MODULE TWO

Defining and Measuring Acute Malnutrition

MODULE OVERVIEW

This module reviews common nutrition and anthropometric terms, the causes of undernutrition in children and practical skills on how to measure acute malnutrition in children under 5.

The module will give field implementers of CMAM an overview of methods used to determine a child's nutritional status: testing for bilateral pitting oedema, using mid-upper arm circumference (MUAC), and weight, height and age as measures. Proficiency in these skills is critical for identifying children who might be eligible for CMAM. Hands-on practice using these methods will be provided in the field visits to outpatient care sites in Module Four.

NOTES

The specific indicators which the CMAM service will use to determine nutritional status should be determined before this training module is conducted. If the service will admit children based on bilateral pitting oedema and MUAC, there is no need to train on how to measure height and calculate weight-for-height (WFH).

If WFH will be used, the trainer should adapt the training to national policy and train participants to use WFH z-score (World Health Organization [WHO] child growth standards). In many countries, CMAM services use WFH as a percentage of the median of the National Centre for Health Statistics (NCHS) child growth references. The trainer must decide which WFH tables to use for the training and discuss international standards and context adaptations with the participants. The WHO tables (sex-specific for length and height) and the NCHS tables (sexes combined for length and height) appear in **Handout 2.5 Weight-for-Height Tables for Field Use**.

In some countries or emergency contexts, indicator cutoffs are adapted to the circumstances (e.g., resources, case loads). The trainer must decide which cutoffs to use for the training and discuss international standards and context adaptations with the participants.

The cutoffs for MUAC are under debate. MUAC is accepted as an independent indicator for severe acute malnutrition (SAM). The current MUAC cutoff for SAM is 110 mm. However, MUAC is not yet accepted as an independent indicator for moderate acute malnutrition (MAM). Some countries use MUAC cutoffs of 120 mm or 125 mm for MAM. For now, this training guide uses the most common cutoff for SAM – below 110 mm – and for MAM — 110 mm to 124.9 mm — and notes that cutoffs are being debated. The guide will be updated for any new cutoffs reflecting evidence-based international guidance.

I. DEFINING AND MEASURING ACUTE MALNUTRITION: CLASSROOM

LEARNING OBJECTIVES	HANDOUTS AND EXERCISES
1. Discuss Causes and Consequences of Undernutrition and Undernutrition Terminology	Handout 2.1 Causal Framework of Undernutrition Handout 2.2 Undernutrition Definitions, Indices, Indicators and Indicator Cutoffs
2. Identify the Clinical Signs of Acute Malnutrition	Handout 2.3 Clinical Manifestations of Acute Malnutrition
3. Measure, Calculate and Classify Acute Malnutrition	Handout 2.4 Assessing Age, Bilateral Pitting Oedema, MUAC, Weight and Height Handout 2.5 Weight-for-Height Tables for Field Use Exercise 2.1 Grades of Bilateral Pitting Oedema Exercise 2.2 Calculating WFH and Classifying Acute Malnutrition
Wrap-Up and Module Evaluation	

MATERIALS

- Blank cards
- Flip chart, markers
- Masking tape
- Cards with headings: Basic, Underlying, Immediate and Consequences
- Sets of cards with undernutrition terms and sets of cards with matching definitions
- Calculators*
- Salter Scales
- Electronic scale (e.g., UNISCALE)
- Height boards*
- Height stick marked to 110 cm (cutoff for 5 years)
- Numbered and simple three-colour MUAC tapes
- Photos of children with marasmus, kwashiorkor and marasmic kwashiorkor

* Not required for services that use only bilateral pitting oedema and MUAC as entry criteria

ADVANCE PREPARATION

- Room setup, materials noted above
- Review all participant handouts
- Arrangements should be made for participants to conduct anthropometric measurements of children in the context of ongoing screening or CMAM services

MODULE DURATION: TWO HOURS

Note: Depending on the needs of their audiences, trainers may choose to skip or spend more or less time on certain learning objectives and activities. The module duration is an estimate of the time it takes to complete all the learning objectives and activities.

LEARNING OBJECTIVE 1:
DISCUSS CAUSES AND CONSEQUENCES OF UNDERNUTRITION AND UNDERNUTRITION TERMINOLOGY

Become familiar with **Handout 2.1. Causal Framework of Undernutrition** and Handout 2.2 Undernutrition Definitions, Indices, Indicators and Indicator Cutoffs.

