Methodological issues in the use of anthropometry for evaluation of nutritional status

Monika Blössner

WHO Department of Nutrition for Health and Development

Measuring height

length

Head circumference

# Nutritional status of lactating mothers: measuring weight,

Mother's height

Reference material

- de Onis M, Onyango AW, Van den Broeck J, Chumlea WC, Martorell R. Measurement and standardization protocols for anthropometry used in the construction of a new international growth reference. Food Nutr Bull 2004;25(1):S27-36.

Standard normal distribution of child growth and prevalence under the curve between SD ranges

2.3%

2.14%

0.13%

13.59% 34.13% 34.13% 13.59%

2.14%

0.13%

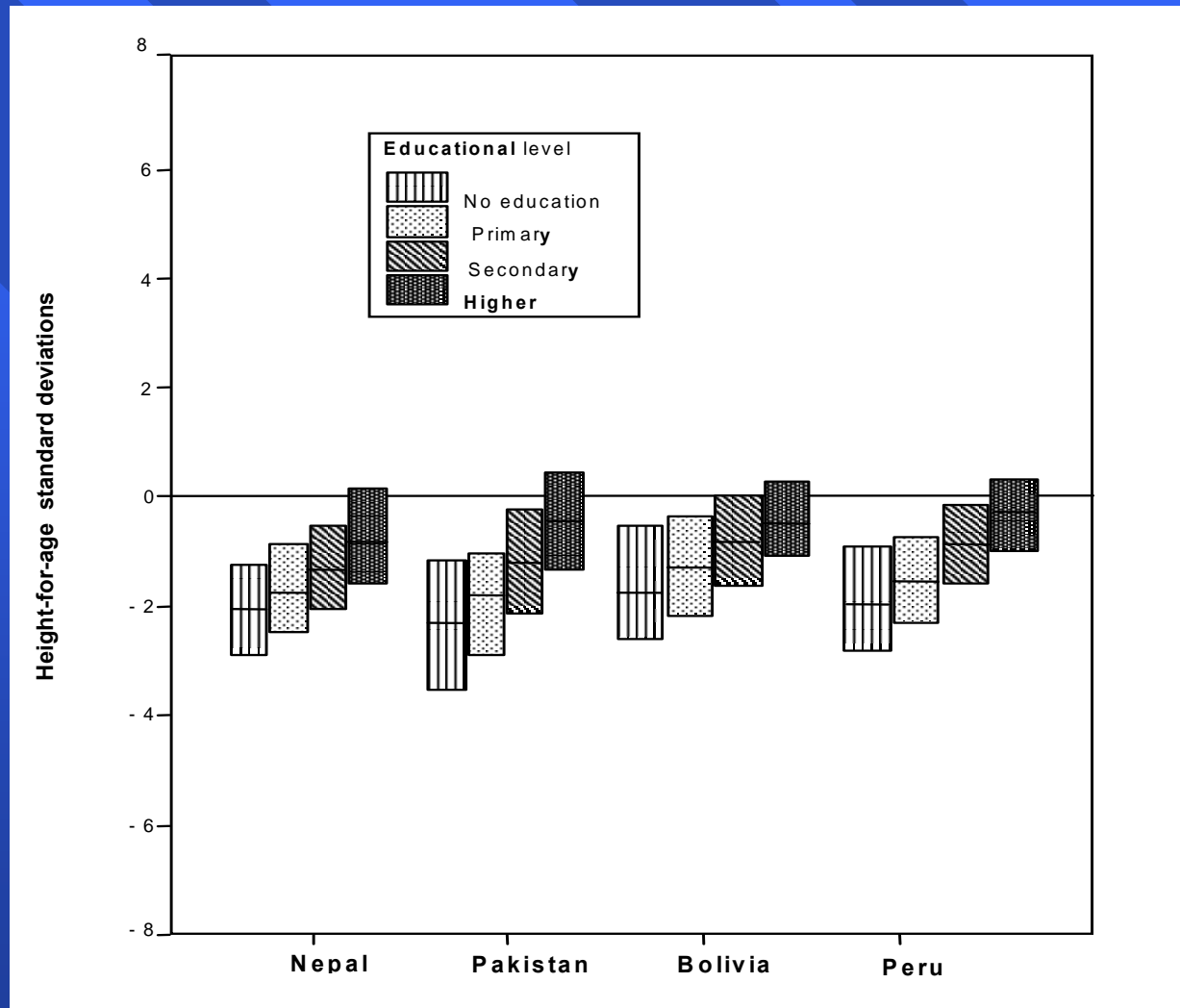-4   -3   -2   -1   0   1   2   3   4
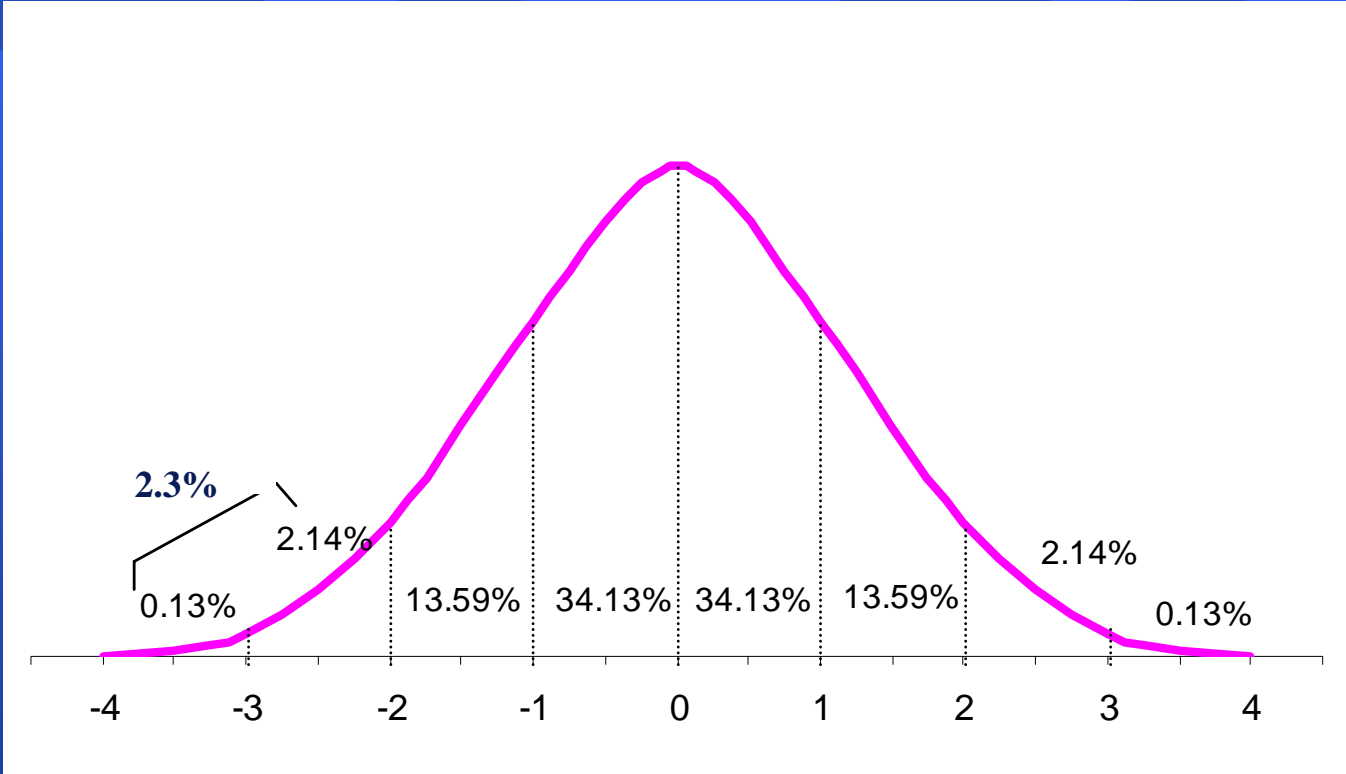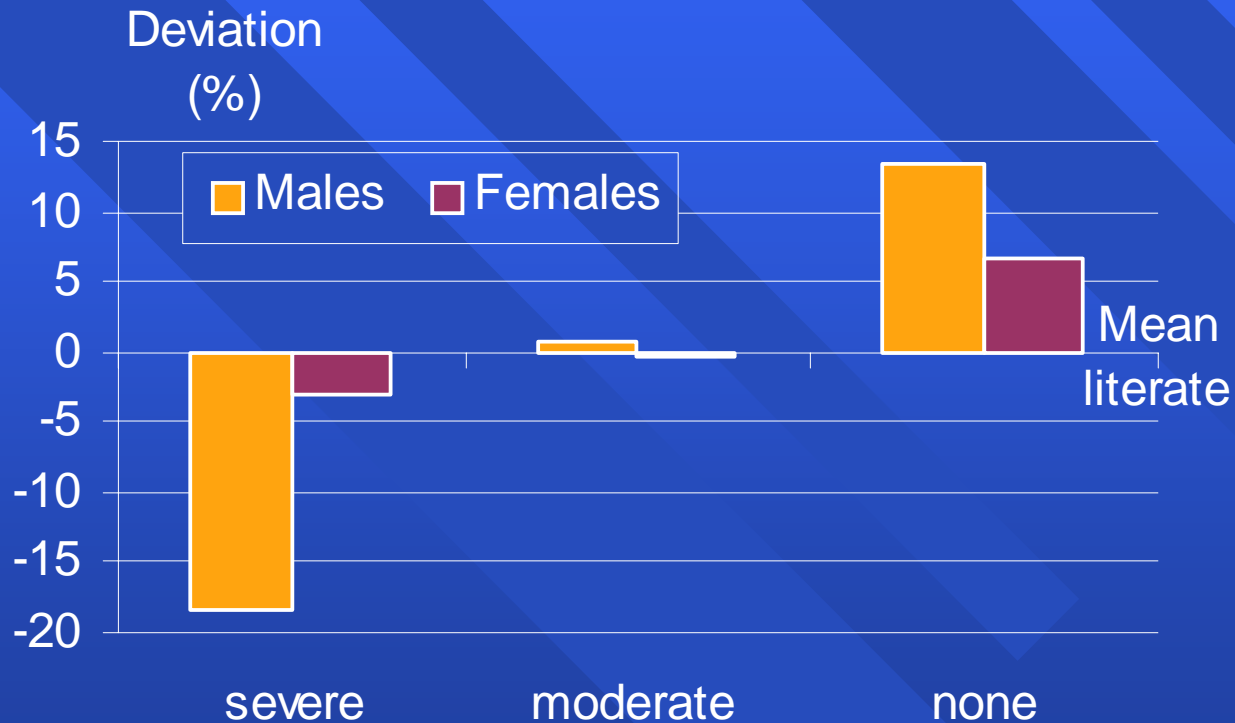
Nutrition through the life cycle
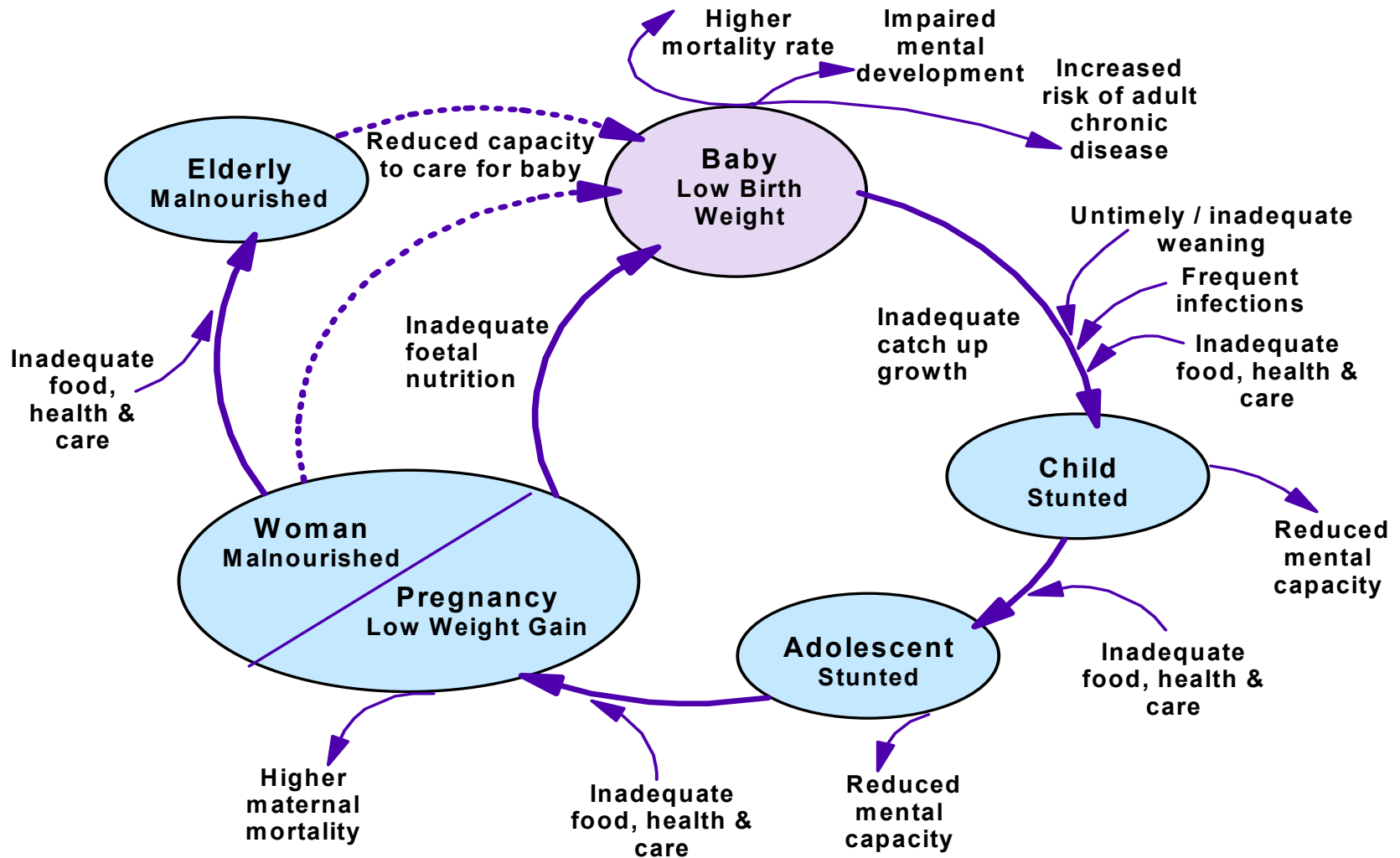
Source: 4th Report on the World Nutrition Situation. ACC/SCN, 2000.

