TRAINING FOR IMPROVED PRACTICE:
Public Health and Nutrition in Emergencies

Basic Concepts: Epidemiology and Anthropometry For Use in Complex Emergencies

- UNICEF Core Corporate Commitments Training In collaboration with:

Feinstein International Famine Center, Tufts University

Mailman School of Public Health, Columbia University

International Emergency and Refugee Health Branch, Centers for Disease Control

"It is not the *type* of illness but rather the *incidence* and *high mortality rates* that make these populations remarkable"

Toole & Waldman

"Many of the deaths reported under 'dysentery, diarrhea and enteric fevers' were in fact, starvation deaths."

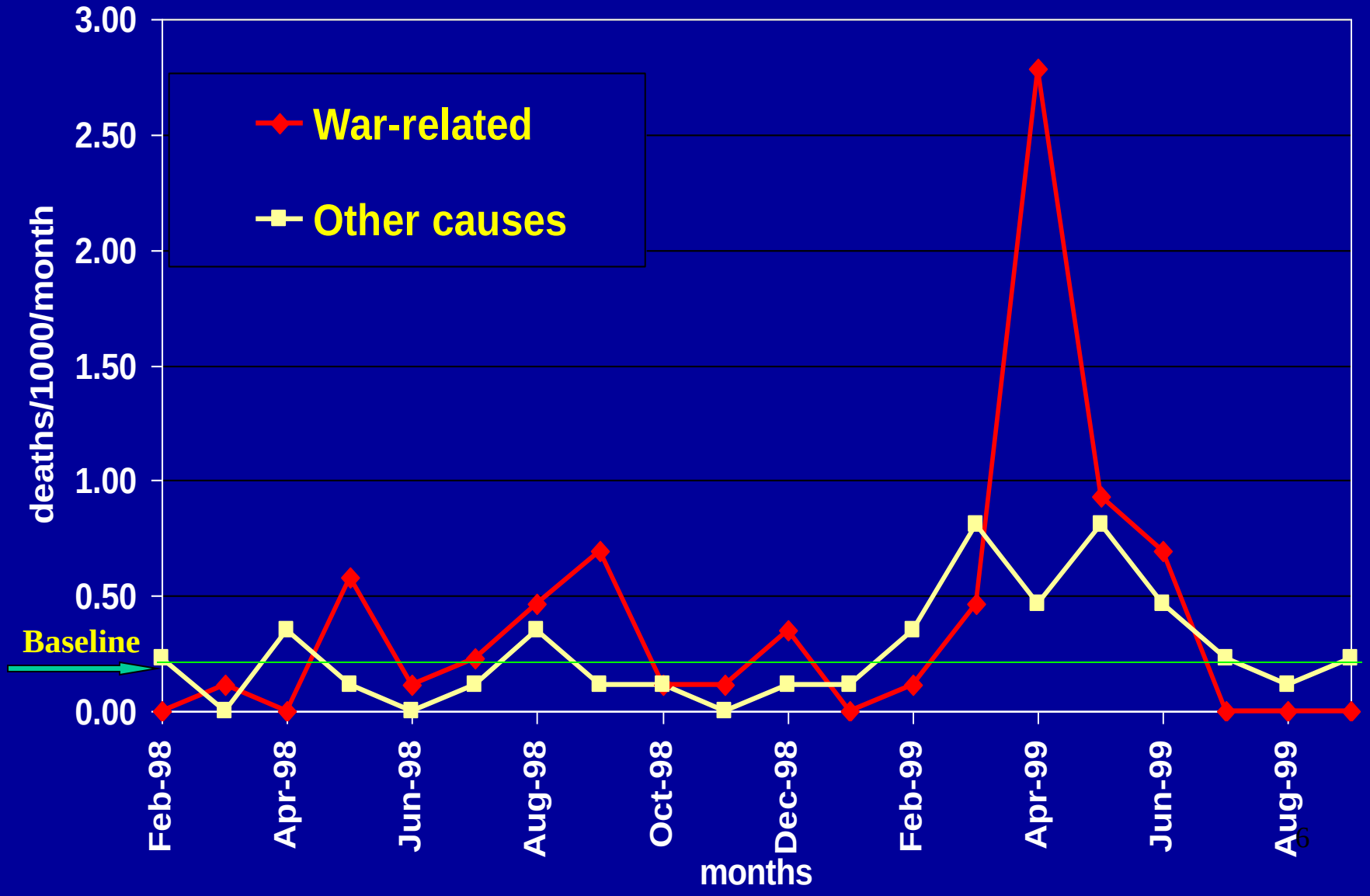
(Sen describing the Great Bengal famine of 1943)

What is epidemiology?

Definitions and Concepts

- **Epidemiology:**
  - **Study of the distribution and determinants of disease**
  - **Time, person, place**
  - **Population-based**

Mortality rates among Kosovar Albanians Feb 1998 to Sept 1999



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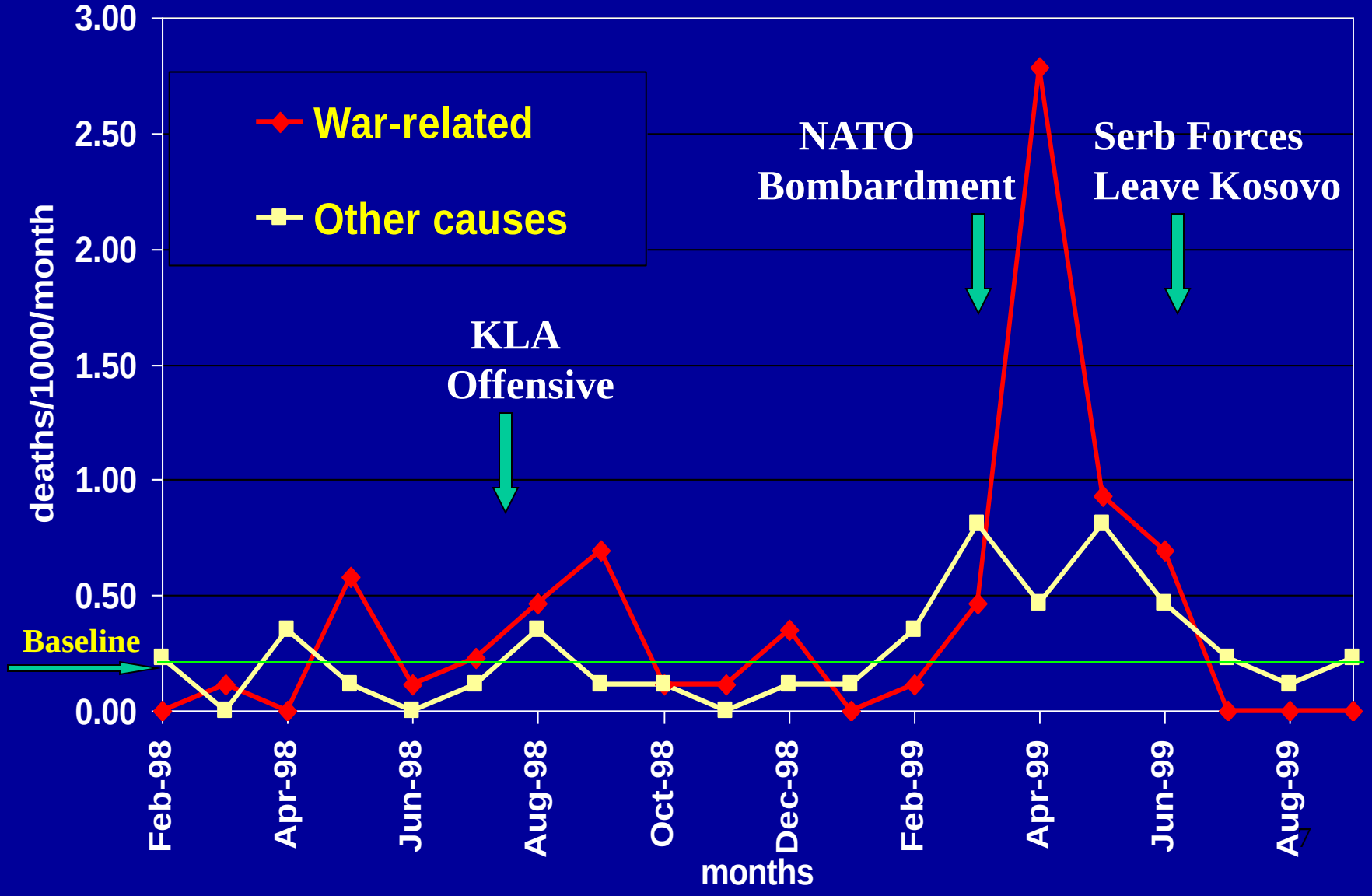


Age and sex specific mortality rates Feb 1998 - June 1999 (deaths/1000/month)

Age & Sex	War-related MR	Other cause MR
0-14 Male	0.04	0.09
0-14 Female	0.05	0.05
15-49 Male	0.80	0.11
15-49 Female	0.07	0.10
50+ Male	2.56	1.15
50+ Female	0.27	1.25

Relative risk for war-related mortality by age and sex, Feb 98 - June 99

Age & Sex	War-related MR (1000/month)	RR [95%CI]
15-49 Male	0.80	
15-49 Female	0.07	
		3.2 [2.0-5.2]
50+ Male	2.56	
50+ Female	0.27	

The Full Epidemiologic Picture

- Initial assessment
- Surveys
- Surveillance
- Monitoring and evaluation of information systems and programs

Methods of Data Collection

	Assessment	Survey	Surveillance
Objective	Rapid appraisal	Medium-term appraisal	Long-term appraisal
Data Type	Qualitative/ Cross sectional snapshot	Quantitative/ Cross sectional snapshot	Quantitative/ Longitudinal trends
Level of interest	Community	Household	Community
Method	Observational / Secondary source	Sample with survey instrument	Periodic or ongoing standardized data collection
Validity	+	++	+++

Outline:

- **Basic Concepts and Assessments:**
  - **Definitions and concepts**
  - **Indicators**
  - **Case study: Guinea, southern Sudan, China**
- **Surveys:**
  - **Methods**
  - **Critical analysis:**
    - **Case studies: Somalia, Ethiopia, North Korea, Afghanistan**
- **Surveillance:**
  - **Principles**
  - **Food security/nutrition case study**

Why collect epidemiological information?