BRAINSTORM: CAUSES OF MALNUTRITION. Give each participant two blank cards and ask them to think about what the causes of child undernutrition are and to write one cause on each card. Ask participants to post their cards and share their ideas.

Using cards marked "Immediate," "Underlying" and "Basic," have participants work together to group the causes by category and to place under the correspondingly labelled card.

- Immediate: e.g., food intake, illness
- Underlying: e.g., food insecurity, inadequate care practices, poor sanitation/water and inadequate health services
- Basic: e.g., political, cultural, religious, economic and social systems including women's status

Direct participants to **Handout 2.1. Causal Framework of Undernutrition** and ask participants if they can name some specific causes of undernutrition.

Note to participants that these causes contribute to all forms of undernutrition, and their presence and interaction will determine how they manifest themselves in a child or a population over time.

ELICITATION: UNDERNUTRITION. If covered in **Module One**, ask participants to define undernutrition and the forms it can take. If not, present the following points:

Undernutrition is a consequence of a deficiency in nutrients in the body and can take the form of:

- Acute malnutrition (bilateral pitting oedema or wasting)
- Stunting
- Underweight
- Micronutrient deficiencies

Note to participants that malnutrition comprises both overnutrition (obesity) and undernutrition, but the term malnutrition is most often utilized for forms of undernutrition (e.g., acute malnutrition).

Ask participants to name consequences to undernutrition (e.g., increased risk of illness, increased risk of mortality due to weakened ability to fight other illness, poor growth, poor cognitive development)

PARTICIPATORY LECTURE: ACUTE MALNUTRITION. Ask participants if they can identify the five methods commonly used to assess the nutritional status of children (if participants have no nutrition background, simply deliver the information in lecture): 1) bilateral pitting oedema; 2) MUAC; 3) WFH; 4) height-for-age (HFA); 5) weight-for-age (WFA). Remind participants that the focus of the training modules – and of CMAM programs – is acute malnutrition. Ask participants which assessment methods (above) assess acute malnutrition. Define acute malnutrition and the cutoffs for SAM and MAM.

LO.1

- **Acute malnutrition** is caused by a decrease in food consumption and/or illness resulting in bilateral pitting oedema or sudden weight loss. It is defined by the presence of **bilateral pitting oedema** or **wasting** (low MUAC or WFH).

- **Acute malnutrition** comprises both SAM and MAM and can have the following indicators (with cutoffs):

	Bilateral Pitting Oedema	**MUAC***	**WFH z-score** (WHO standards or NCHS references)	**WFH as a percentage of the median** (NCHS references)
SAM:	Present	< 110 mm*	< -3	< 70%
MAM:	Not present	> 110 mm* and < 125 mm*	≥ -3 and < -2	≥ 70% and < 80%

*cutoffs being debated

NOTE: If WFH is to be used, adapt the training according to the national policy, training participants to use the WFH z-score (WHO standards) or WFH as a percentage of the median (NCHS references)

PRACTICE: ACUTE MALNUTRITION DEFINITIONS. Still working in pairs, give participants a set of matching cards: 6 with undernutrition terms, and 6 with matching definitions (see below). Ask each group to match the terms with the definitions. Discuss in plenary.

Refer participants to **Handout 2.2 Undernutrition Definitions, Indices, Indicators and Indicator Cutoffs** for later reading and reference.

MATCH TERM WITH CORRECT DEFINITION (ANSWER KEY)

