WHO Growth Standards and Clinical Assessment of Undernutrition

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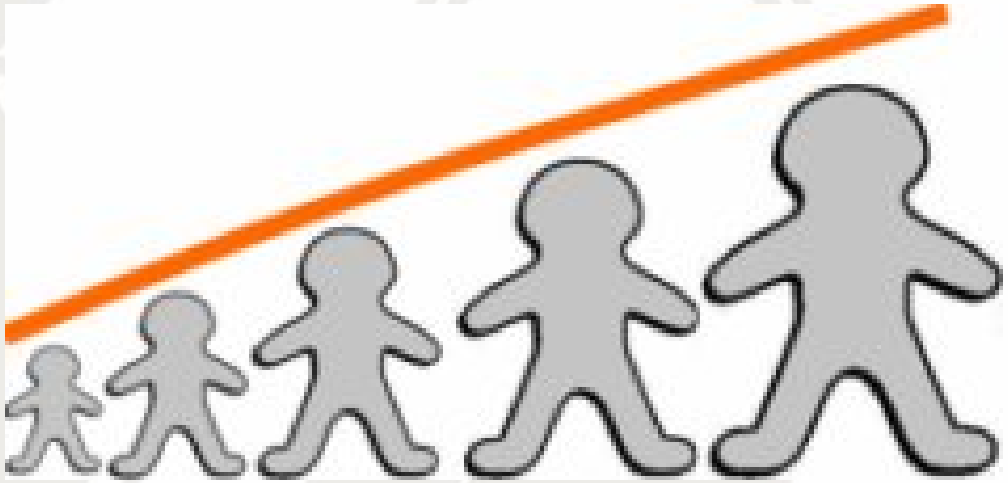
Objectives

- Understand the WHO Child Growth Standards, the principles behind their development, and compare to other growth standards
- Know the anthropometric measures to assess acute vs. chronic undernutrition and how to apply in a clinical setting

Presentation Outline

- **Growth reference charts**
  - Rationale of WHO Child Growth Standards
  - Differences between WHO and CDC charts
- **Classifying Undernutrition**
  - Importance of standard nutrition assessment
  - Acute and Chronic undernutrition



Growth Reference Curves

www.dcchildrens.com

Growth Reference Differences

	NCHS charts (1977)	CDC charts (2000)	WHO (2006)
Sample population	White, middle-class infants living in Ohio and Massachusetts (1929-1975)	Children living in US (1963-1994)	Children from California, Oman, Norway, Brazil, Ghana, and India (1997-2003)
Users	DHS, USAID, other countries, UN agencies	Pediatricians and researchers in U.S.	Normative; intended for global use, but dependent on host governments*
Infant feeding practices	Mixed breast and formula-fed	Representative of breastfeeding rates in US	Predominantly breastfed or exclusively breastfed for at least 4 months
Issues	•Restricted SES and race •Predominately bottle-fed •Limited measurements (birth,1,3,6,9,12,18,24mon) •Outdated precise curve fitting model •Disjunction at 24 months for length/height •Sample size varied by age	•Revised NCHS charts •Updated with NHANES data (periodic collection)	•BMI-for-age intended for examining obesity, but use unclear •Excludes large population •Cutoffs not functionally based •Not yet adopted in US

WHO Child Growth Standards - Rationale

- **Observations impetus for new study**
  - Breastfed infants grow differently
  - Growth not independent of infant feeding practices
  - Variability in growth at different ages
  - Disjunction in curves length/height
  - Advances made in technologies, design methods, and biostats can produce refined curves
  - Interethnic variability due to environment, not genetics

Optimal Growing Conditions : Study Site and Participant Selection

- **Study Site criteria**
  - Low infant mortality rate and <5% prevalence of stunting, wasting, and underweight at 12-23 months of age
  - Low mobility of target population to allow follow-up
  - Existence of breastfeeding support systems

- **Participant eligibility criteria**
  - Mother willing to follow feeding recommendations (see below)
  - Term birth, single birth, absence of significant co-morbidity
  - Non-smoking household

- **Infant Feeding**
  - Exclusive or predominant breastfeeding for at least 4 mo
  - Introduction of complementary foods at 6 mo
  - Partial breastfeeding for at least 12 months
  - Intensive lactational support provided

WHO Multicenter Growth Reference Study Map

WHO Child Growth Standards Study Design

Study population (n=8,440):

California, Oman, Norway, Brazil, Ghana, and India

- Longitudinal component with from birth - 24 months
  - Frequent measure in first 1.5 mo (birth weight, 1, 2, 4, 6 wks)
  - Monthly 2-12 mo; every two months from 12-24 mo
  - Overlap period of 6 mo to help correct for length/height measures
- Cross-sectional component from 18-71 months
  - Curves only go to 5 years, but need to account for growth variability in year 5