Variation of height-for-age according to maternal education

Source: de Onis M. Socioeconomic status and child growth. Int J Epidemiol 2003;32:503-5.

Deviation from sex-specific mean literacy rate associated to levels of malnutrition

Deviation (%)

Legend: ■ Males ■ Females

Y-axis: 15, 10, 5, 0, -5, -10, -15, -20

X-axis: severe, moderate, none

Mean literate

Source: Adapted from Martorell et al., 1992.

Methods in anthropometry

- **Anthropometric indicators**

- **Reference population**

- **Cut-off points**

- **Applications of anthropometry**

Anthropometric indicators

- **Attained growth**
  - **Length/height-for-age** $\sqrt{}$
  - **Weight-for-age** $\sqrt{}$
  - **BMI-for-age** $\sqrt{}$
  - **MUAC-for-age** $\sqrt{}$
  - **Head circumference-for-age**
  - **Subscapular skinfold-for-age**
  - **Triceps skinfold-for-age**
  - **Weight-for-height/length** $\sqrt{}$
  - **MUAC-for-height/length** $\sqrt{}$

Mean weight-for-age z-score
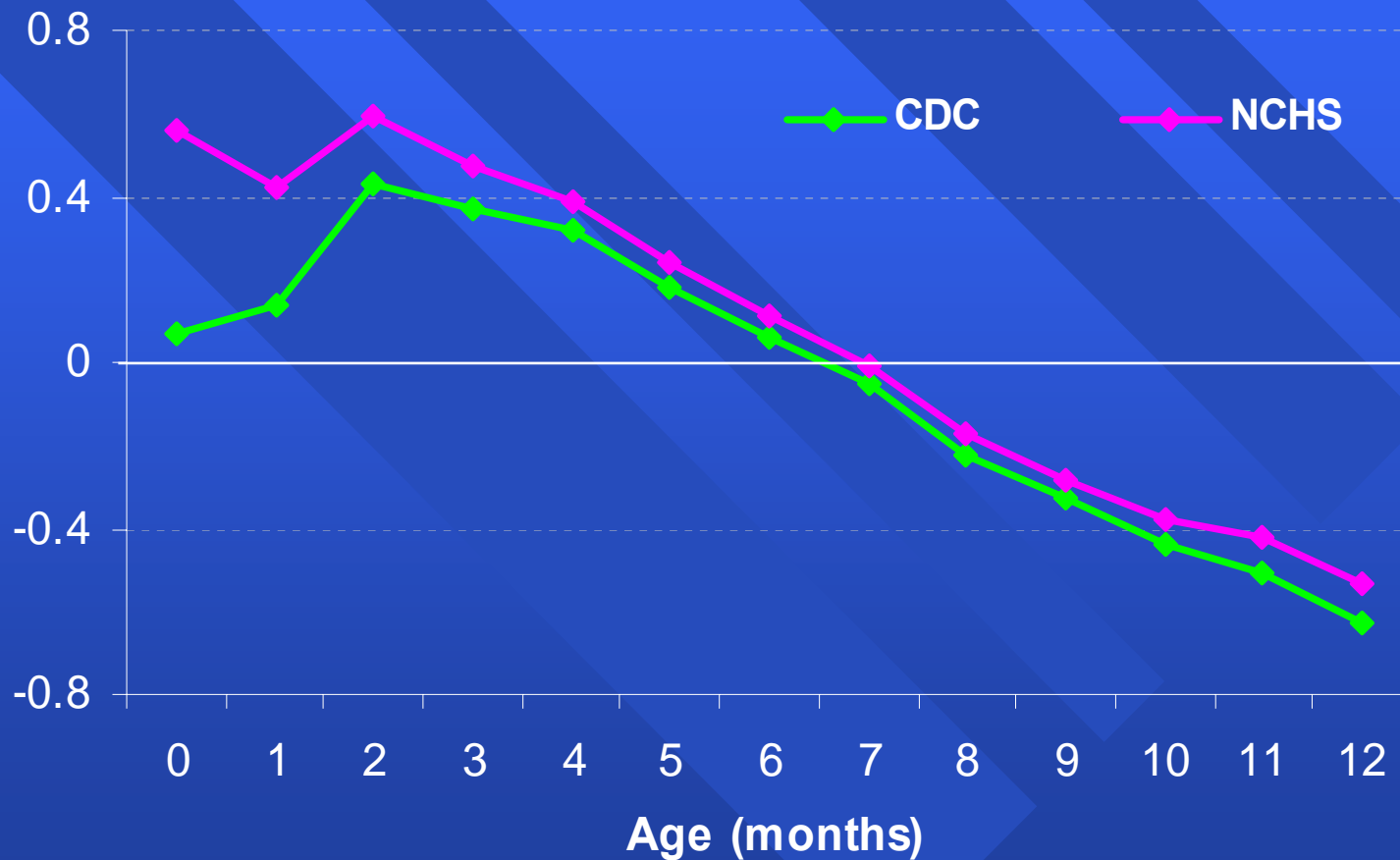
Source: de Onis M, Onyango A. The CDC reference and the growth of breast-fed infants. Acta Paediatrica 2003;92:413-9.

Mean length-for-age z-score
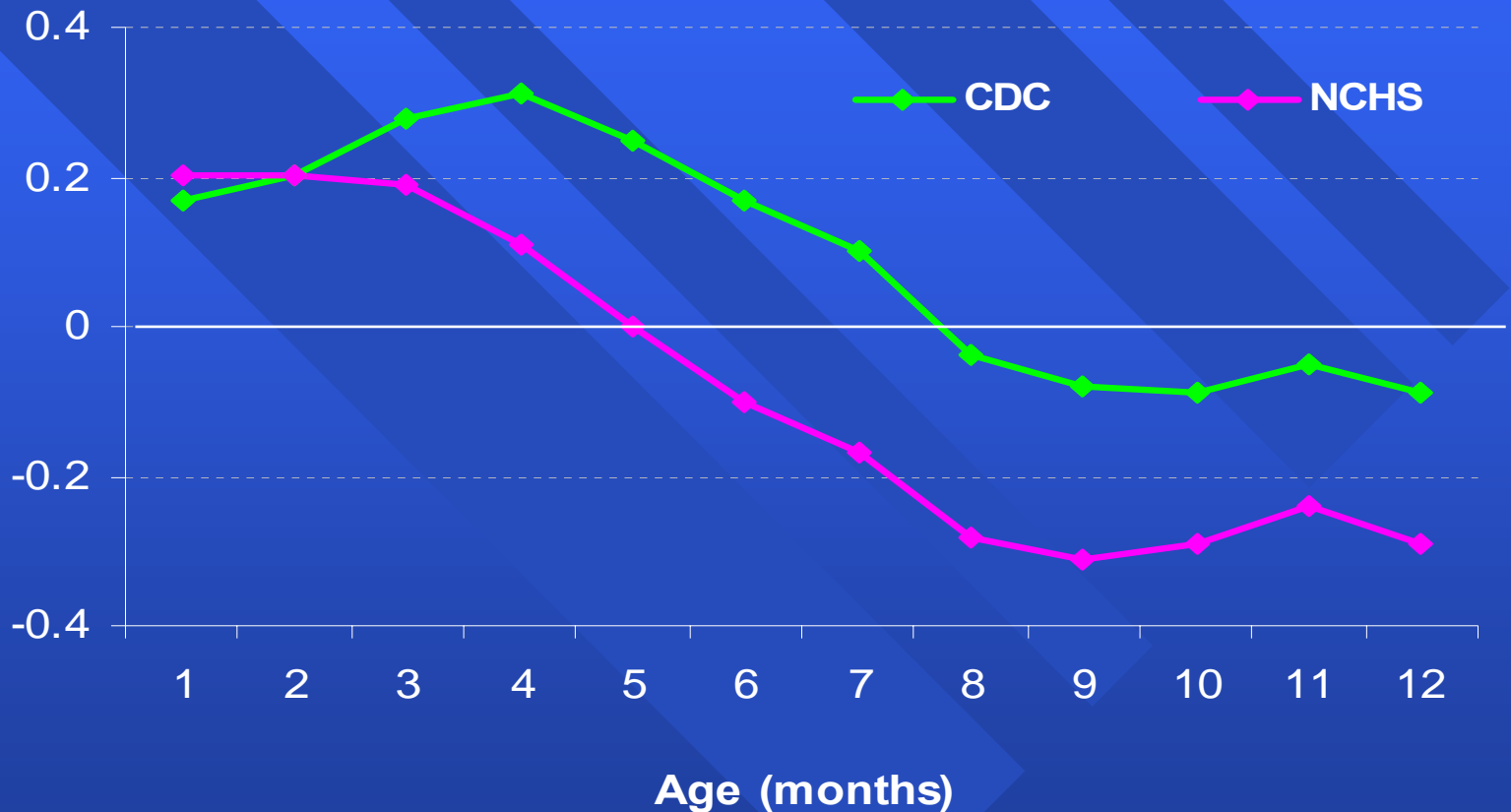
Source: de Onis M, Onyango A. The CDC reference and the growth of breast-fed infants. Acta Paediatrica 2003;92:413-9.