Terms	Definitions
Acute malnutrition	▪ Bilateral pitting oedema ▪ MUAC < 125 mm ▪ **Or** WFH z-score < -2 (low WFH) (WHO standards) ▪ **Or** WFH as a percentage of the median < 80% (NCHS references)
Moderate acute malnutrition (MAM)	▪ MUAC < 125 mm and ≥ 110 mm (cutoff being debated) ▪ **Or** WFH z-score < -2 and ≥ -3 (WHO standards) ▪ **Or** WFH as a percentage of the median < 80% and ≥ 70% (NCHS references)
Severe acute malnutrition (SAM)	▪ Bilateral pitting oedema +/++/+++ ▪ MUAC < 110 mm (cutoff being debated) ▪ **Or** WFH z-score < -3 (WHO standards) ▪ **Or** WFH as a percentage of the median < 70% (NCHS references) ▪ A child with SAM has an elevated risk of death
Clinical manifestations of SAM	▪ Marasmus (severe wasting) ▪ Kwashiorkor (bilateral pitting oedema or swelling of nutritional origin) ▪ Marasmic kwashiorkor (both bilateral pitting oedema and severe wasting)
Bilateral pitting oedema	▪ A sign of SAM ▪ Also called kwashiorkor, nutritional oedema or oedematous malnutrition ▪ Verified when thumb pressure applied on top of both feet for three seconds leaves a pit (indentation) in both feet after the thumb is lifted ▪ An abnormal infiltration and excess accumulation of serous fluid in connective tissue or in a serous cavity
Severe wasting	▪ A sign of SAM ▪ MUAC < 110 mm (cutoff being debated) ▪ **Or** WFH z-score < -3 (WHO standards) ▪ **Or** WFH as a percentage of the median < 70% (NCHS references) ▪ Also called marasmus ▪ A child with severe wasting has a high risk of death

LEARNING OBJECTIVE 2:
IDENTIFY THE CLINICAL SIGNS OF ACUTE MALNUTRITION

Become familiar with **Handout 2.3 Clinical Manifestations of Acute Malnutrition.**

BRAINSTORM AND WORKING GROUPS: CLINICAL MANIFESTATIONS OF ACUTE MALNUTRITION. In plenary, ask participants if they can name the three clinical manifestations of acute malnutrition:

- Marasmus (severe wasting)
- Kwashiorkor (bilateral pitting oedema)
- Marasmic kwashiorkor (severe wasting and bilateral pitting oedema)

Divide participants into working groups and ask them to name the characteristics of clinical manifestations of acute malnutrition: marasmus, kwashiorkor and marasmic kwashiorkor. Have one group present their answers and the other groups add additional points. Fill in any gaps.

Refer participants to **Handout 2.3 Clinical Manifestations of Acute Malnutrition** and review the classifications together. Invite and answer any questions.

PRACTICE: CLINICAL MANIFESTATIONS. Show pictures of children with marasmus, kwashiorkor and marasmic kwashiorkor and ask participants to classify them by clinical manifestation. Answer any questions.

LEARNING OBJECTIVE 3:
MEASURE, CALCULATE AND CLASSIFY ACUTE MALNUTRITION

Become familiar with **Handout 2.4 Assessing Age, Bilateral Pitting Oedema, MUAC, Weight and Height** and Handout 2.5 Weight-for-Height Tables for Field Use.

PARTICIPATORY LECTURE: ASSESSING AGE. Ask participants if they know when estimation of a child's age is important. Note that it is relevant for the use of MUAC as this indicator of SAM is used only for children 6-59 months and for the classification of treatment for SAM. In cases where the age of the child cannot be verified through a child health card (CHC) or immunisation card, methods of estimating age include:

- **Estimating the month and year of birth with the help of a local events calendar.**
- **Recall of the mother/caregiver** is valid in the case of estimating the cutoff age of 6 months.
- In case the above methods fail, a young child's **swallow skills** can be tested with RUTF. If they pass the appetite test (can eat the RUTF), they are considered to be old enough to qualify for admission to outpatient care.
- For older children, age may be estimated based on **height**. The standard international proxy for children 59 months is 110 cm.

PARTICIPATORY LECTURE: BILATERAL PITTING OEDEMA. Describe how bilateral pitting is assessed (see **Handout 2.4**), noting that it is important that both feet are tested. If it is neither bilateral nor pitting, the oedema is not of nutrition origin. Describe the three grades of bilateral pitting oedema. Discuss how to assess bilateral pitting oedema grades ++ and +++. Note that participants will have the opportunity to assess bilateral pitting oedema in field site visits. Underline the importance of a second opinion in cases where bilateral pitting oedema is present.

PRACTICE: RECOGNISING BILATERAL PITTING OEDEMA. Refer participants to **Exercise 2.1 Grades of Bilateral Pitting Oedema.** Have the participants work in pairs to look at the photos and identify the severity of the bilateral pitting oedema. Review answers together.