Major Uses of Epidemiogical Data

- To characterize health/nutrition status
- To design interventions
- To target
- To monitor
- To evaluate interventions
- To advocate
- To build capacity

Definitions and Concepts

- **Complex Emergencies:**
  - **"Relatively** *acute* **situations that affect large civilian populations and usually involve a combination of war or civil strife,** *food shortages* **and population displacement that results in significant** *excess mortality***."**

(Toole MJ)

Indicators, Indices and Cut-Offs

- **Indicators:**
  - **Prevalence of wasting**
  - **Mortality rates**
- **Indices:**
  - **WH Z score or % median**
  - **Deaths/10,000/day**
- **Cut-Offs:**
  - **10% GAM**
  - **CMR > 1/10,000/day**

Indicators: Mortality Rates

- **Rates:**
  - **How often an event occurs, have a numerator, denominator and time dimension**

Background: Mortality Rates

- Important objective tool in assessment and monitoring
- First widely used in emergencies in 1980s
- Derivation: doubling of baseline mortality for SS Africa of 0.5/10,000/day, SE Asia tripling
- Evolve with phases of an emergency
- Ratio of <5MR:CMR important

Definitions and Concepts

- **Crude mortality rate (CMR)**
  - **> 1-2 deaths/ 10,000 people/day**

    Or
  - **> 3-6 deaths/ 1,000 people/month**

- **< 5 mortality rate (<5 MR)**
  - **> 2-4 deaths/ 10,000 children/day**

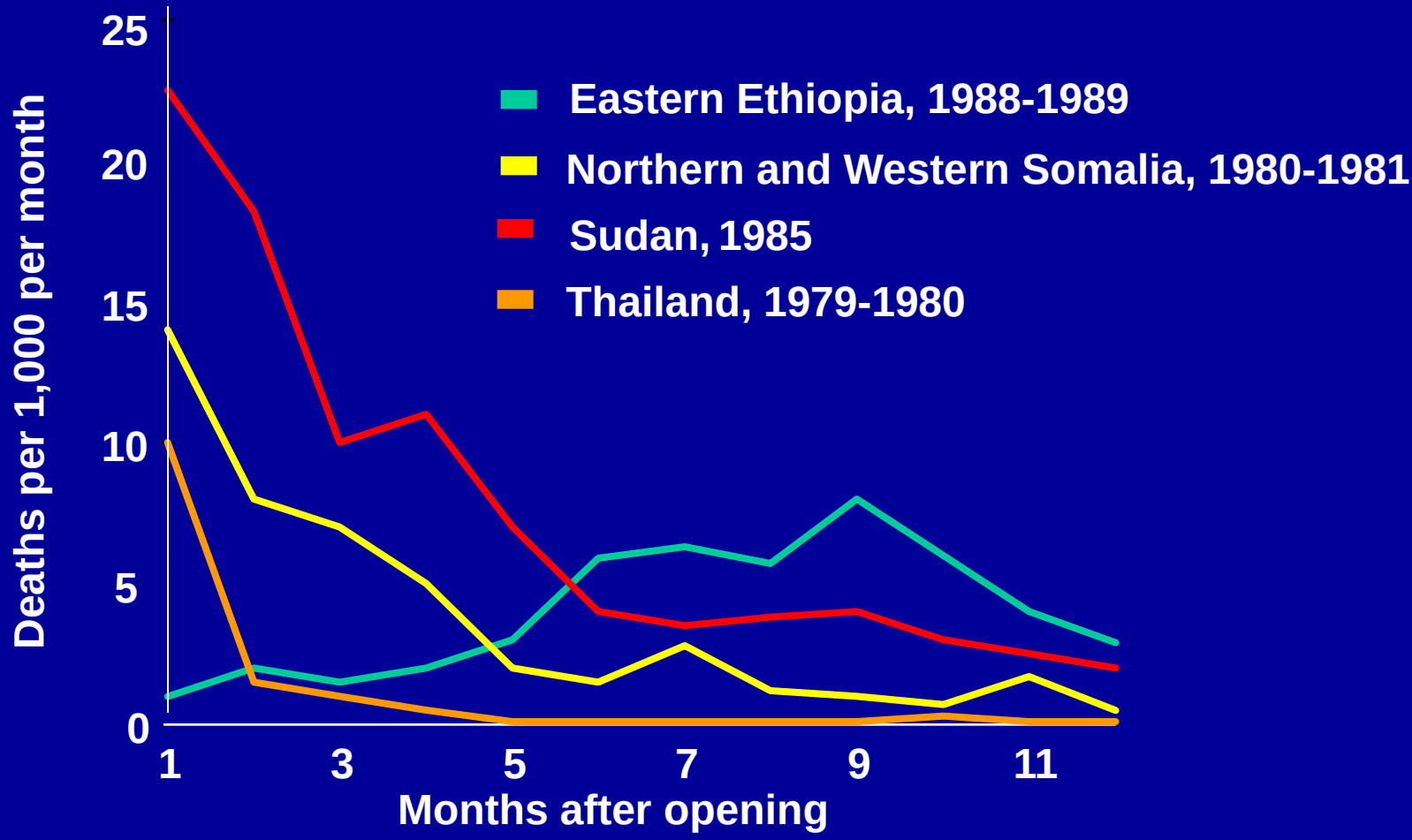
    Or
  - **> 6-12 deaths/ 1,000 children/month**

Crude Daily Mortality Rates
Emergency Phase: Deaths/10,000/day

Country	CMR*	Baseline
Thailand (1979)	10.7	0.5
Somalia (1980)	11.3	0.6
Sudan (1985)	10.1	0.6
Malawi (1986)	1.8	0.5
Ethiopia (1989)	2.4	0.6
Ethiopia (1991)	5.0	0.6
Northern Iraq (1991)	4.2	0.2
Kenya (1992)	7.4	0.6
Somalia (1992)	17.0	0.6
Zaire (1994)	30.0	0.5
Southern Sudan (1998)	20.0	0.6
Kosovo (1999)	1.0	0.1
Ethiopia (2000)	3.2	0.6

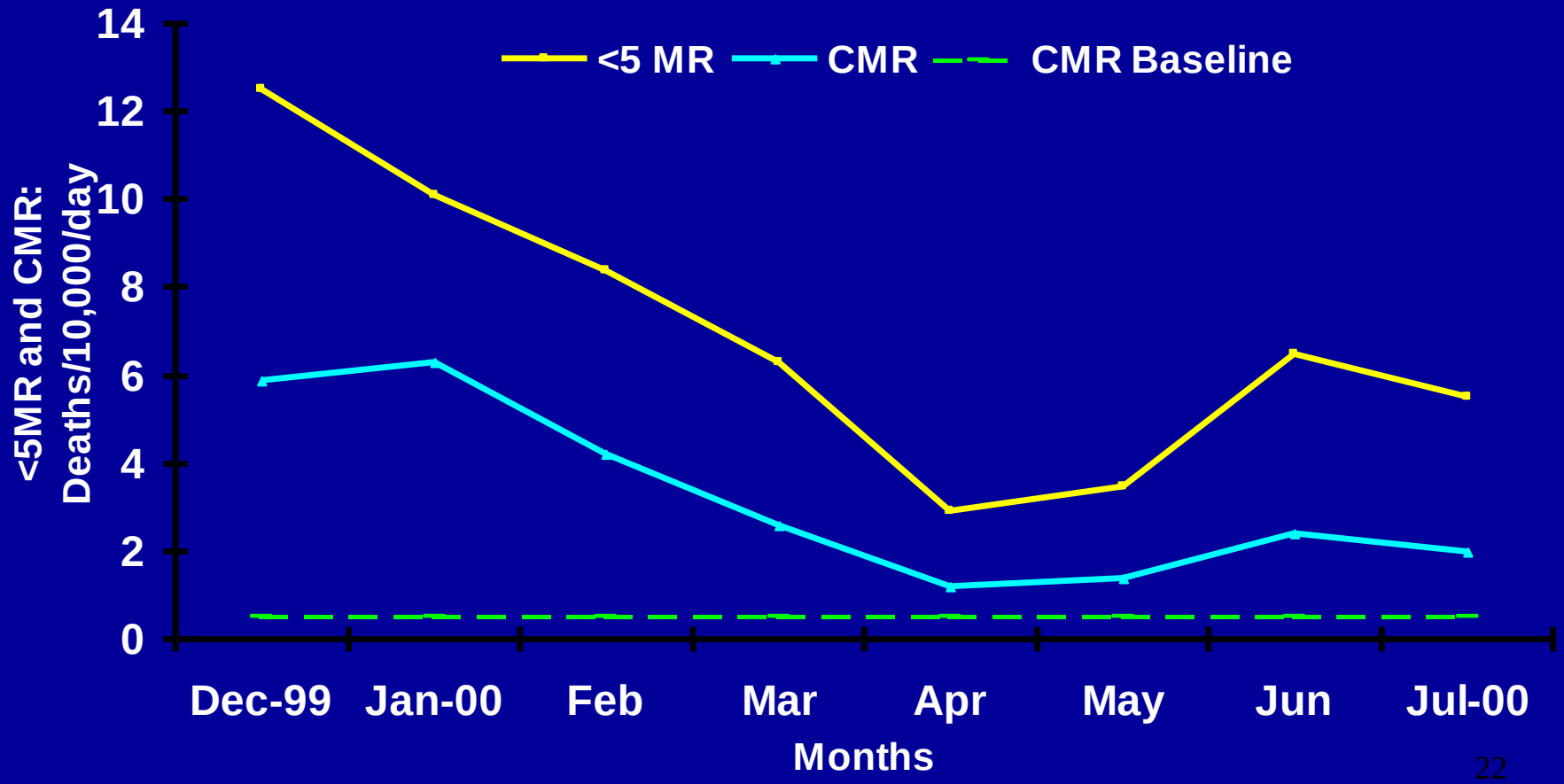
Source: U.S. Centers for Disease Control and Prevention

Crude Mortality Rates in Selected Refugee Camps, 1979-1989



Source: Centers for Disease Control and Prevention, Famine-Affected, Refugee, and Displaced Populations: Recommendations for Public Health Issues. *MMWR*, 1992;41(No. RR-13):7.