Mean BMI-for-age of the Calcutta boys compared with the French, Dutch, British, and NCHS reference medians
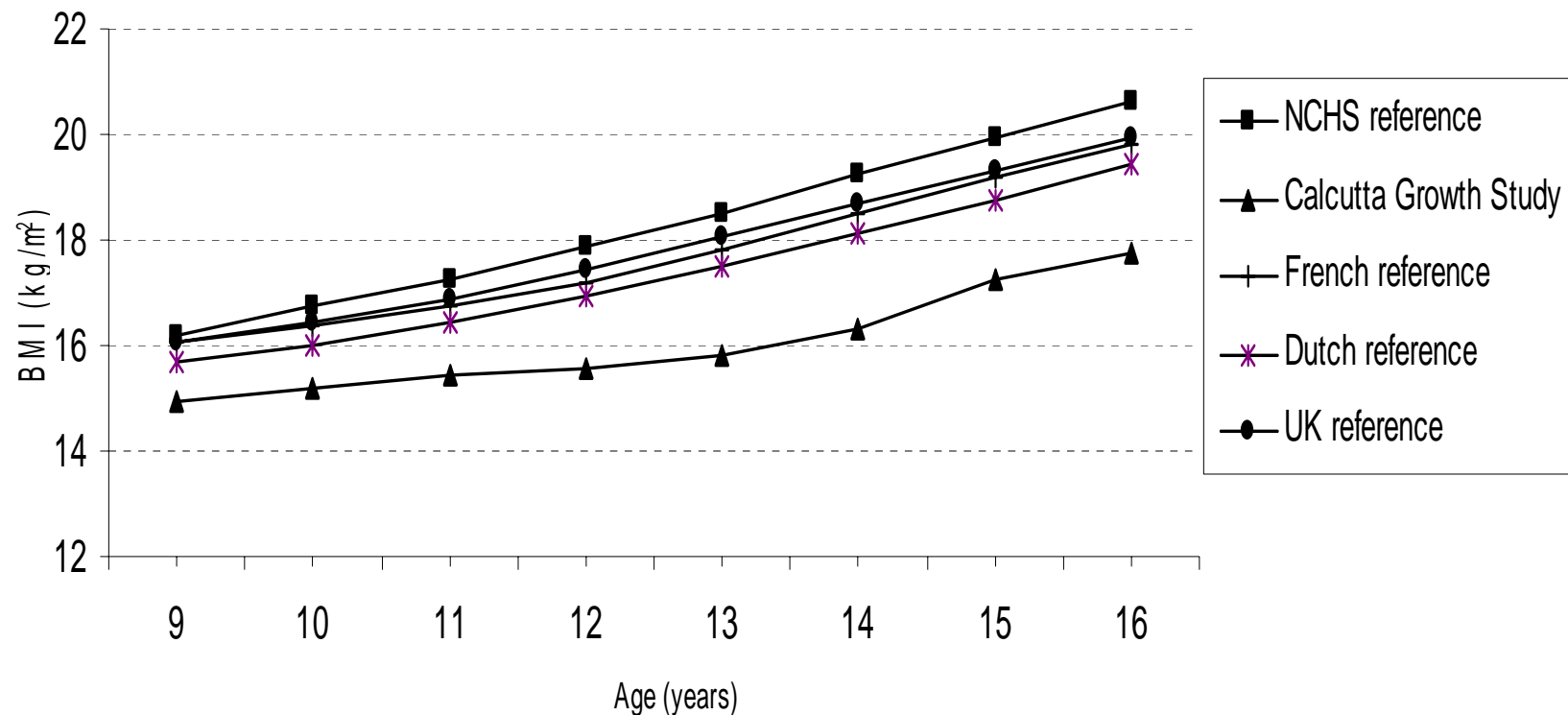
Source: de Onis M et al. The National Centre for Health Statistics reference and the growth of Indian adolescent Boys. Am J Clin Nutr 2001;74:248-53.

Background

- **Child growth internationally recognized as an important public health indicator**

- **Numerous surveys <u>but</u> not comparable**

- **WHO's systematic standardization of data initiated in 1986**

WHO Global Database on Child Growth and Malnutrition

General objectives

- **To establish a global nutritional surveillance system**

- **To compile, standardize and disseminate results of anthropometric surveys performed worldwide**

WHO Global Database on Child Growth and Malnutrition

Specific objectives

- **Characterize nutritional status**
- **Enable international comparison**
- **Identify populations in need**
- **Evaluate interventions**
- **Monitor secular trends**
- **Raise political awareness**

WHO Global Database on Child Growth and Malnutrition

Methods: Data standardization

- **Use of the NCHS/WHO international reference**

- **Prevalence of wasting, stunting, underweight and overweight**

- **Cut-off points in Z-scores: <-2, <-3 and >+2 SD**

- **Stratification by age, sex, region, urban/rural**

- **Summary statistics: means & SDs of z-scores**

WHO Global Database on Child Growth and Malnutrition

Database Indicators

- **Wasting or low weight-for-height (cut-offs <-3 and <-2 SD)**

- **Stunting or low height-for-age (cut-offs <-3 and <-2 SD)**

- **Underweight or low weight-for-age (cut-offs <-3 and <-2 SD)**

- **Overweight or high weight-for-height (cut-off >+2 SD)**

WHO Global Database on Child Growth and Malnutrition

Database work-flow

Data search, review of methods and data extraction

Check for completeness and consistencies across indicators and summary statistics

Get back to data holders:
- Clarification
- Further analysis
- Raw data

Assist analysis

Run standard analysis

- Enter data into WHO Global Database
- Archive background documents and raw data

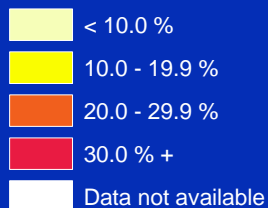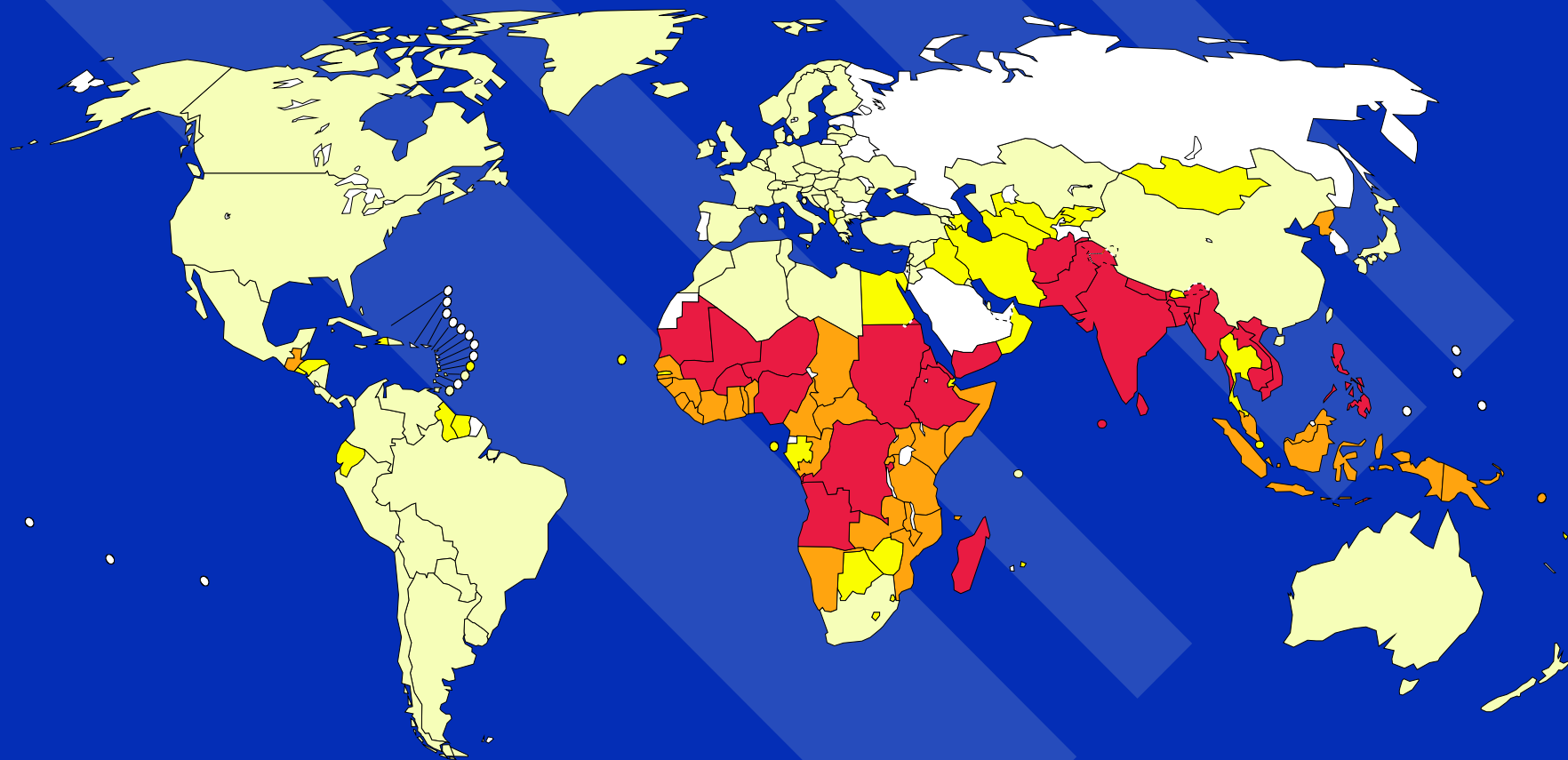WHO Global Database on Child Growth and Malnutrition