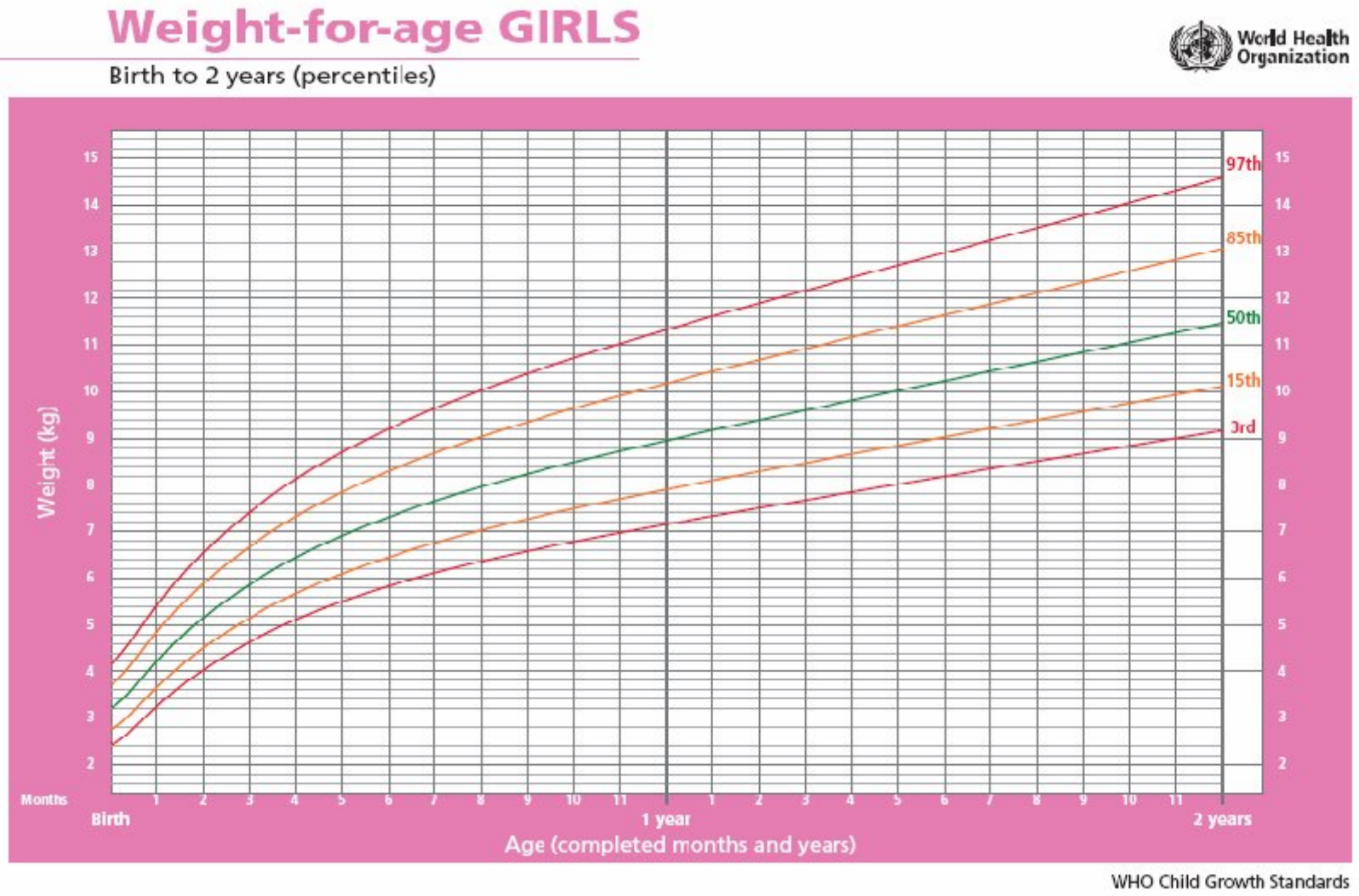
WHO Child Growth Standards

Rather than recommending an update of "how children are growing", this reference describes "how children *should* grow."