Time: Mortality Trends, Gode District, Ethiopia December 1999 - July 2000



How Do We Calculate CMRs?

What is the CMR and < 5 MR* in deaths/10,000/day if there were 91 deaths in a population of 33,000 persons over a 10 day period? Children <5 make-up 20% of population and 60 deaths were in children <5.

How Do We Calculate CMRs?

$$\text{CMR} = \frac{\text{total \# of deaths}}{\text{total population}} \times 10{,}000 / \text{No. days}$$

$$= \frac{91 \text{ deaths}}{33{,}000 \text{ people}} \times 10{,}000 / 10 \text{ days}$$

$$= 2.8 \text{ deaths} / 10{,}000 / \text{day}$$

How Do We Calculate <5 MRs?

CMR = total # of deaths x 10,000 / No. days
total <5 population

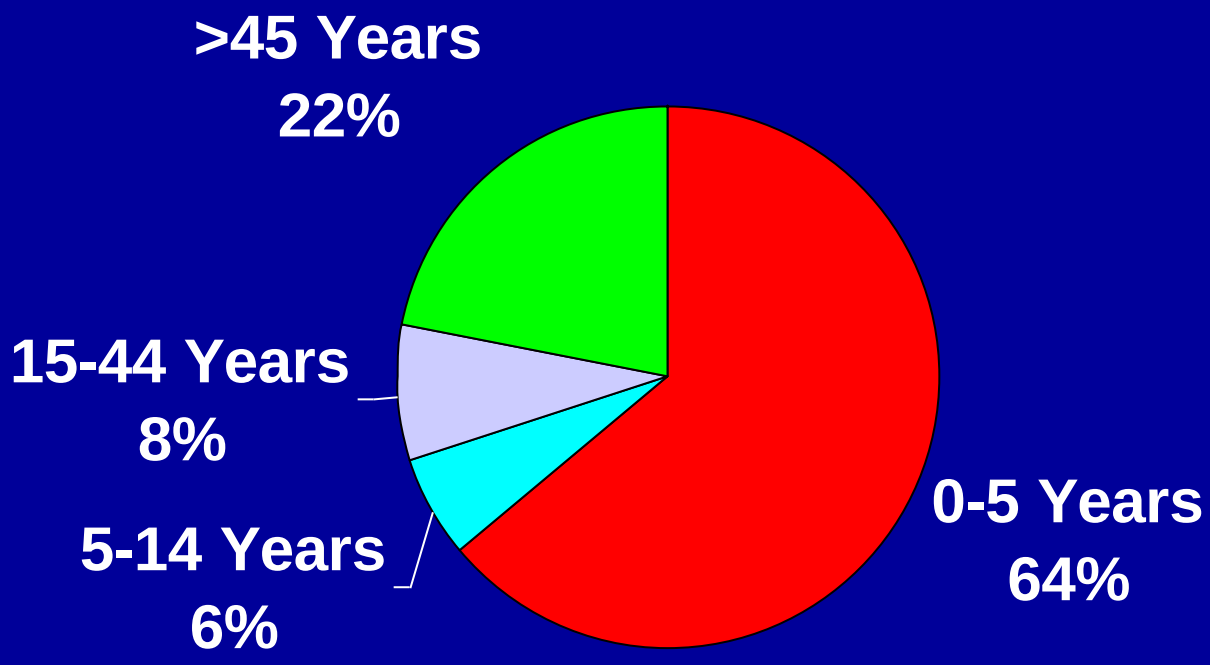
$$= \frac{60 \text{ deaths}}{6{,}600 \text{ people}} \times 10{,}000 / 10 \text{ days}$$

= 9.1 deaths / 10,000 / day

Person: Mortality and Morbidity; Who is dying

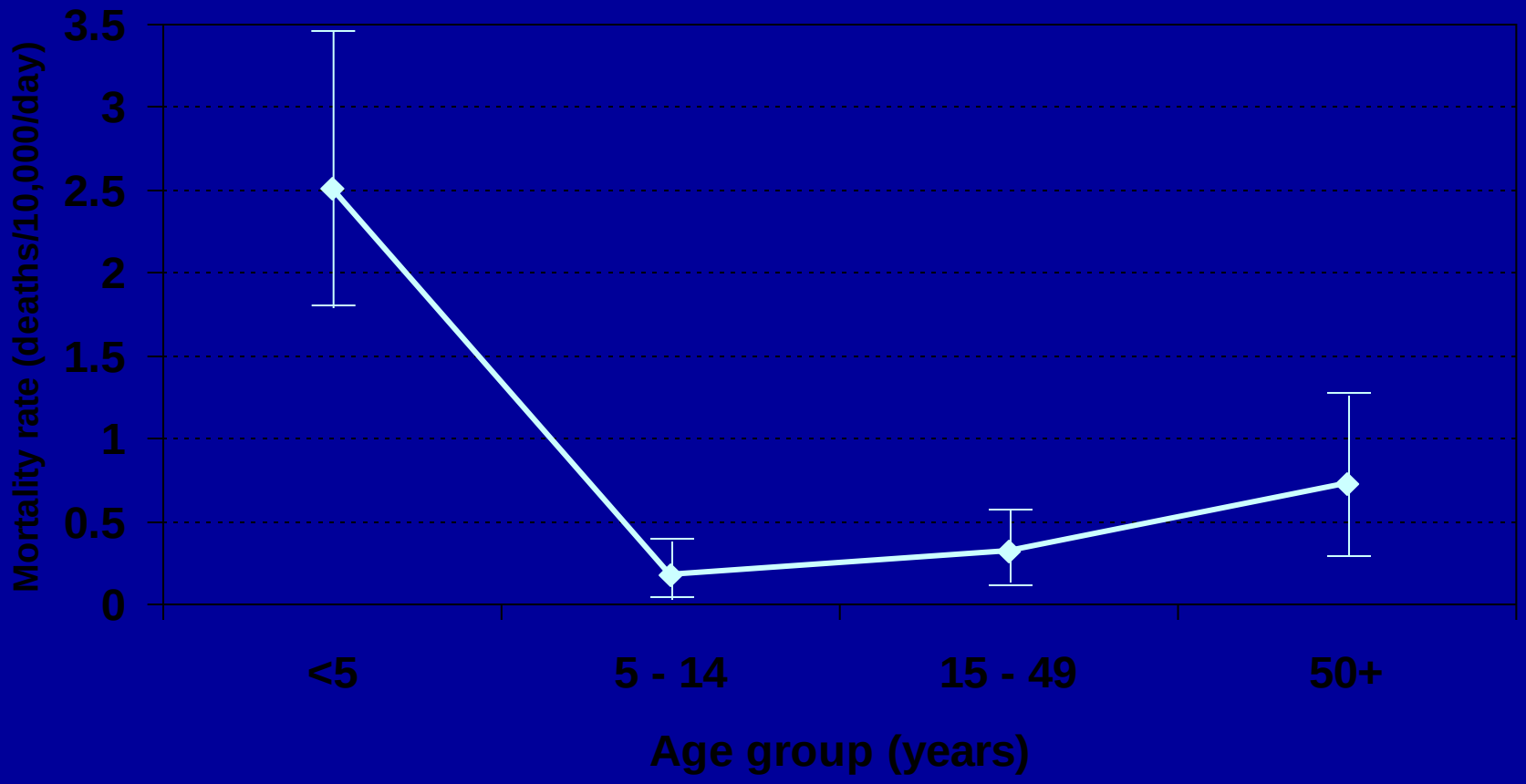
- **Vulnerable groups:**
  - **< 5 year old children**
  - **Pregnant and lactating women**
  - **Elderly**
  - **Entire communities**

Deaths by age, Kurdish refugees, March 1991, Turkey / Iraq border



Yip, R et al.