Coverage (January 2005)

- 484 national surveys from 164 countries

- 503 sub-national surveys 158 countries

- 99% children <5 yr in developing countries

- 69% children <5 yr in developed countries

- 2639 references

WHO Global Database on Child Growth and Malnutrition

Global distribution of child underweight

Legend:
- < 10.0 %
- 10.0 - 19.9 %
- 20.0 - 29.9 %
- 30.0 % +
- Data not available

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Global and regional estimates of stunted children in 2000

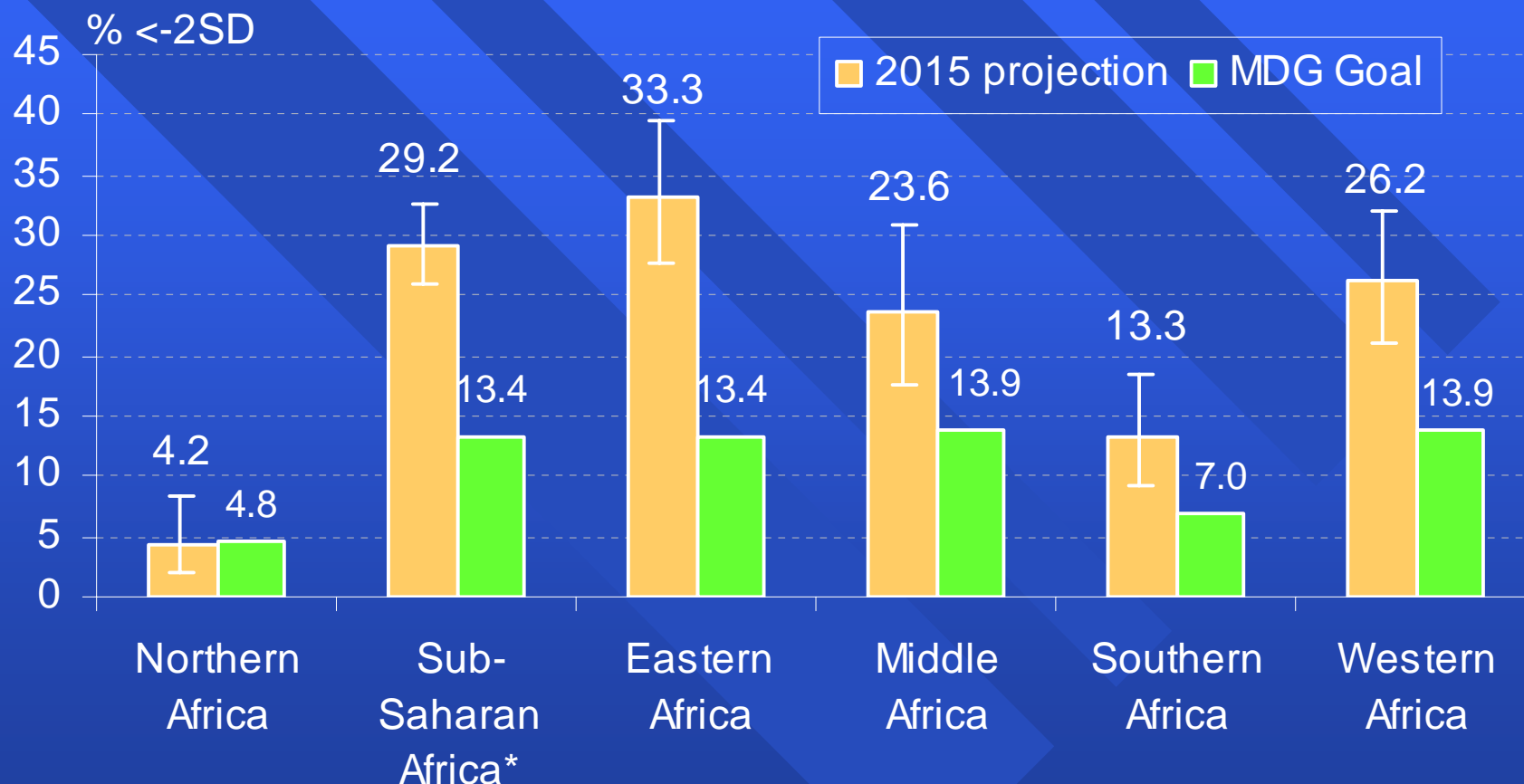| Region	Stunted children (%)	Stunted children (millions)
Africa	35	45
Asia	30	109
Latin America & Caribbean	14	8
All developing countries	30	162

Source: de Onis et al. Methodology for estimating regional and global trends of child malnutrition. Int J Epidemiol 2004;33:1260-70.

Trends of underweight prevalence in children <5 years compared to the MDG Goal in 2015
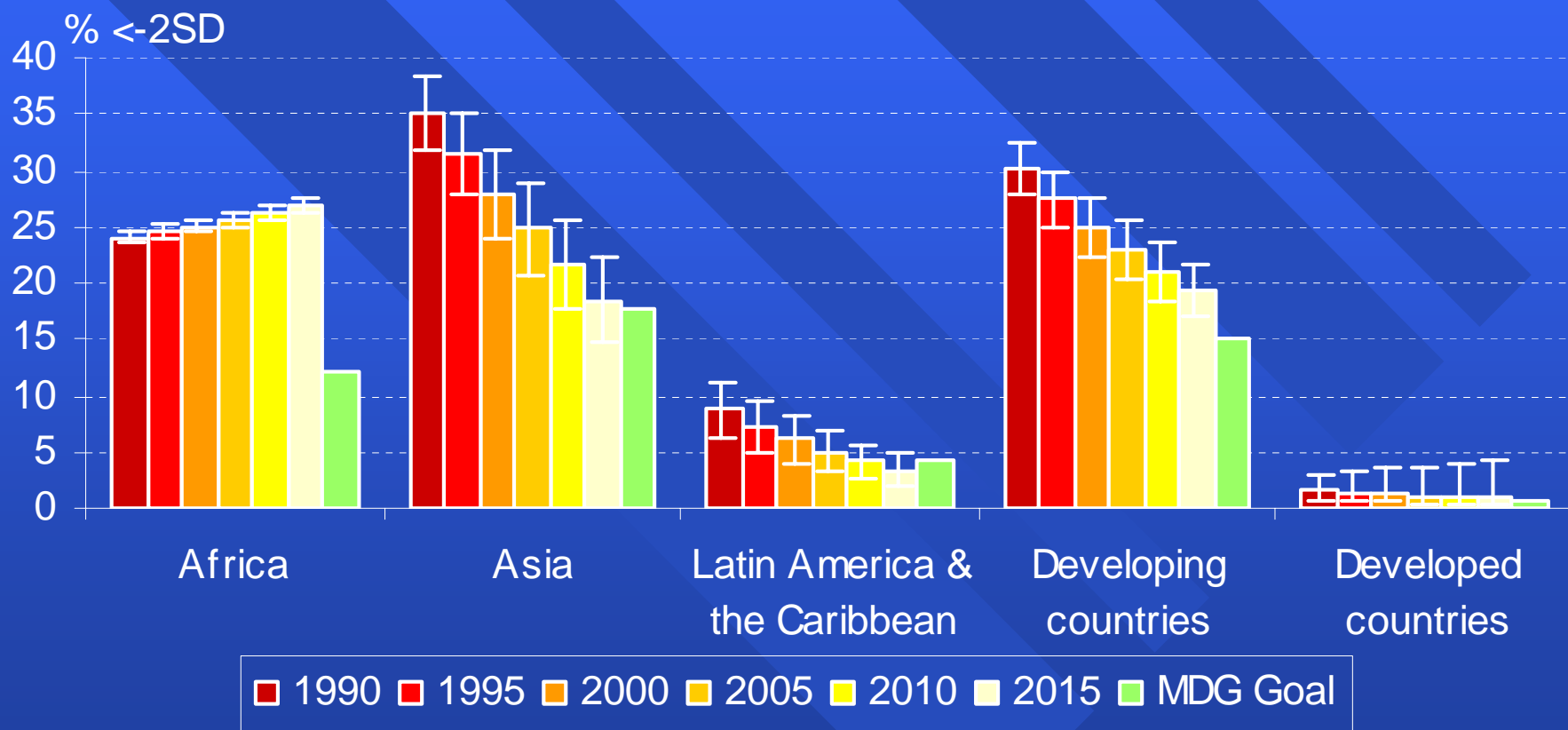
Source: de Onis M, Blössner M. **The World Health Organization Global Database on Child Growth and Malnutrition: methodology and applications. Int J Epidemiol 2003;32:518-26.**