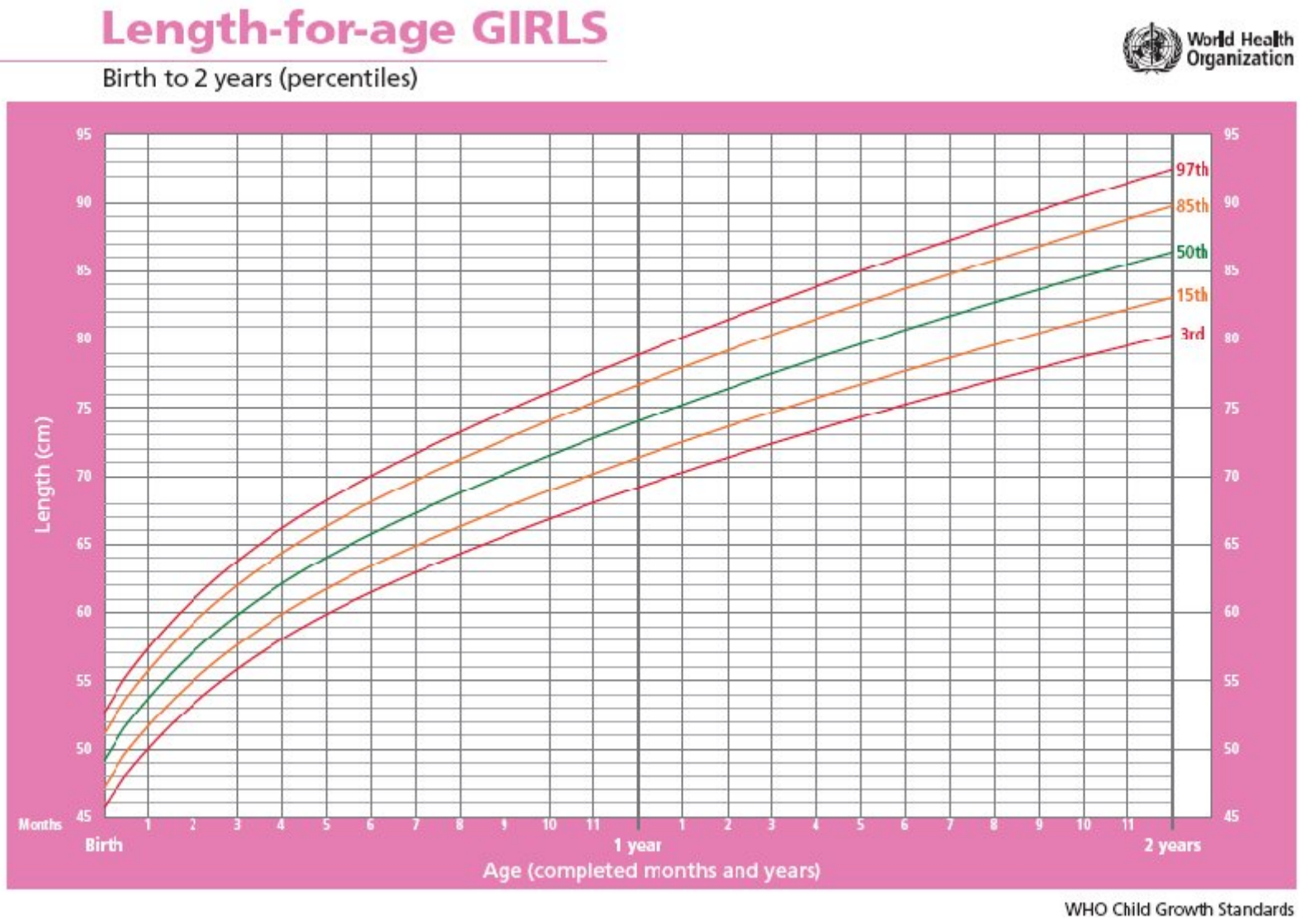
2006 : Curves published for 0-5 years

2007 : Curves published for 5-19 years (combined NCHS and WHO data)