Mortality rates February 2001 – March 2002, by age – Badghis province, Afghanistan

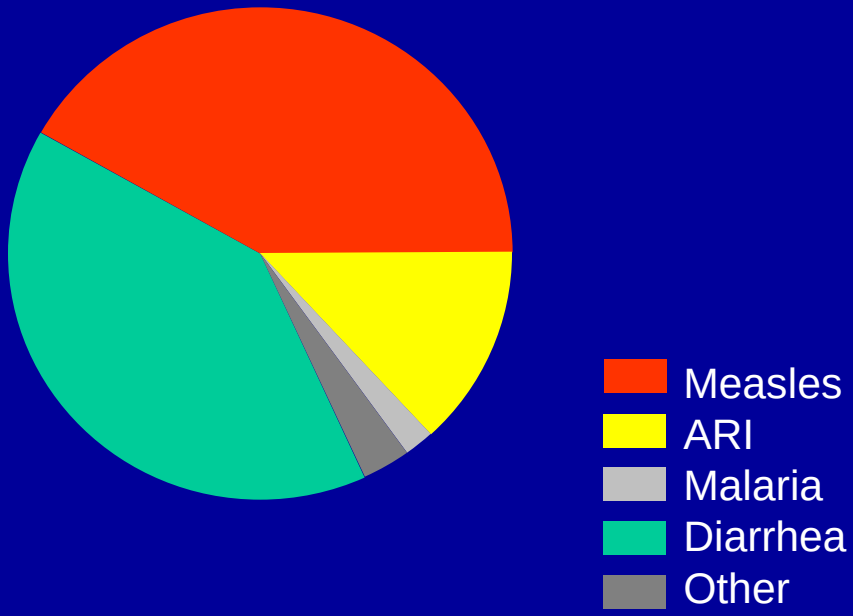


What is causing the mortality and morbidity?

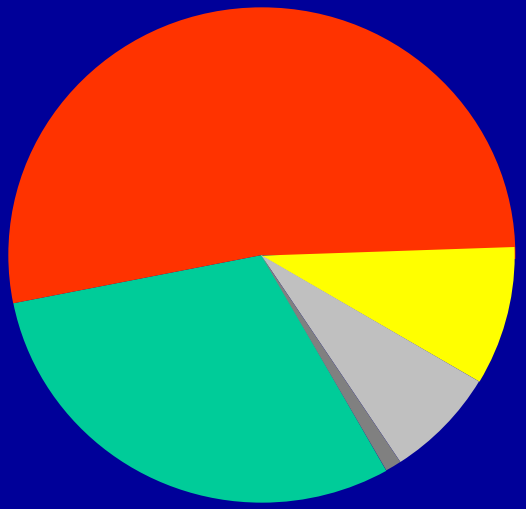
- **Major causes of death:**
  - ***Malnutrition***
  - **Measles**
  - **Diarrhoea**
  - **RTI**
  - **Malaria**

Major Causes of Death in Refugee Populations <5 Years

Somalia: Gedo Region, 7 Camps January, 1980

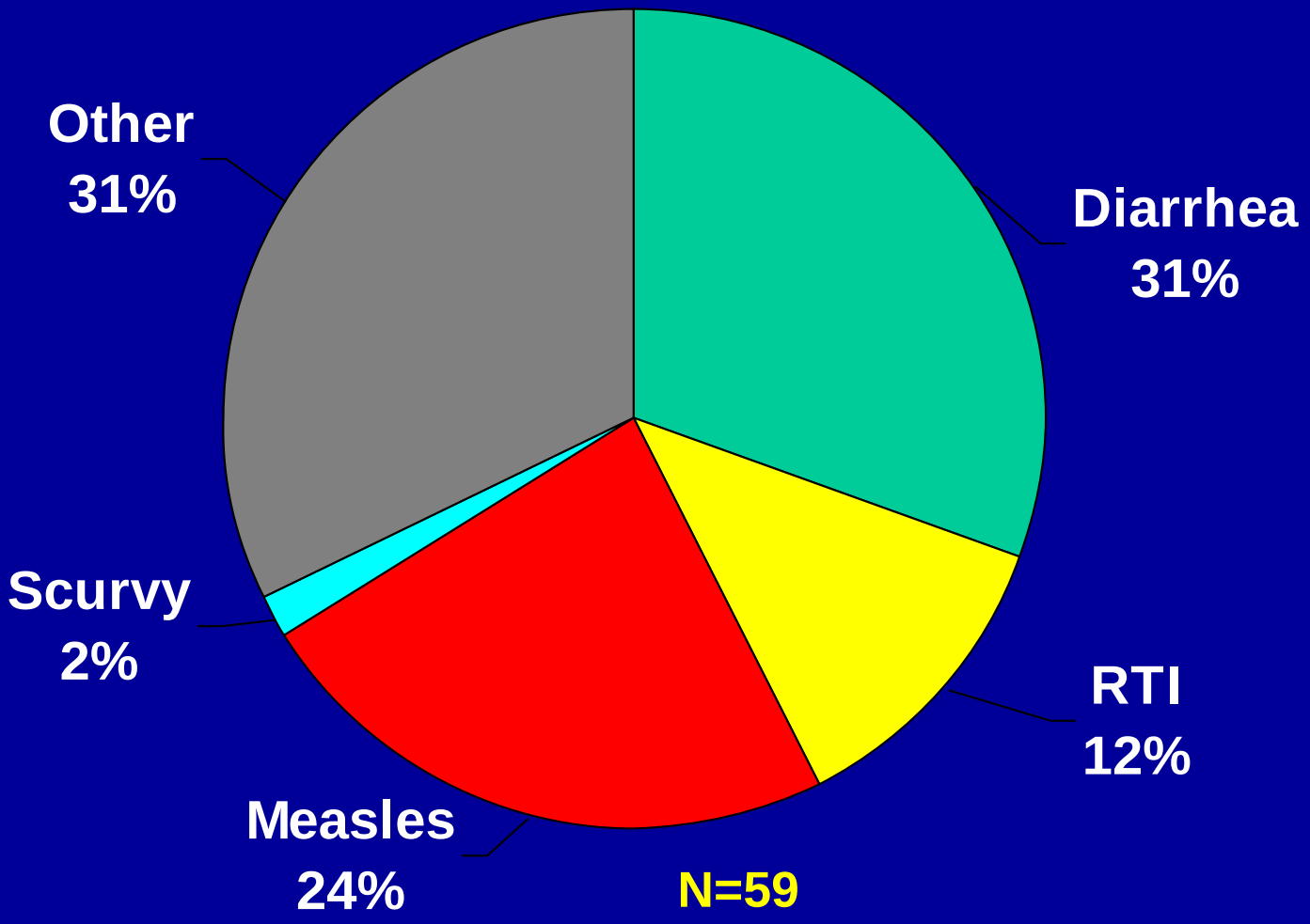


Sudan: Wad Kowli Camp February, 1985



Source: Centers for Disease Control and Prevention, Famine-Affected, Refugee, and Displaced Populations: Recommendations for Public Health Issues. MMWR, 1992;41(No. RR-13):8.

Causes of Death, Children < 5 yrs, Kohistan District, Afghanistan, April 2001



N=59

Source: SCF US / CDC/ UNICEF

Results of recent anthropometric surveys among children < 5 years in areas affected by severe drought 1999-2001

Country	Year	Prevalence of Wasting <-2 Z scores W/H	Organization
Georgia	2000	<2%	SCF/CDC
Mongolia	2001	<2%	CDC
Afghanistan	2001	6-12%	SCF/CDC/ACF
Ethiopia	2000-1	20 - 40%	SCF/CDC/NGOS
Kenya	2000-1	20 - 40%	WV
Somalia	2001	20 - 40%	Care
Southern Sudan	2001	20 - 40%	Tear fund, MSF

BASIC CONCEPTS – Anthropometry in emergencies

Nutritional indices are constructed from a combination of measurements, while nutritional indicators relate to the use or application of indices in practice (Q1.) *True/False?*

Can you think of examples of common measures used to calculate nutritional indices? (Q2)