LO.3

EXERCISE 2.1 GRADES OF BILATERAL PITTING OEDEMA (WITH ANSWERS)

PHOTO 1

BILATERAL PITTING OEDEMA +

This child has bilateral pitting oedema in both feet. This is grade + (mild). But the child might have grade ++ or +++, so the legs and face also should be checked.

PHOTO 2

BILATERAL PITTING OEDEMA ++

This child's feet, lower legs, hands and lower arms are swollen. This is grade ++ (moderate).

PHOTO 3

BILATERAL PITTING OEDEMA +++

This child has generalised bilateral pitting oedema, including feet, legs, arms, hands and face. This is grade +++ (severe).

DEMONSTRATION: USING MUAC TAPE. Refer participants to **Handout 2.4 Assessing Age, Bilateral Pitting Oedema, MUAC, Weight and Height**. Ask how many participants have used MUAC tapes and which type (numbered or coloured). Pass out MUAC tapes to participants and review briefly the cutoffs for SAM and MAM and how to find the measures on the tape. Demonstrate how to use MUAC tapes, outlining the process described in **Handout 2.4, Section 3.** Repeat the process for both numbered and coloured tapes. Ask participants to practice on each other.

PARTICIPATORY LECTURE: MEASURING WEIGHT AND LENGTH/HEIGHT. Show participants the Salter Scale and the United Nations Children's Fund (UNICEF) UNISCALE, noting that they will encounter these scales in the field and have the opportunity to practice. For the Salter Scale, outline the considerations in **Handout 2.4, Section 4**. For the UNISCALE, briefly outline how the child can be weighed in the mother/caregiver's arms.

PARTICIPATORY LECTURE: MEASURING LENGTH/HEIGHT. (Note: in cases where bilateral pitting oedema and MUAC are used for admission criteria, do not train participants to measure height of child.) Show participants the height board and note that length is measured for children under two or with a height below 85 cm (NCHS) or 87 cm (WHO), while height is measured for children over two or with a height above 85 cm (NCHS) or 87 cm (WHO). Describe the procedure outlined in **Handout 2.4, Section 5**. Note that in the case of children over two who are unable to stand, the measure will be taken lying down. In this case an adjustment downward of 0.5 cm is made to the measurement.

PARTICIPATORY LECTURE: CALCULATING WFH Z-SCORE. Refer participants to **Handout 2.5 Weight-for-Height Tables for Field Use** and ask participants if they are familiar with the tables. If not, carefully review the WFH tables with them. Make note that the first two tables are used to calculate WFH z-score using WHO Child Growth Standards and that the second two tables are used to calculate WFH as a percentage of the median using NCHS Child Growth References. Note that the training will address WFH z-score first.

Demonstrate step-by-step on a flip chart the process of how to determine WFH z-score:

1. Determine the age of the child in order to decide whether to use the length table or the height table. Remind participants that if a child over the age of 2 (or over 87 cm) must be measured lying down for whatever reason, subtract 0.5 cm from the measurement.

2. Find the child's height in the height column if using the height table or child's length in length column if using the length table. Note that length and height measurements ending on one decimal are rounded up or down:
   0.1, 0.2, 0.3, 0.4 are rounded down to 0.0 cm
   0.5, 0.6, 0.7 0.8, 0.9 are rounded up to 1.0 cm

3. Looking at the right side of the chart for a girl or the left side of the chart for a boy, find the median weight for a child of that height or length. Determine whether the weight of the child is above or below -1, -2, -3 or -4 standard deviations (SDs).

4. Calculate the exact z-score by subtracting the median weight from the child's weight and dividing by the SD (in kg).

$$\frac{\text{(child's weight)} - \text{(standard child's weight)}}{\text{(one SD)}} = \text{z-score}$$

LO.3

PRACTICE: CALCULATING WFH Z-SCORE. Refer participants to **Exercise 2.2 Calculating WFH and Classifying Acute Malnutrition**. Work in plenary to calculate the WFH z-score for children 1 and 2 in the exercise. Answer any questions then ask participants to work in pairs to calculate the WFH z-score for children 3-10. Ask volunteer pairs to read their answers aloud. Answer further questions.