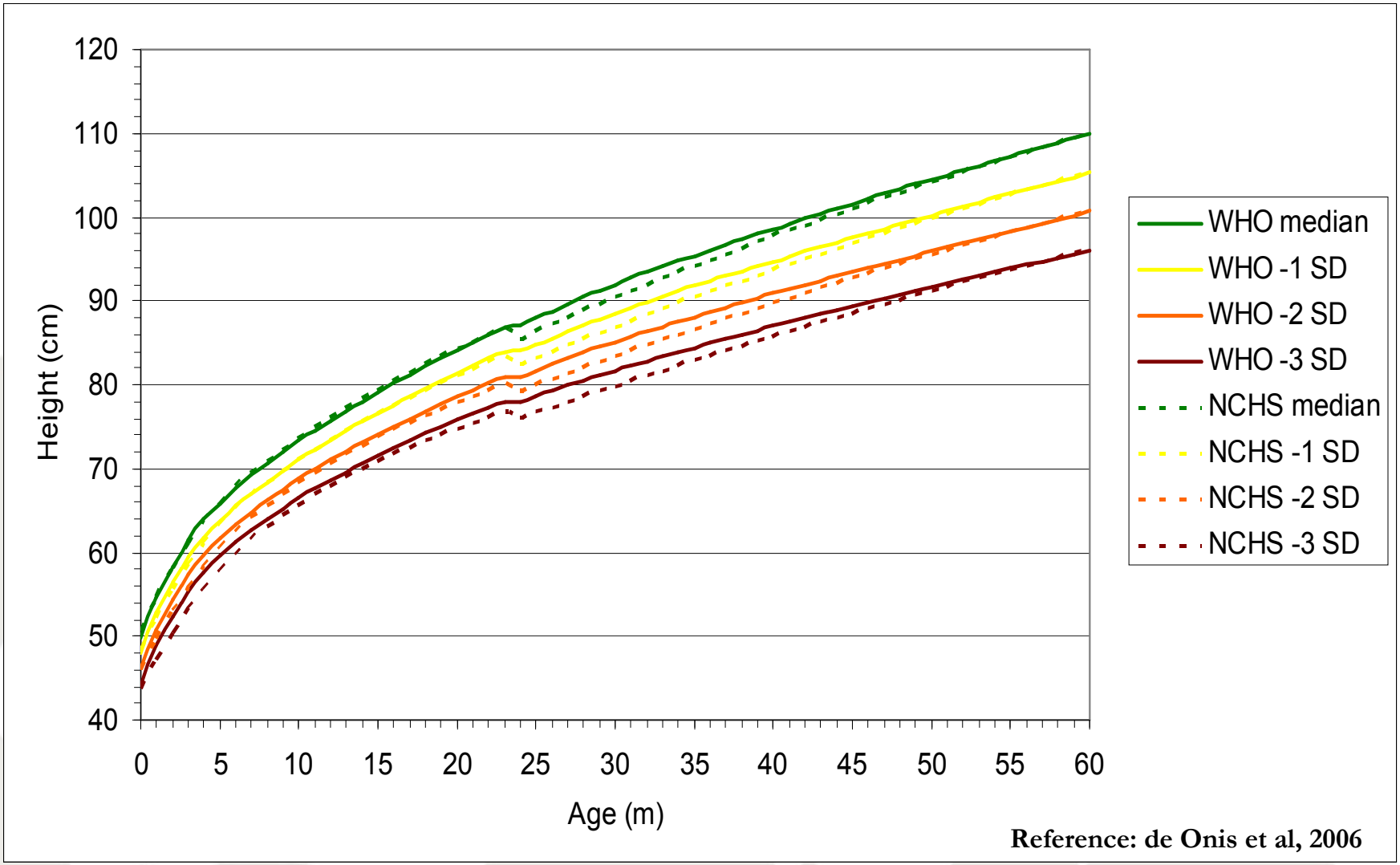
WHO Child Growth Standards



WHO Child Growth Standards



Comparison of NCHS and WHO: Boys length/height-to-age



Reference: de Onis et al, 2006

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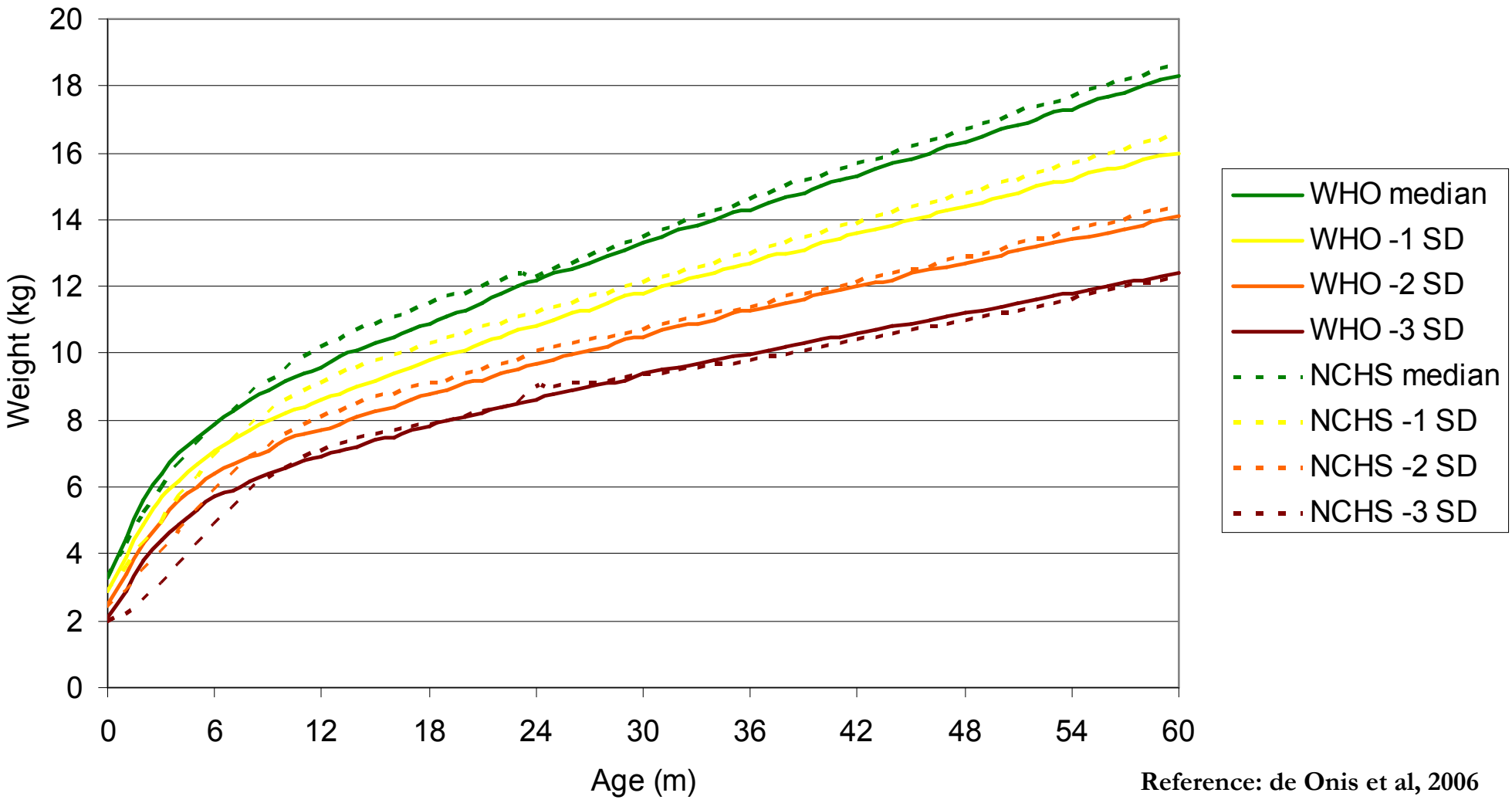