Age; Height; Length; Weight and Mid Upper Arm circumference

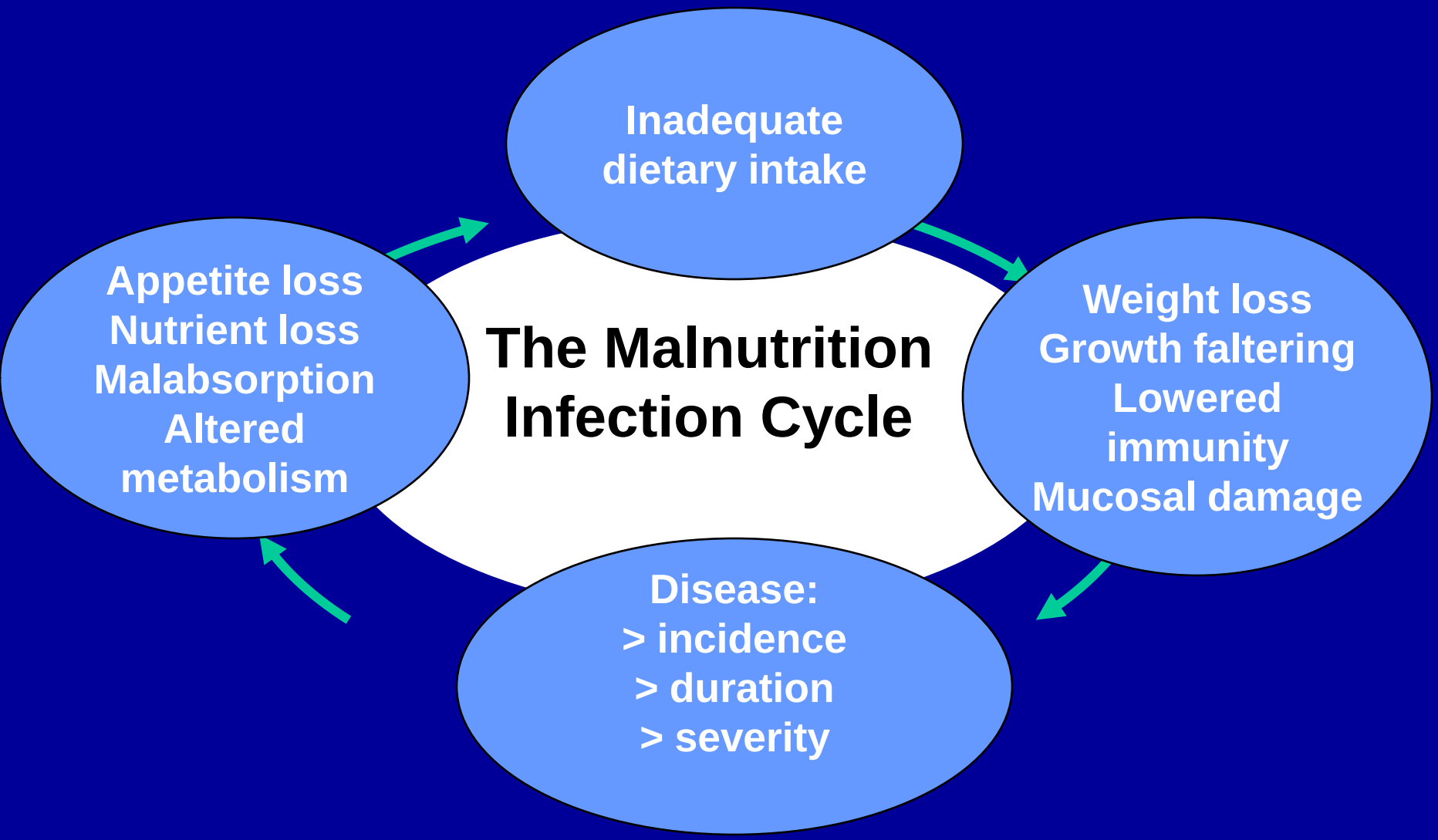
Indices

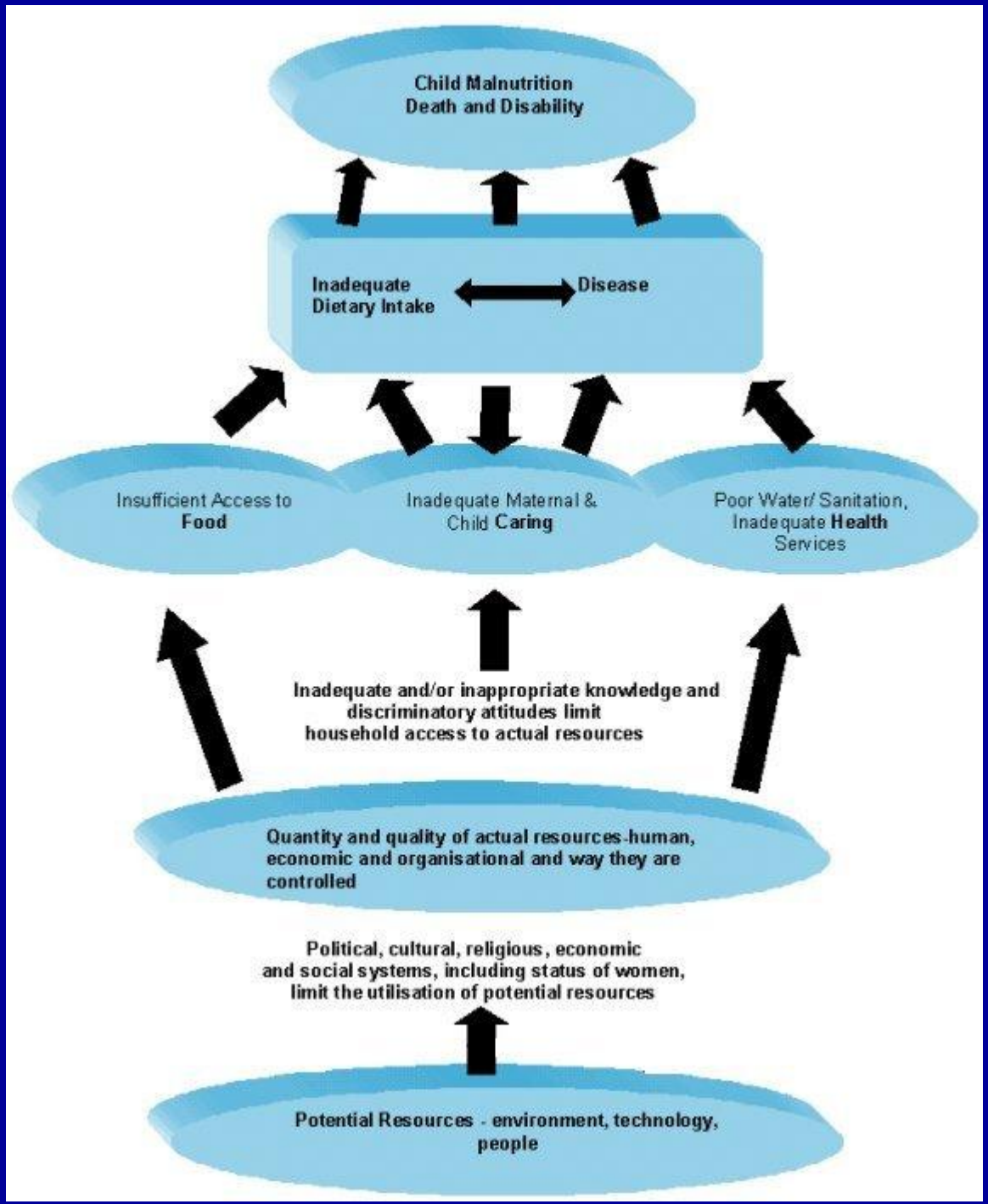
- Simple to measure and interpret
- Easy to teach
- Relevant for emergencies:predicts mortality
- Reproducible/ low observer error
- Valid
- International standards

Causes of Malnutrition

In famine situations, epidemics are just as likely to contribute to high prevalence of malnutrition among children under five, as food shortages. (Q 3)

True/False?


Inadequate dietary intake
Weight loss
Growth faltering
Lowered immunity
Mucosal damage
Disease:
> incidence
> duration
> severity
Appetite loss
Nutrient loss
Malabsorption
Altered metabolism
The Malnutrition Infection Cycle


Child Malnutrition
Death and Disability
Inadequate
Dietary Intake
Disease
Insufficient Access to
Food
Inadequate Maternal &
Child Caring
Poor Water/ Sanitation,
Inadequate Health
Services
Inadequate and/or inappropriate knowledge and
discriminatory attitudes limit
household access to actual resources
Quantity and quality of actual resources-human,
economic and organisational and way they are
controlled
Political, cultural, religious, economic
and social systems, including status of women,
limit the utilisation of potential resources
Potential Resources - environment, technology,
people

Why do we measure nutritional or anthropometric status?

- Nutritional screening
- To monitor growth of infants and young children
- To assess the nutritional status of individuals, for example do they qualify for supplementary feeding
- To assess the nutritional status of populations (among children and or adults)

Match the anthropometric measures or indices with their application. (Q4)

Nutritional Screening: ***Mid Upper Arm Circumference***

Monitoring Growth: ***Height For Age***

Entry criteria to Feeding Programmes: ***Weight For Height or Length with cut-off points***

Assessing Nutritional Status of a population:

- **Children:** ***Weight For Height or Length***
- **Adults:** ***Body Mass Index***
  Mid Upper Arm Circumference

Match the nutritional index with the condition it reflects (Q5).

Weight-for-Height (WFH) reflects recent weight loss or gain	WASTING
Height-for-Age (HFA) reflects skeletal growth	STUNTING
Weight-for-Age (WFA) is a composite index and is used as a measure of 'UNDERWEIGHT'	WASTING AND STUNTING

Converting a child's measurements into nutritional status

The individual child's measurement is compared with the expected value of a child of the same height or age from a reference population

(also known as reference standards or values)

The child's measurement is then expressed as the percentage of the median or as an SD score

Which reference values should you use?

- The World Health Organization recommend that we use International Reference Values, known as the NCHS/WHO/CDC reference values

The international reference values are valid for use in all contexts and should always be used in emergencies. (Q6)

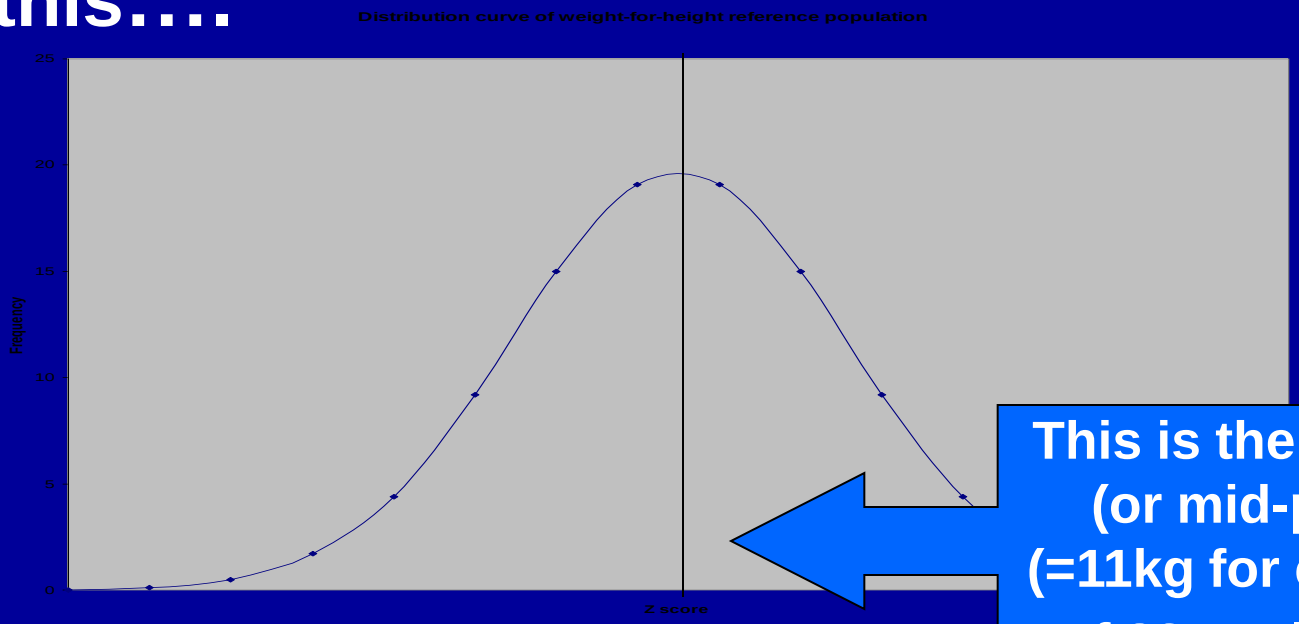
True/False?