Subregional projections of underweight prevalence with 95% CI in 2015 compared to MDG Goal

% <-2SD

Legend: ■ 2015 projection ■ MDG Goal

Region	2015 projection	MDG Goal
Northern Africa	4.2	4.8
Sub-Saharan Africa*	29.2	13.4
Eastern Africa	33.3	13.4
Middle Africa	23.6	13.9
Southern Africa	13.3	7.0
Western Africa	26.2	13.9

Wasting and overweight in preschool children

Overweight

Wasting

Overweight estimates in preschool children

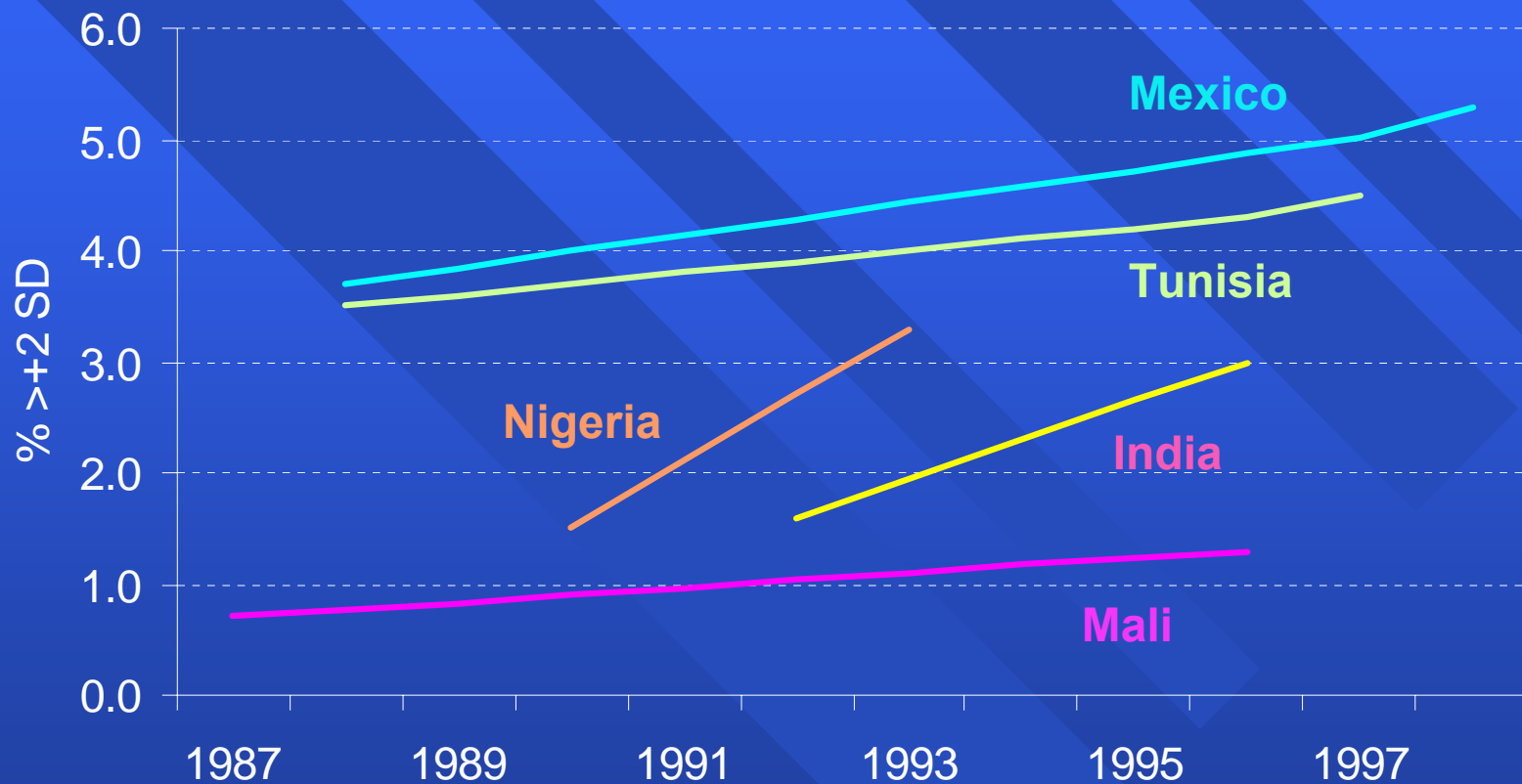| Region	Overweight children (%)	(millions)
Africa	3.9	4.5
Asia	2.9	10.6
Latin America & Caribbean	4.4	2.4
All developing countries	3.3	17.6

Source: de Onis M and Blössner M. Prevalence and trends of overweight among preschool children in developing countries. Am J Clin Nutr 2000;72:1032-9.