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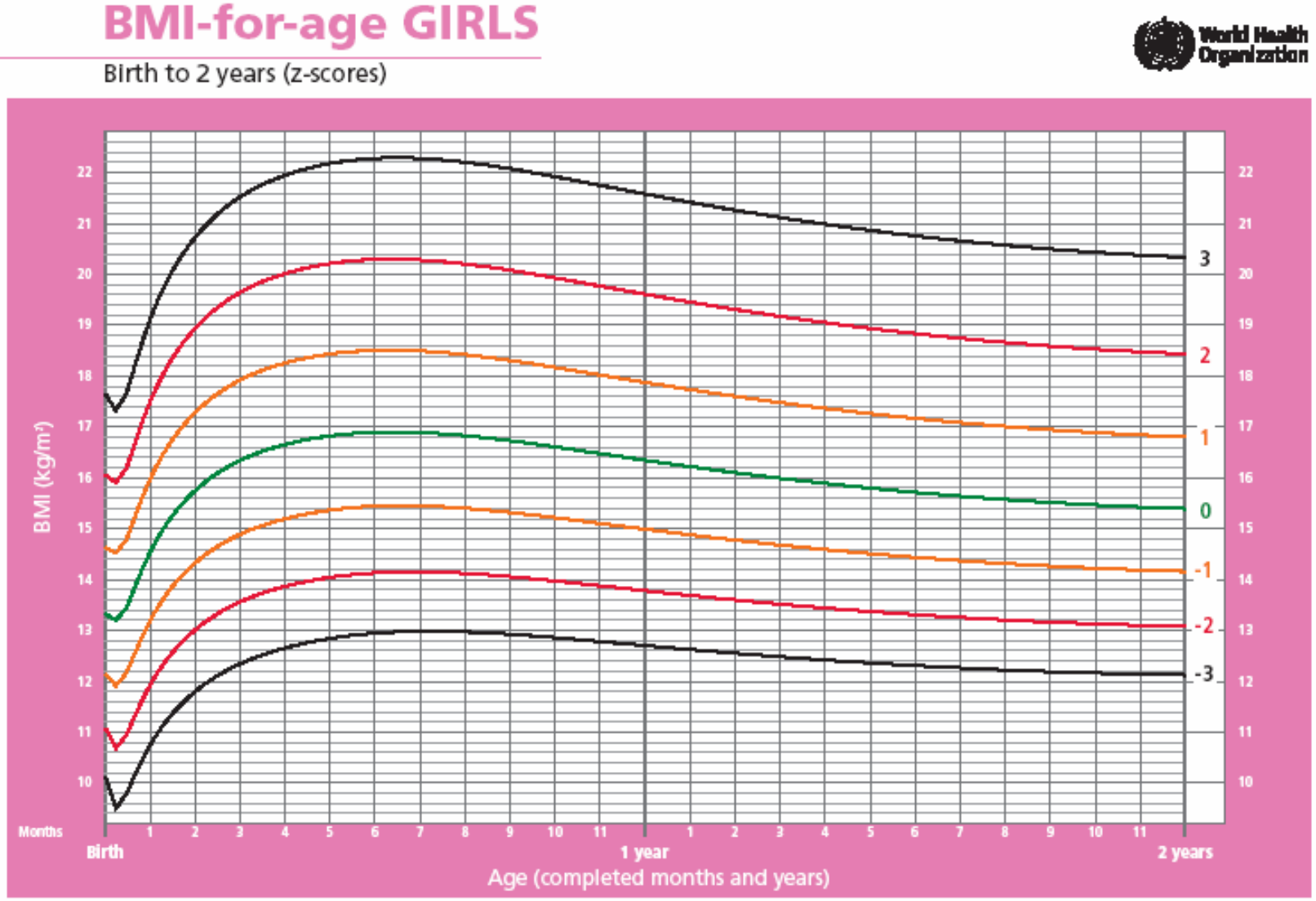
WHO Child Growth Standards Issues & Implications

- Results demonstrated that children in different regions can attain comparable standards of health, weight, and development; thus, environmental factors appear to be a principal determinant in growth distributions across populations
- Breastfeeding now considered the “biological norm”
- Intended to be globally representative, but some important populations not represented
- Population surveys by USAID (DHS) will likely report using both WHO standards (2006) and NCHS references