- **Evidence suggests that "the growth patterns of well fed healthy pre-school children from diverse ethnic backgrounds are surprisingly similar."**
  (de Onis and Habicht, 1996)

- **"Child growth appears to be mainly influenced by socioeconomic status and not by race or by ethnicity. For example, height, age and weight data among privileged groups in Egypt, Togo and Haiti were nearly identical to the NCHS/CDC international reference population."**
  (Graitcer and Gentry, 1981)

What does the reference population look like?

If we plotted the weights of all children in the reference sample who were 82 cm in length, for example, we would have an approximately normal distribution curve, like this….



This is the median (or mid-point) (=11kg for children of 82 cm length)

The formula for calculating a child's Percent of the Median (Q7)

The child's value is expressed as a percentage of the reference weight for a child of the same age or height.

% Median =

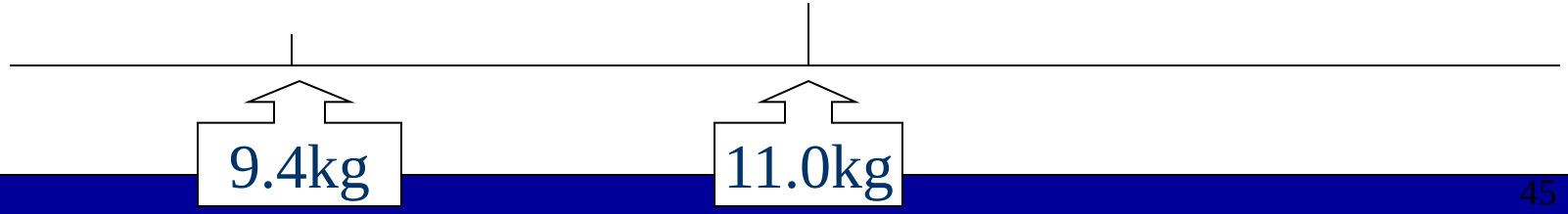
(Actual weight/ Reference weight) x 100

EXAMPLE:

Length of child = 82 cm

Reference weight = 11 kg = (9.4 kg / 11 kg) x 100 = 85%

Weight of child= 9.4 kg



Example of a table of Percent of Median reference values

WEIGHT FOR HEIGHT (Stature) FOR BOTH BOYS AND GIRLS

Height	Median	80%	70%
85.0cm	12.0kg	9.6kg	8.4kg
85.5	12.1	9.7	8.5
86.0	12.2	9.8	8.5
86.5	12.3	9.8	8.6
87.0	12.4	9.9	8.7
87.5	12.5	10.0	8.8

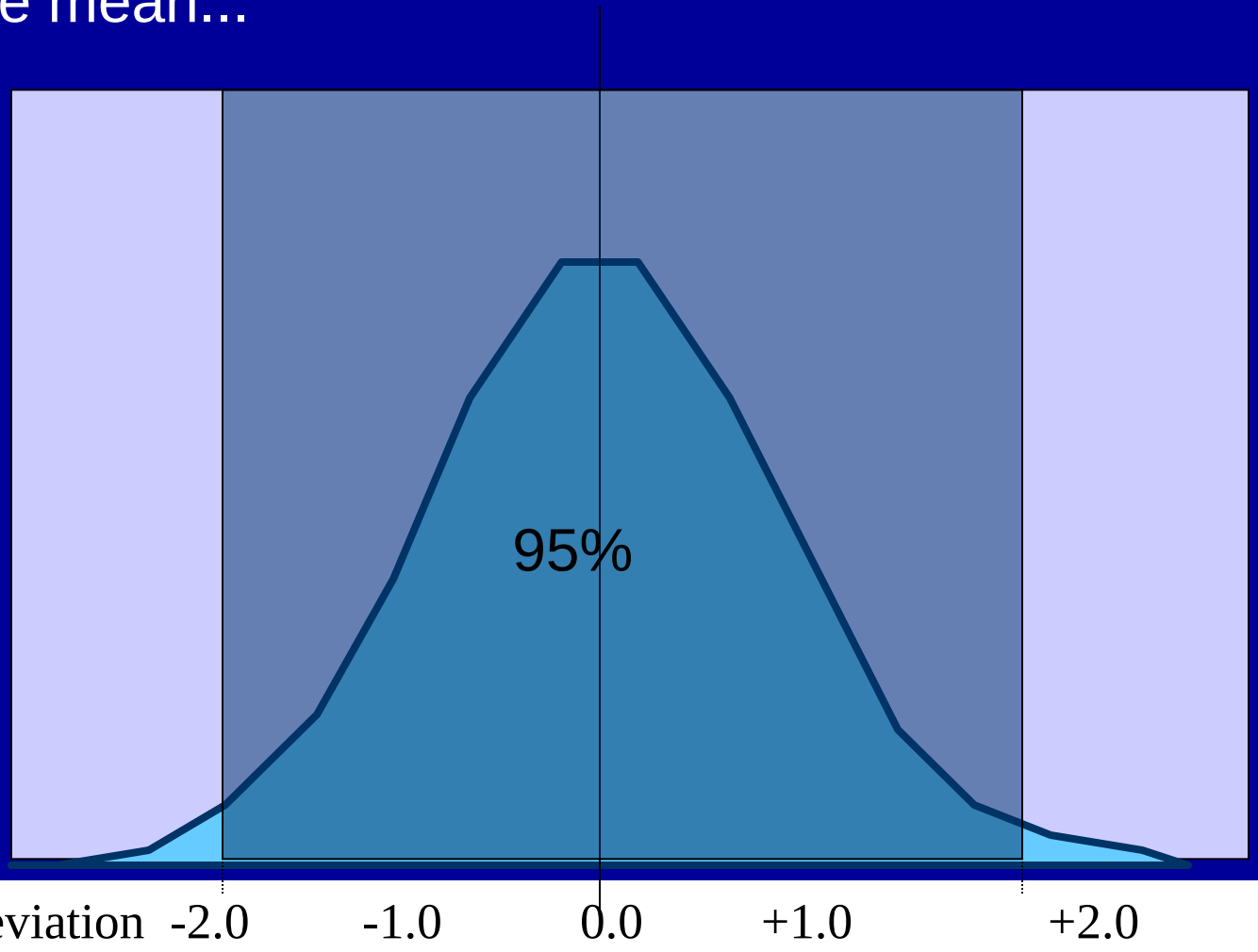
What is the median weight of a child of 86.5 cm?

Calculate percentage of median for: (Q8)

a. A boy whose height is 85.0 cm and weight is 9.0 kg

b. A girl whose height is 87.0 cm cm and weight is 9.0 kg

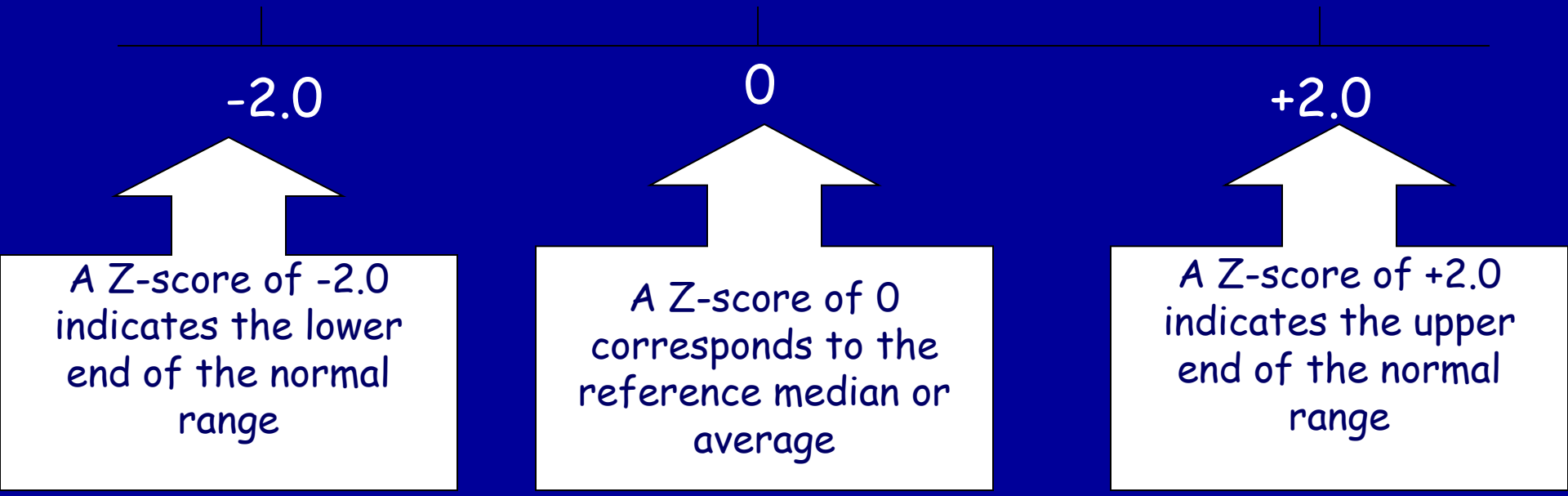
Standard deviation is a measure of how widely values are dispersed around the mean (average) or the spread of values around the mean...