EXERCISE 2.2 CALCULATING WFH AND CLASSIFYING ACUTE MALNUTRITION– PART A: CALCULATING WFH Z-SCORE (WITH ANSWERS)

WFH Z-score (WHO standards)

Child Name	Sex	Age (in years unless noted)	Bilateral Pitting Oedema	MUAC (mm or colour)	Height (cm)	Weight (kg)	WFH Z-Score
Child 1	F	3		Green	98.2	12.5	**< -1 and > -2**
Child 2	M	5		123	110.0	14.8	**< -2 and > -3**
Child 3	M	5	++	Yellow	102.2	13.5	**< -2 and > -3**
Child 4	F	4		110	91.1	9.3	**< -3**
Child 5	M	9 months		125	69.9 (Length)	6.7	**< -2 and > -3**
Child 6	F	4	+++	Yellow	105.2	18.0	**> median**
Child 7	F	8 months	+	105	68.2 (Length)	5.0	**< -3**
Child 8	M	1		Red	84.3 (Length)	8.9	**= -3**
Child 9	F	2		109	97.2	11.0	**< -2 and > -3**
Child 10	M	1.5	+	Green	89.7	12.9	**= median**

PARTICIPATORY LECTURE: CALCULATING WFH AS A PERCENTAGE OF THE MEDIAN. Refer participants again to **Handout 2.5 Weight-for-Height Tables for Field Use** noting that on this round they are to work with the second pair of tables. Note that there are not separate tables for length vs. height, nor separate columns for gender.

Demonstrate step-by-step on a flip chart the process of how to determine WFH as a percentage of the median:

1. Remind participants that if a child over the age of 2 (or over 85 cm) must be measured lying down for some reason, subtract 0.5 cm from the measurement.

3. Find the child's height or length in length column. Note that length and height measurements ending on one decimal are rounded up or down:

0.1, 0.2 are rounded down to 0.0 cm
0.3, 0.4 are rounded up to 0.5 cm
0.6, 0.7 are rounded down to 0.5 cm
0.8, 0.9 are rounded up to 1.0 cm

3. Find the median weight for that child, irrespective of gender. Determine whether the weight of the child is above or below 85, 80, 75, 70 or 65 percent.

4. Calculate the exact percentage of the median by dividing the child's weight by the median weight.

$$\frac{\text{child's weight}}{\text{median reference weight}} = \text{percentage of the median}$$

PRACTICE: CALCULATING WFH AS A PERCENTAGE OF THE MEDIAN. Refer participants to **Exercise 2.2 Calculating WFH and Classifying Acute Malnutrition**. Work in plenary to calculate the WFH as a percentage of the median for children 1 and 2 in the exercise. Answer any questions then ask participants to work in pairs to calculate the WFH as a percentage of the median for the children 3-10. Ask volunteer pairs to read their answers aloud. Answer further questions.

LO.3

EXERCISE 2.2 CALCULATING WFH AND CLASSIFYING ACUTE MALNUTRITION– CALCULATING WFH AS A PERCENTAGE OF THE MEDIAN (WITH ANSWERS)

WFH as a Percentage of the Median (NCHS references)

Child Name	Age (in years unless noted)	Bilateral Pitting Oedema	MUAC (mm or colour)	Height (cm)	Weight (kg)	WFH as a Percentage of the Median
Child 1	3	no	Green	98.2	12.5	**≥ 80%**
Child 2	5	no	123	110.2	14.8	**= 80%**
Child 3	5	++	Yellow	102.2	13.5	**≥ 80%**
Child 4	4	no	110	91.2	9.3	**= 70%**
Child 5	9 months	no	125	70.2 (Length)	6.7	**<80%**
Child 6	4	+++	Yellow	105.2	18.0	**≥80%**
Child 7	8 months	+	105	68.2 (Length)	5.0	**<70%**
Child 8	1	no	Red	84.2 (Length)	8.9	**<80%**
Child 9	2	no	109	97.2	11.0	**<80%**
Child 10	1.5	+	Green	89.2	12.9	**= median**

PRACTICE: DETERMINING CHILD'S NUTRITIONAL STATUS. Refer participants back to **Exercise 2.2 Calculating WFH and Classifying Acute Malnutrition**. Still working in pairs, ask them to use the information on the presence of bilateral pitting oedema and MUAC scores to determine whether the child has SAM or MAM or is normal. Remind participants to use all the information on the sheet to make their determinations. Note to participants that:

- If a child has bilateral pitting oedema, it is still useful to measure MUAC or WFH to check for marasmic kwashiorkor.
- Bilateral pitting oedema could increase the child's WFH and mask wasting or other warning signs, however a child with bilateral pitting oedema is automatically classified as having SAM.
- In countries that use only bilateral pitting oedema and MUAC as entry criteria, information on height and weight is not necessary.