Trends of overweight in children
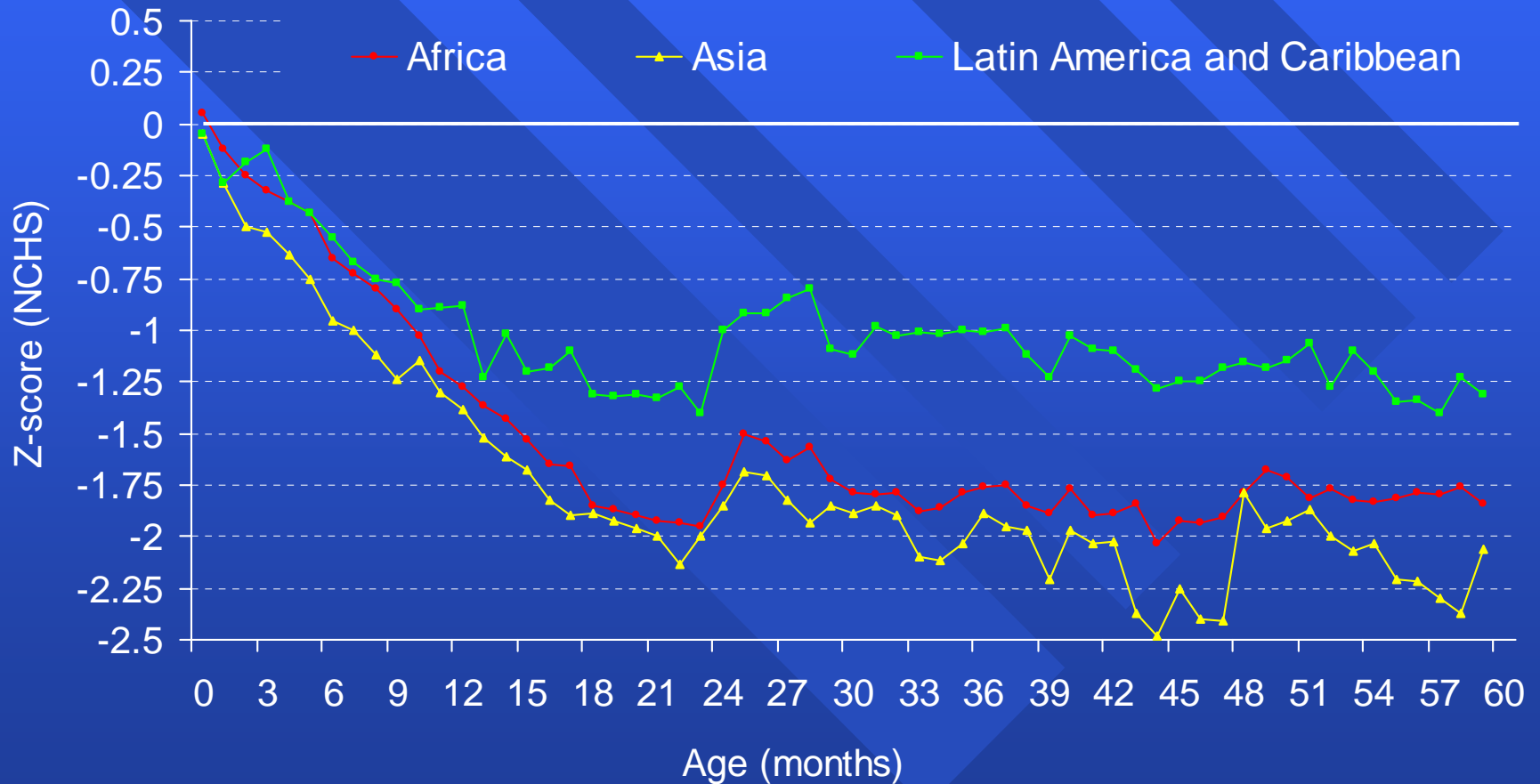

Source: de Onis M and Blössner M. Prevalence and trends of overweight among preschool children in developing countries. Am J Clin Nutr 2000;72:1032-9.

Timing of growth faltering
Height-for-age by region

Legend: Africa — Asia — Latin America and Caribbean

X-axis: Age (months)
Y-axis: Z-score (NCHS)

Source: Shrimpton et al. Worldwide timing of growth faltering: implications for nutritional interventions. Pediatrics 2001;107(5) http://www.pediatrics.org/cgi/content/full/107/5/e75.

Estimated burden of 10 leading risk factors

Rank	Risk Factor	DALYs (millions)	Global DALYs % total
1	**Underweight**	138	9.5%
2	Unsafe sex	92	6.3%
3	Blood pressure	64	4.4%
4	Tobacco	59	4.1%
5	Alcohol	58	4.0%
6	Unsafe water, sanitation, and hygiene	54	3.7%
7	Cholesterol	40	2.8%
8	Indoor smoke from solid fuels	39	2.6%
9	Iron deficiency	35	2.4%
10	Overweight	33	2.3%

RR of mortality overall and by cause associated with low weight-for-age

| Cause of Death	< -3 SD	< -2 to -3 SD	-1 to –2 SD	>-1 SD
Diarrhea	12.50	5.39	2.32	1.0
Pneumonia	8.09	4.03	2.01	1.0
Malaria	9.49	4.48	2.12	1.0
Measles	5.22	3.01	1.73	1.0
All-cause	8.72	4.24	2.06	1.0

Source: Caulfield LE et al. Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria, and measles. Am J Clin Nutr 2004;80:193-8.

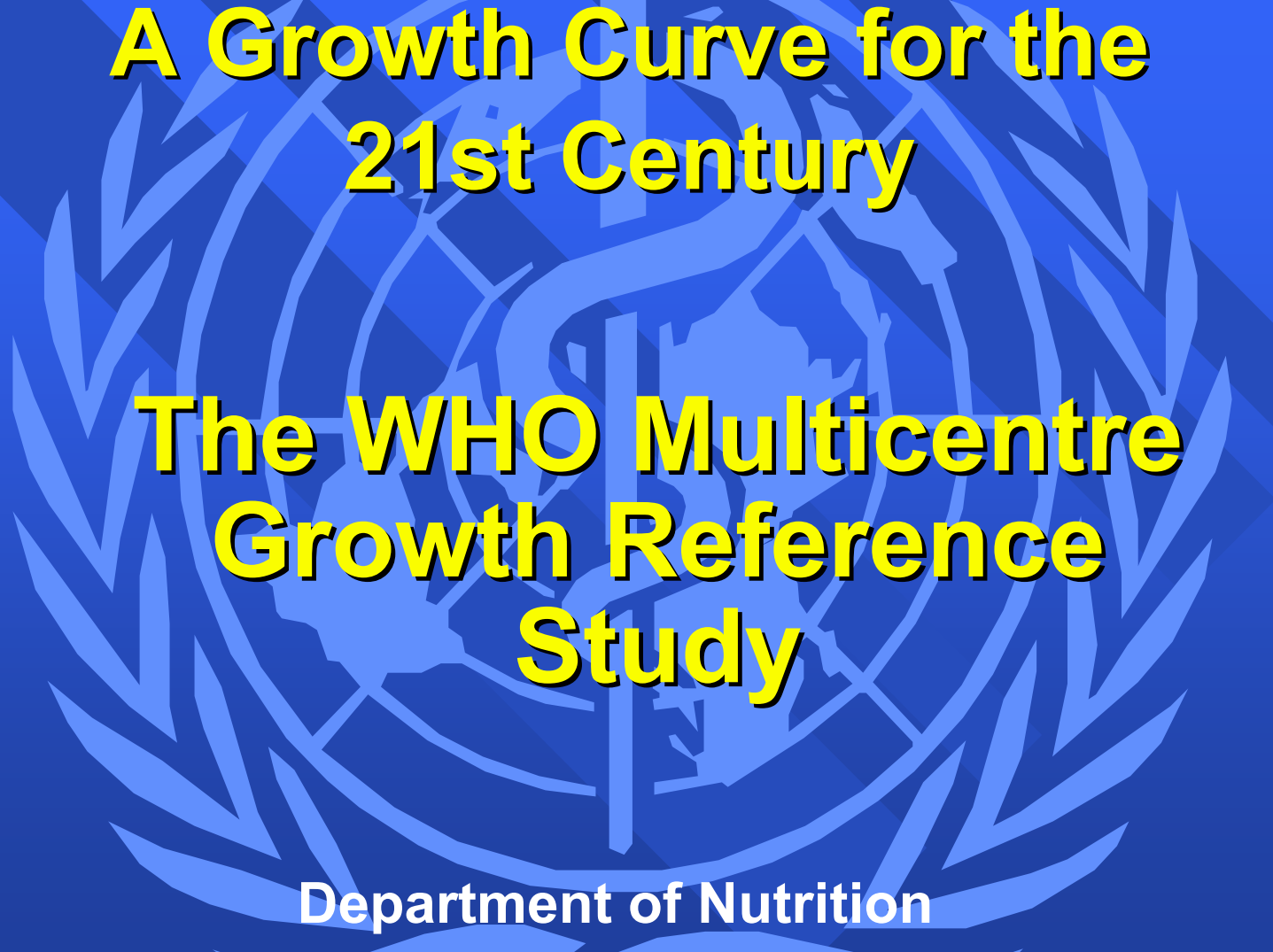# Mean Z-scores and prevalence by WA category according to WHO mortality Region

Region	Mean Z-score	Percent of Children in WA Category (%)			
		< -3 SD	> -3,< -2 SD	> -2,< -1 SD	> -1 SD,< 0
Afr D	-1.54	7.2	25.1	38.3	29.4
Afr E	-1.5	6.8	24.2	38.3	24.2
Amr A	0	0.1	2.1	13.6	34.1
Amr B	-0.35	0.5	4.5	20.8	37.9
Amr D	-0.84	1.6	10.8	31.3	36.3
Emr B	-0.6	0.8	7.3	26.3	38.1
Emr D	-1.33	4.7	20.4	37.8	27.9
Eur A	0	0.1	2.1	13.6	34.1
Eur B	-0.57	0.7	6.9	25.7	38.2
Eur C	-0.05	0.2	2.4	14.5	34.9
Sear B	-1.35	5.0	20.8	37.9	27.5
Sear D	-1.9	13.4	32.5	35.8	15.5
Wpr A	-0.22	0.3	3.5	18.0	36.9
Wpr B	-1	2.3	13.6	34.1	34.1