95% of all values fall within -2 and + 2 standard deviations. This is known as the “normal” range

Calculating Z-scores (or SD scores)

The child's measurement--their weight, is expressed in multiples of the reference standard deviation value for weight



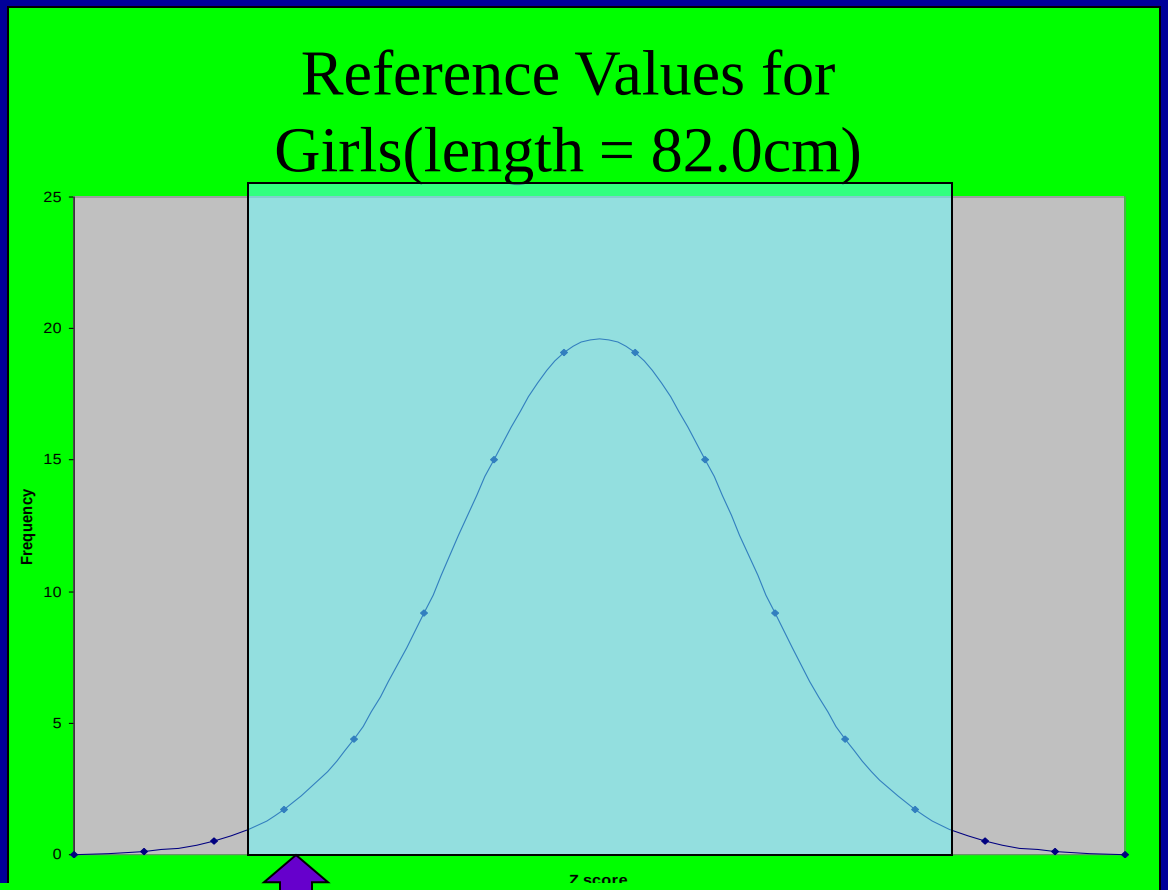
Example

Halima Ahmed:

Weight = 9.4 kg

Length = 82.0 cm

Halima's weight is just above 9.2 which is towards the lower end of the normal range



The formula for calculating Z-scores is:

$$\text{Z-score} = \frac{\text{[Actual weight - Reference median weight]}}{\text{Standard deviation of reference population}}$$

Lets look at Halima's measurement for example…

Z-score =

The formula for calculating Z-scores is:

$$\text{Z-score} = \frac{\text{[Actual weight - Reference median weight]}}{\text{Standard deviation of reference population}}$$

Lets look at Halima's measurement for example…

Z-score = (9.4 - 11.0) / 0.9 = -1.77

What about children who have nutritional oedema?

Do not calculate the nutritional status of children who have nutritional oedema

Why not?

The nutritional status of a child with nutritional oedema is categorized as: (Q9)

Severe Acute Malnutrition

Example of a table of Z-score reference values

WEIGHT FOR HEIGHT (Stature) FOR BOTH BOYS AND GIRLS

Height	Mean	StdDev	-2SD	-3SD
85.0cm	12.0kg	1.08	9.8kg	8.8kg
85.5	12.1	1.10	9.9	8.8
86.0	12.2	1.10	10.0	8.9
86.5	12.3	1.10	10.1	9.0
87.0	12.4	1.10	10.2	9.1
87.5	12.5	1.10	10.3	9.2

Cut-off Points for Categories of Acute Malnutrition (individual children)

(recommended by WHO & UNICEF)

- **Moderate Acute Malnutrition:**
  -3 to < -2 Z-scores WFH/L
  70 to < 80% Median WFH/L

- **Severe Acute Malnutrition**:
  < -3 Z-scores WFH/L
  <70% Median WFH/L
  Nutritional Oedema

Categories of Acute Malnutrition for prevalence estimates (children)

(Not Universally Adopted)

Global Acute Malnutrition (GAM):

Moderate & Severe Combined=

< 80% or < -2 Z-scores

or nutritional oedema

Severe Acute Malnutrition (SAM):

< 70% or < -3 Z-scores

or nutritional oedema

Revision

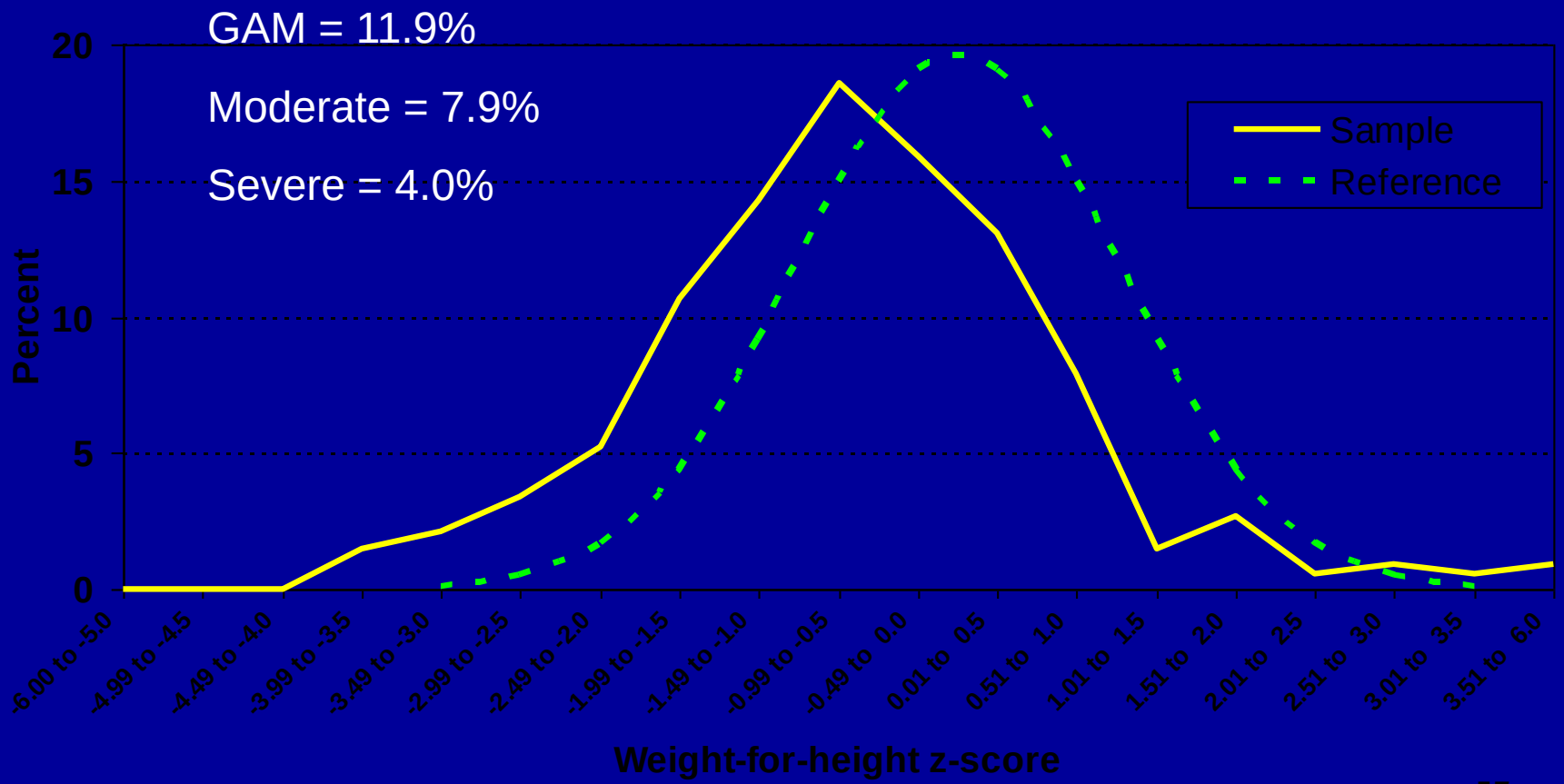
The population classification Global Acute Malnutrition (GAM) includes which of the following categories? *Q11.*

< -2.0 Z-scores or Nutritional Oedema

Match the anthropometric cut-off points with the correct classification of acute malnutrition. *Q12.*

Severe Acute Malnutrition	D. WFH< -3 Z-scores (or oedema)
Moderate Acute Malnutrition	A. WFH < -2 to -3 Z-scores
Normal Range	B. WFH -2 to < 2 Z-scores
Global Acute Malnutrition	C WFH < -2 or oedema

Distribution of weight-for-height SD-scores, children < 5 years of age, Zabul Province, Afghanistan, December 2002



Nutritional Screening: Use of Mid Upper Arm Circumference (MUAC)

WHO?