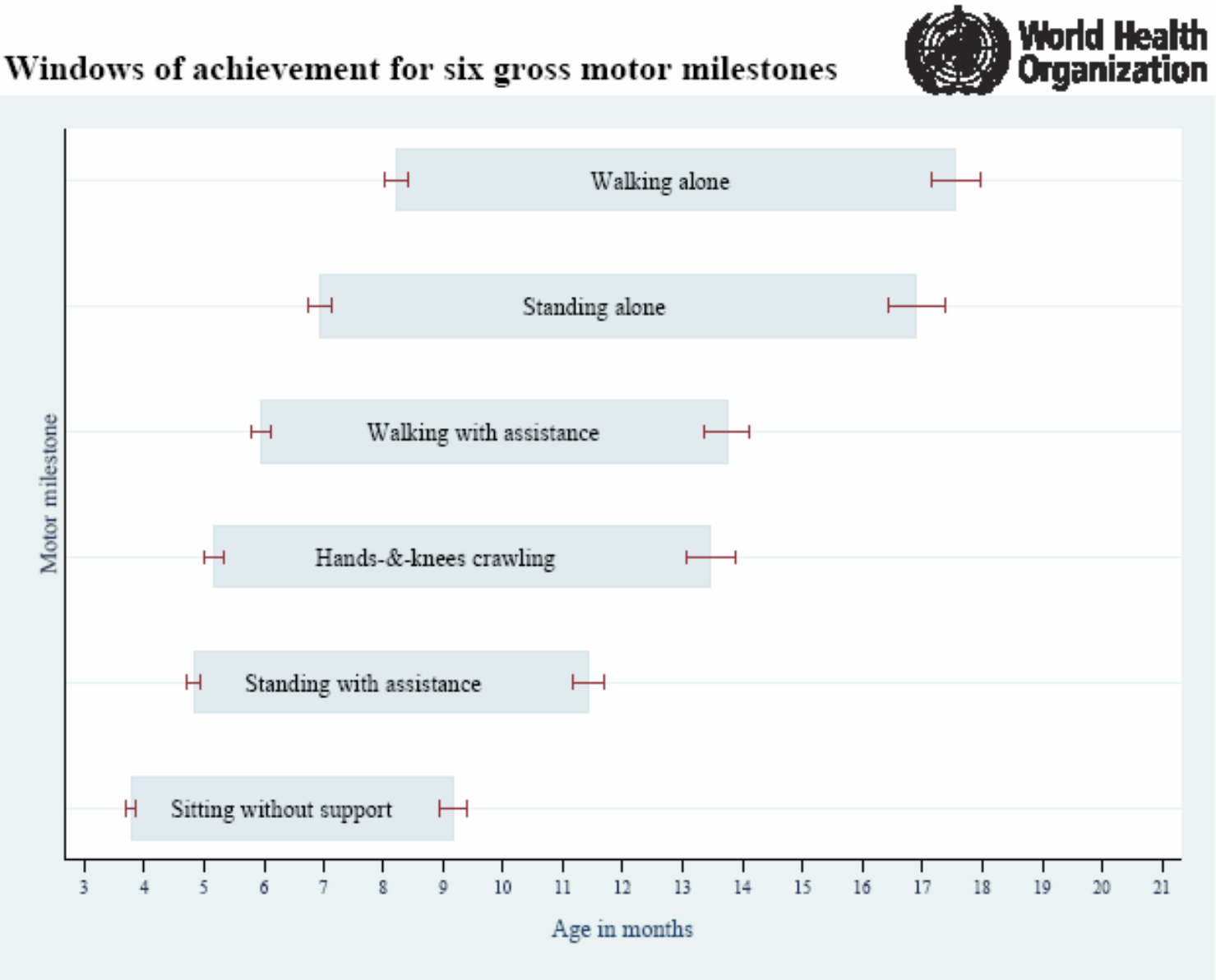
WHO Child Growth Standards
New Additions

- **Body Mass Index (BMI) Charts**
  - Infants to 5 years of age
  - Assessing healthy weight in children
- **Windows of Achievement**
  - Includes 6 key development milestones to link physical growth with motor development
- **WHO Reference 2007**
  - Growth data for 5-19 year olds
  - Reconstruction of the 1977 National Center for Health Statistics (NCHS)/WHO reference
  - Uses the original NCHS data set supplemented with data from the WHO child growth standards sample for under-fives

WHO Standards: BMI Chart



WHO Standard: Windows of Achievement



Reference: WHO Multicentre Growth Reference Study Group. WHO Motor Development Study: Windows of achievement for six gross motor development milestones. Acta Paediatrica Supplement 2006;450:86-95.

WHO Child Growth Standards (2006)

- **Available at:**

http://www.who.int/childgrowth/en

Nutritional Assessments: Acute and Chronic Undernutrition

Importance of Nutritional Assessment

- Programming implications
- Policy implications
- Targeting at-risk populations
- Effectively utilizing limited resources
- Monitoring and Evaluation (M&E) plan
- Funding organization may request

Methods: Measuring Length/Height

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Length for < 2 yrs – lying down

Height for ≥ 2 yrs – standing up

Methods: Measuring Weight

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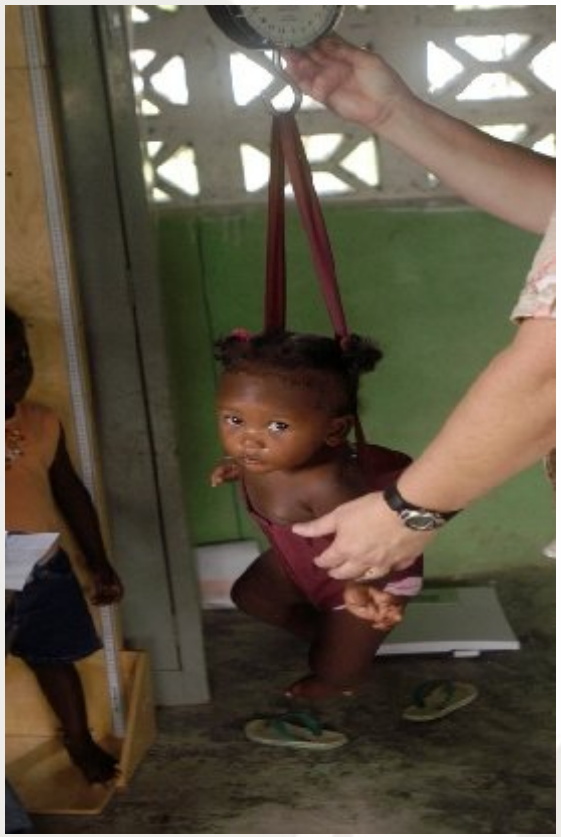
Measured with hanging scales or digital scales



Methods: Classifying Undernutrition

Acute Undernutrition: Wasting

How to assess?

