treatment is resource intensive and requires many skilled and motivated staff. Where SAM is common, the number of cases exceeds available inpatient capacity, which limits the effect of treatment; case-fatality rates are 20–30% and coverage is commonly under 10%. Programmes of community-based therapeutic care substantially reduce case-fatality rates and increase coverage rates. These programmes use new, ready-to-use, therapeutic foods and are designed to increase access to services, reduce opportunity costs, encourage early presentation and compliance, and thereby increase coverage and recovery rates. In community-based therapeutic care, all patients with SAM without complications are treated as outpatients. This approach promises to be a successful and cost-effective treatment strategy.

Joint Statement WHO/UNICEF/WFP:

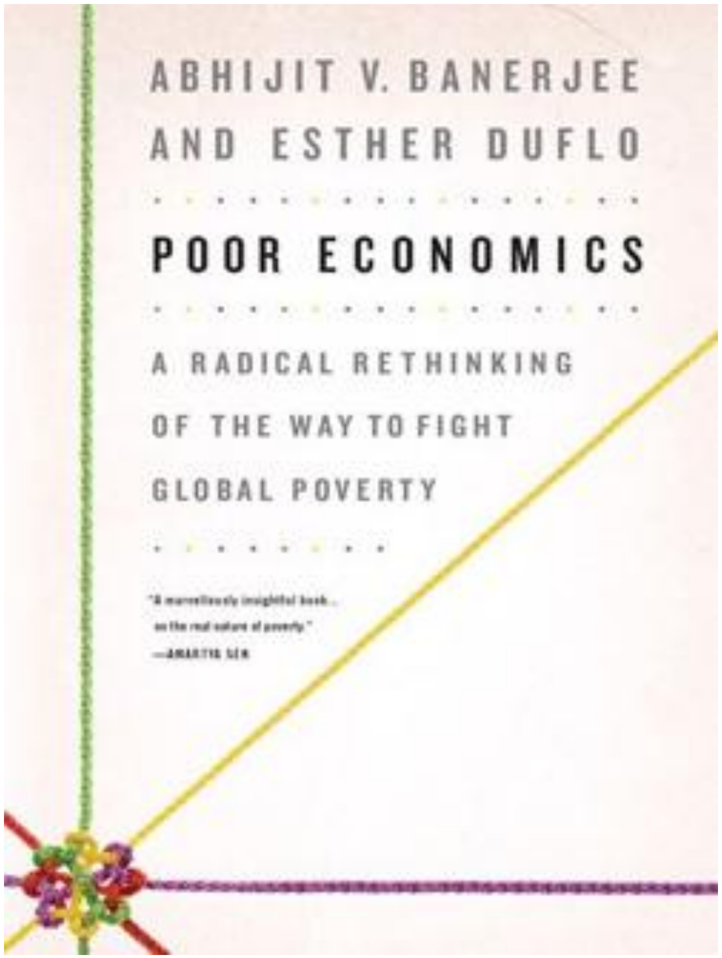
From Clinics to Community-based management of SAM



Recommendations other issues

Food and Nutrition Security

Poor economics



- The poor bear responsibility for too many aspects in life!!!
- The richer you are, the more the “right” decisions are made for you.

Poor Economics

Poor

- No piped water; they have to purify the water themselves
- Cannot afford ready-made fortified complementary foods and therefore have to make sure that their children get enough nutrients and prepare their food separately

Rich

- City put chlorine in the water supply
- Access to safe good quality complementary food.

Double Standards?

Medical

HIV/AIDS

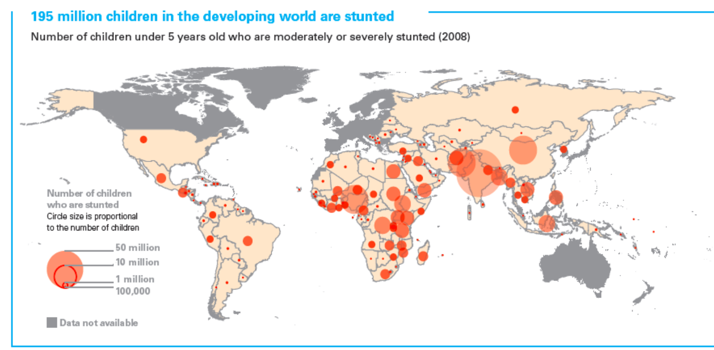
- WHO: CD4 < 350
- First new line of treatment (200 US annual)

Double Standards?

Nutrition

Nutrition

- 100 USD will give children the right start at 2 years of age!



WFP's vision on nutrition

- A world in which all human beings have access to adequate nutrition, enabling them to develop their full potential and live healthy and fulfilled lives.

Thank you