Mean Z-scores of infants in the "12-month breastfed pooled data set" relative to the NCHS/WHO reference
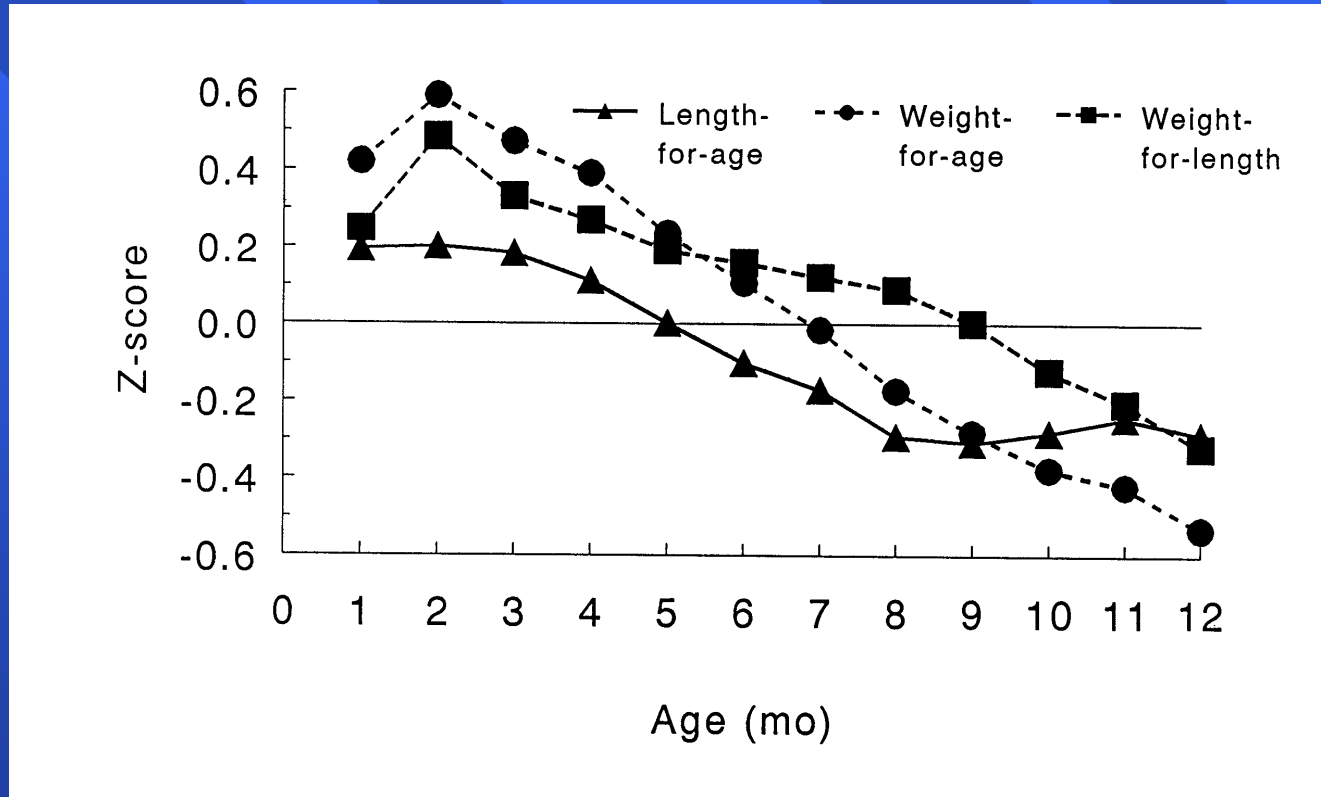
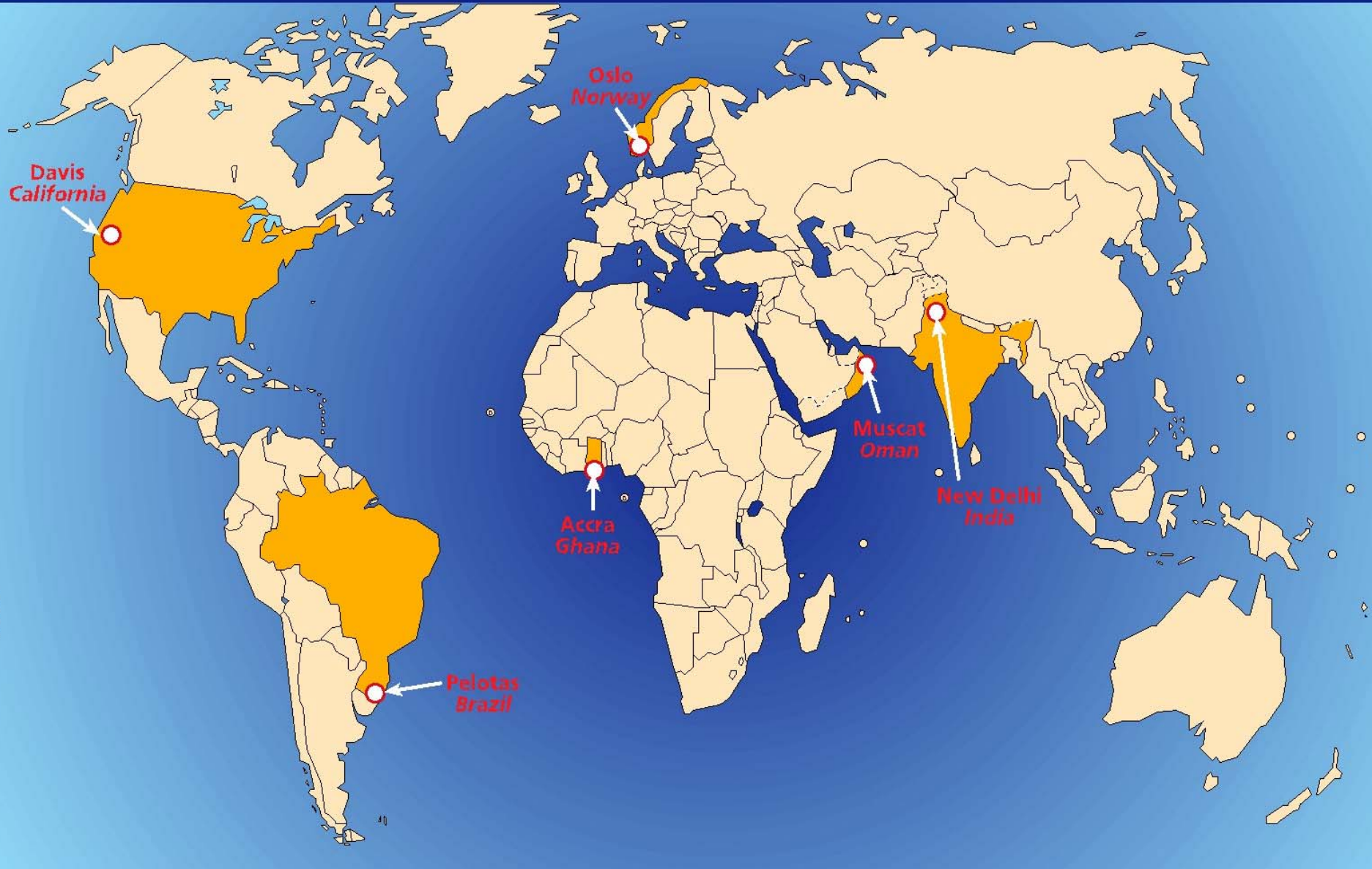Source: An Evaluation of Infant Growth. Geneva: Switzerland: WHO, 1994.

A Growth Curve for the 21st Century

The WHO Multicentre Growth Reference Study

Department of Nutrition

WHO MULTICENTRE GROWTH REFERENCE STUDY (MGRS)

Davis
California

Oslo
Norway

Muscat
Oman

New Delhi
India

Accra
Ghana

Pelotas
Brazil

Main features of the new International Growth Reference

- ● **Prescriptive (versus descriptive) reference**

- ● **International sample**

- ● **Breastfed infants**

- ● **Healthy populations with unconstrained growth**

WHO Multicentre Growth Reference Study

Anthropometric protocols

- Anthropometric equipment

- Training of field workers

- Standardization sessions

- Measurement techniques

- Quality control during data collection (data verification, validation, completeness, etc.)

WHO Multicentre Growth Reference Study

Project timeline of the new international child growth standards