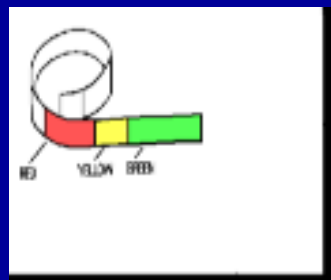
- **All** children aged between 1 and 5 years of age

HOW?

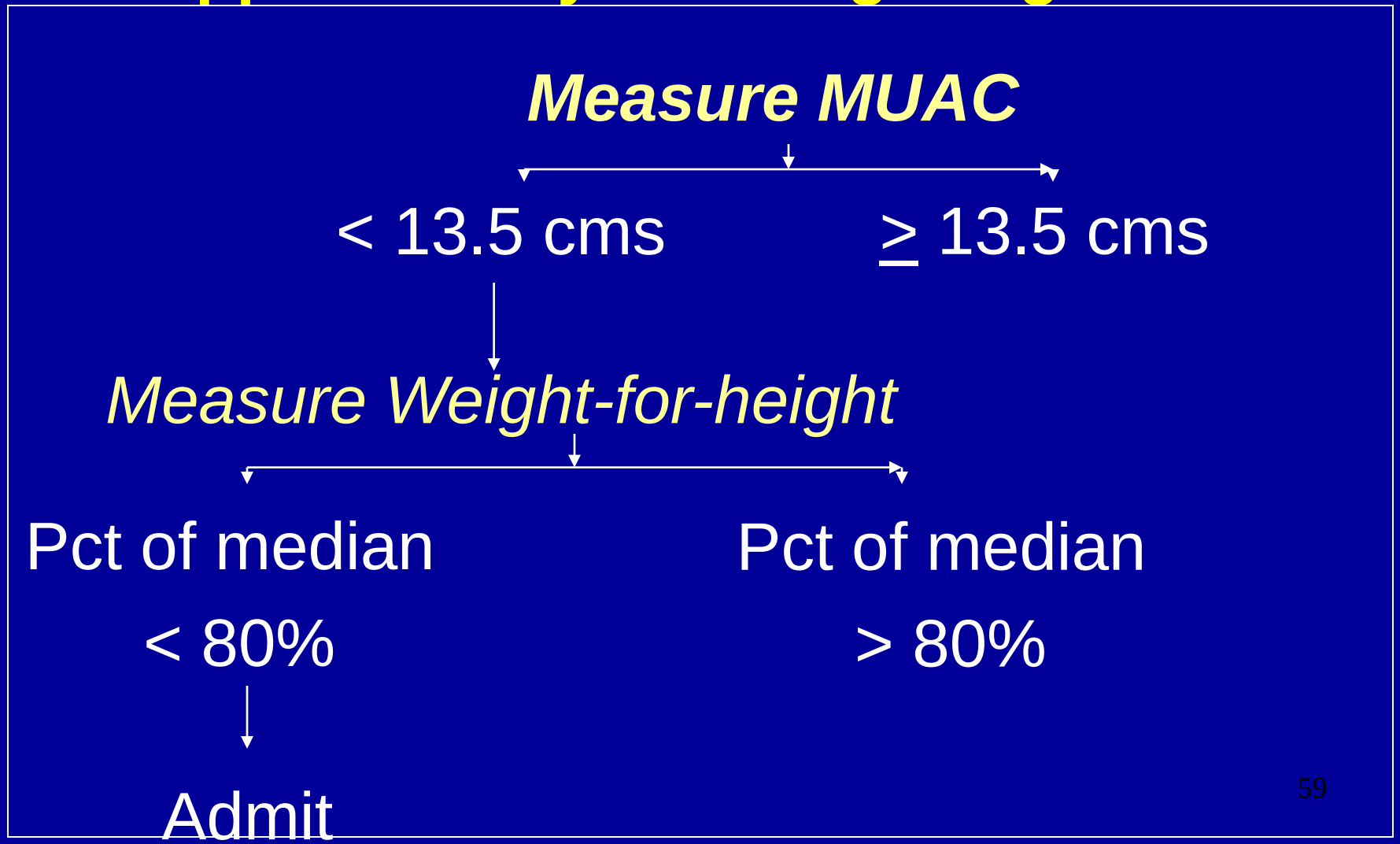
- Mid upper arm circumference is measured using an insertion tape, or MUAC strip

WHY?

- To identify potentially malnourished children
- MUAC < 13.5cm referred for further measurements (height and weight) and possible supplementary or therapeutic feeding



Use of MUAC – Screening children 6-59 months of age for entry to Supplementary Feeding Programmes



Anthropometry in Adults

- Body mass index (BMI)
- The ratio of weight and height:

  Weight (kg) / (Height [m]) ^{2}
- Single cut-off points for all ages:

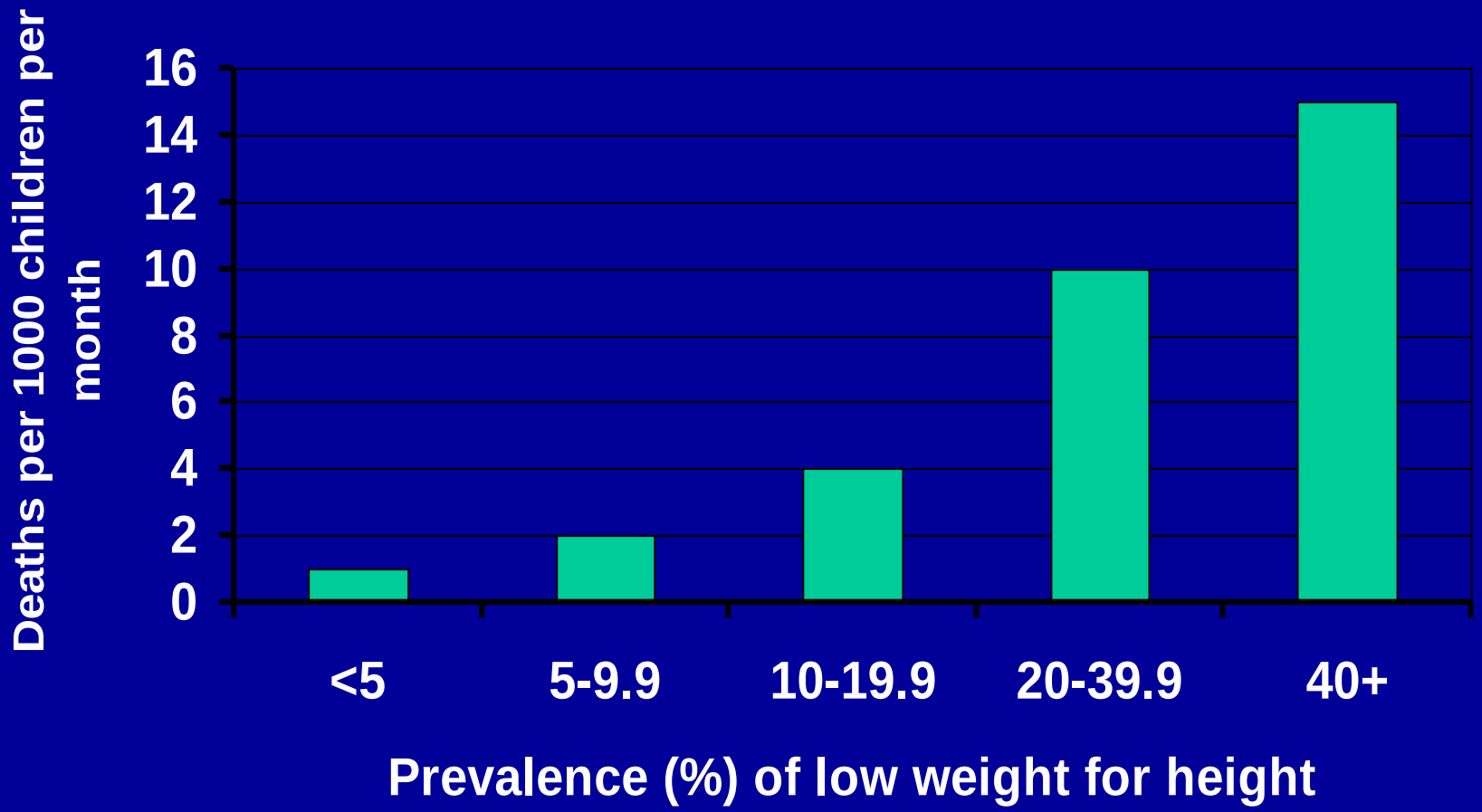
BMI	Category of undernutrition
≥ 18.5	Normal
17.0 - 18.4	Mild thinness
16.0 - 16.9	Moderate thinness
< 16.0	Severe thinness

Pregnant Women: Anthropometric criteria *

Global undernutrition	MUAC < 21.0 cm
Moderate undernutrition	MUAC 18.5-21.0 cm
Severe undernutrition	MUAC <18.5 cm

* MSF unpublished revised nutrition guidelines

Association between crude mortality rates and the prevalence of low weight for height for children under 5 in 41 refugee camps



*Source: Toole, Malkki, 1992