WHO weight-for-height tables

Acute Undernutrition: WHO tables (< 120cm)

- Mild -1 to -2 SD
- Moderate -2 to -3 SD
- Severe > -3 SD

Child A:

Age 12 months

Weight 7.4 kg

Length 70.5cm

- Z-score between -1 and -2 SD

Simplified field tables

Weight-for-height GIRLS
2 to 5 years (z-scores)

World Health Organization

cm	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
65.0	5.6	6.1	6.6	7.2	7.9	8.7	9.7
65.5	5.7	6.2	6.7	7.4	8.1	8.9	9.8
66.0	5.8	6.3	6.8	7.5	8.2	9.0	10.0
66.5	5.8	6.4	6.9	7.6	8.3	9.1	10.1
67.0	5.9	6.4	7.0	7.7	8.4	9.3	10.2
67.5	6.0	6.5	7.1	7.8	8.5	9.4	10.4
68.0	6.1	6.6	7.2	7.9	8.7	9.5	10.5
68.5	6.2	6.7	7.3	8.0	8.8	9.7	10.7
69.0	6.3	6.8	7.4	8.1	8.9	9.8	10.8
69.5	6.3	6.9	7.5	8.2	9.0	9.9	10.9
70.0	6.4	7.0	7.6	8.3	9.1	10.0	11.1
70.5	6.5	7.1	7.7	8.4	9.2	10.1	11.2
71.0	6.6	7.1	7.8	8.5	9.3	10.3	11.3
71.5	6.7	7.2	7.9	8.6	9.4	10.4	11.5
72.0	6.7	7.3	8.0	8.7	9.5	10.5	11.6
72.5	6.8	7.4	8.1	8.8	9.7	10.6	11.7
73.0	6.9	7.5	8.1	8.9	9.8	10.7	11.8
73.5	7.0	7.6	8.2	9.0	9.9	10.8	12.0
74.0	7.0	7.6	8.3	9.1	10.0	11.0	12.1
74.5	7.1	7.7	8.4	9.2	10.1	11.1	12.2
75.0	7.2	7.8	8.5	9.3	10.2	11.2	12.3
75.5	7.2	7.9	8.6	9.4	10.3	11.3	12.5
76.0	7.3	8.0	8.7	9.5	10.4	11.4	12.6
76.5	7.4	8.0	8.7	9.6	10.5	11.5	12.7
77.0	7.5	8.1	8.8	9.6	10.6	11.6	12.8
77.5	7.5	8.2	8.9	9.7	10.7	11.7	12.9
78.0	7.6	8.3	9.0	9.8	10.8	11.8	13.1
78.5	7.7	8.4	9.1	9.9	10.9	12.0	13.2
79.0	7.8	8.4	9.2	10.0	11.0	12.1	13.3
79.5	7.8	8.5	9.3	10.1	11.1	12.2	13.4

7.4

Methods: Classifying Undernutrition

Chronic Undernutrition: Stunting

How to assess?

WHO height-for-age tables

Chronic Undernutrition

- Mild -1 to -2 SD
- Moderate -2 to -3 SD
- Severe > -3 SD

Child A:

Age 7 years, 3 months

Height 109.5cm

- Z-score is between -2 and -3 SD

www.dechildrens.com

Simplified field tables

Height-for-age GIRLS
5 to 19 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
5: 1	61	95.3	100.1	104.8	109.6	114.4	119.1	123.9
5: 2	62	95.7	100.5	105.3	110.1	114.9	119.7	124.5
5: 3	63	96.1	101.0	105.8	110.6	115.5	120.3	125.2
5: 4	64	96.5	101.4	106.3	111.2	116.0	120.9	125.8
5: 5	65	97.0	101.9	106.8	111.7	116.5	121.5	126.4
5: 6	66	97.4	102.3	107.2	112.2	117.1	122.0	127.0
5: 7	67	97.8	102.7	107.7	112.7	117.6	122.6	127.6
5: 8	68	98.2	103.2	108.2	113.2	118.2	123.2	128.2
5: 9	69	98.6	103.6	108.6	113.7	118.7	123.7	128.8
5: 10	70	99.0	104.0	109.1	114.2	119.2	124.3	129.3
5: 11	71	99.4	104.5	109.6	114.6	119.7	124.8	129.9
6: 0	72	99.8	104.9	110.0	115.1	120.2	125.4	130.5
6: 1	73	100.2	105.3	110.5	115.6	120.8	125.9	131.1
6: 2	74	100.5	105.7	110.9	116.1	121.3	126.4	131.6
6: 3	75	100.9	106.1	111.3	116.6	121.8	127.0	132.2
6: 4	76	101.3	106.6	111.8	117.0	122.3	127.5	132.7
6: 5	77	101.7	107.0	112.2	117.5	122.8	128.0	133.3
6: 6	78	102.1	107.4	112.7	118.0	123.3	128.6	133.9
6: 7	79	102.5	107.8	113.1	118.4	123.8	129.1	134.4
6: 8	80	102.9	108.2	113.6	118.9	124.3	129.6	135.0
6: 9	81	103.2	108.6	114.0	119.4	124.8	130.2	135.5
6: 10	82	103.6	109.0	114.5	119.9	125.3	130.7	136.1
6: 11	83	104.0	109.5	114.9	120.3	125.8	131.2	136.7
7: 0	84	104.4	109.9	115.3	120.8	126.3	131.7	137.2
7: 1	85	104.8	110.3	115.8	121.3	126.8	132.3	137.8
7: 2	86	[illegible]	[illegible]	116.2	121.8	127.3	132.8	138.3
7: 3	87	[illegible]	[illegible]	116.7	122.2	127.8	133.3	138.9
[illegible]	88	[illegible]	[illegible]	117.1	122.7	128.3	133.9	139.4
7: 5	89	106.4	112.0	117.6	123.2	128.8	134.4	140.0
7: 6	90	106.8	112.4	118.0	123.7	129.3	134.9	140.6

109.5

Mid-Upper Arm Circumference (MUAC) Measurements

- **MUAC measurements have traditionally been used in *emergency* situations as a *rapid* means of assessing population levels of wasting, or acute malnutrition**

- **MUAC is considered easier when the collection of height and weight measurements are difficult**

- **MUAC is an indicator of muscle growth**

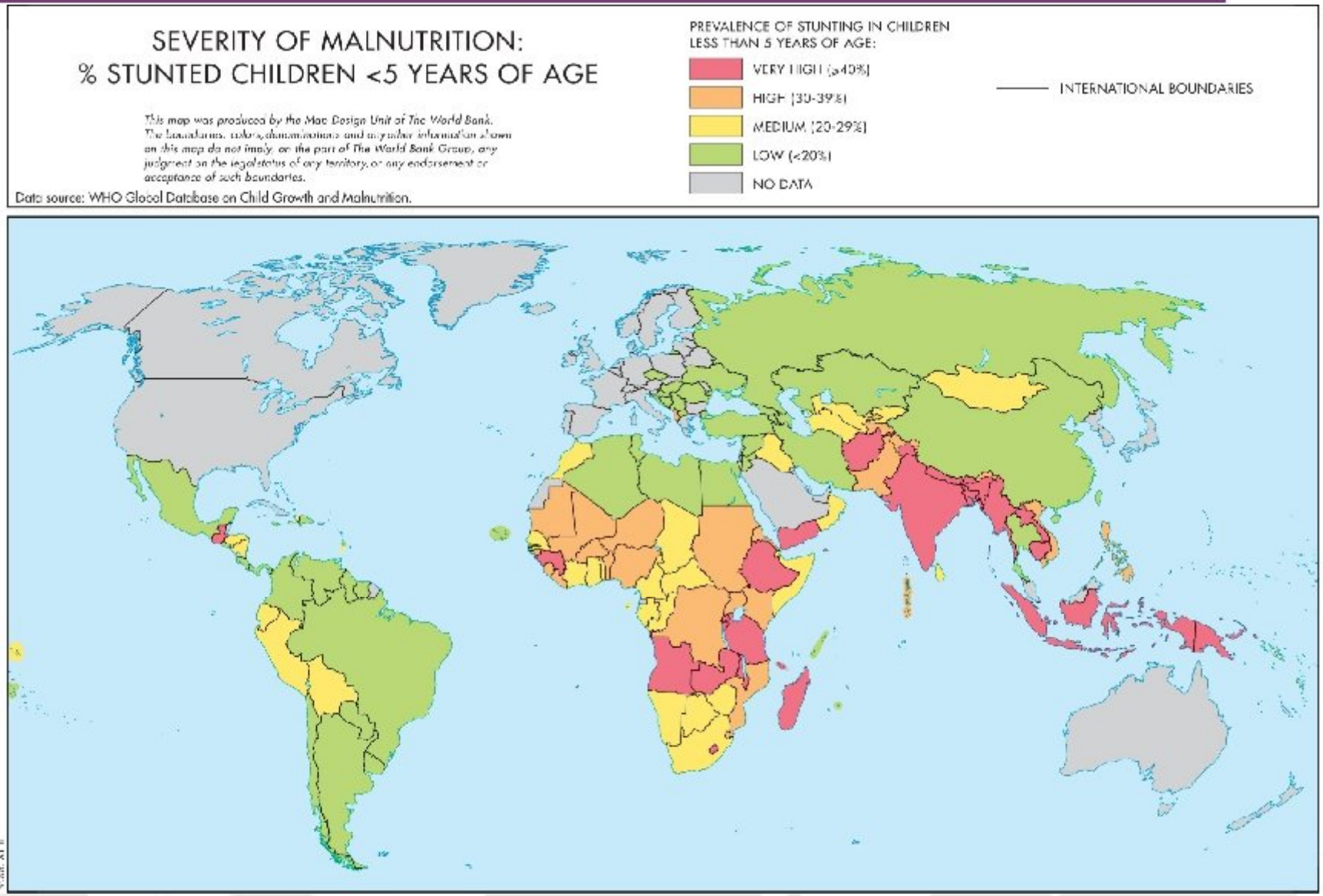
MUAC Methodology

- Left arm is usually measured by convention
- Tape measure is same as for HC measurements
- Point is marked midway between the acromion (shoulder) and olecranon (elbow) when arm is bent at a right angle
- Measurement is made with arm hanging loose at the side
- Tape is passed around the arm at the marked level and tightened so it touches, but does not compress the skin

MUAC Limitations

- Single cut-off point to identify malnourished children under 5 years
- Based on Polish children in 1960
- Controversy whether MUAC is age and sex dependent
- MUAC-for-age references established
- MUAC-for-height references established
- Recommended for assessment in emergency situations

Global Undernutrition



Questions?