Ask for volunteer pairs to read their answers aloud and then discuss and summarize in plenary. Ask participants what they would record for Child 7's admission criterion (this child has marasmic kwashiorkor). Refer to answer sheet and fill in gaps.

LO.3

EXERCISE 2.2 CALCULATING WFH AND CLASSIFYING ACUTE MALNUTRITION– WFH Z-SCORE (WHO STANDARDS) (WITH ANSWERS)

Bilateral Pitting Oedema and MUAC

Child Name	Age (in years unless noted)	Bilateral Pitting Oedema	MUAC (mm or colour)	Classification
Child 1	3	no	Green	**OK**
Child 2	5	no	123	**Moderate**
Child 3	5	++	Yellow	**Severe (bilateral pitting oedema)**
Child 4	4	no	110	**Moderate**
Child 5	9 months	no	125	**Moderate**
Child 6	4	+++	Yellow	**Severe (bilateral pitting oedema)**
Child 7	8 months	+	105	**Severe (marasmic kwashiorkor)**
Child 8	1	no	Red	**Severe (MUAC)**
Child 9	2	no	109	**Severe (MUAC)**
Child 10	1.5	+	Green	**Severe (bilateral pitting oedema)**

Bilateral Pitting Oedema and MUAC and WFH Z-score (WHO Standards)

Child Name	Sex	Age (in years unless noted)	Bilateral Pitting Oedema	MUAC (mm or colour)	Height (cm)	Weight (kg)	WFH Z-Score	Classification
Child 1	F	3	no	Green	98.2	12.5	< -1 and > -2	**Moderate**
Child 2	M	5	no	123	110.0	14.8	< -2 and > -3	**Moderate**
Child 3	M	5	++	Yellow	102.2	13.5	< -2 and > -3	**Severe (bilateral pitting oedema)**
Child 4	F	4	no	110	91.1	9.3	< -3	**Severe (WFH)**
Child 5	M	9 months	no	125	69.9	6.7	< -2 and > -3	**Moderate**
Child 6	F	4	+++	Yellow	105.2	18	> median	**Severe (bilateral pitting oedema)**
Child 7	F	8 months	+	105	68.2	5.0	< -3	**Severe (marasmic kwashiorkor)**
Child 8	M	1	no	Red	84.3	8.9	= -3	**Severe (MUAC)**
Child 9	F	2	no	109	97.2	11	< -2 and > -3	**Severe (MUAC)**
Child 10	M	1.5	+	Green	89.7	12.9	= median	**Severe (bilateral pitting oedema)**

LO.3

Bilateral Pitting Oedema and MUAC and WFH as a Percentage of the Median (NCHS references)

Child Name	Age (years)	Bilateral Pitting Oedema	MUAC (mm or colour)	Height (cm)	Weight (kg)	WFH as a % of Median	Classification
Child 1	3	no	Green	98.2	12.5	≥ 80%	**Normal**
Child 2	5	no	123	110.2	14.8	= 80%	**Moderate (MUAC)**
Child 3	5	++	Yellow	102.2	13.5	≥ 80%	**Severe (bilateral pitting oedema)**
Child 4	4	no	110	91.2	9.3	= 70%	**Moderate (borderline)**
Child 5	9 months	no	125	70.2	6.7	< 80%	**Moderate**
Child 6	4	+++	Yellow	105.2	18.0	≥ 80%	**Severe (bilateral pitting oedema)**
Child 7	8 months	+	105	68.2	5.0	< 70%	**Severe (marasmic kwashiorkor)**
Child 8	1	no	Red	84.2	8.9	< 80%	**Severe (MUAC)**
Child 9	2	no	109	97.2	11.0	< 80%	**Severe (MUAC)**
Child 10	1.5	+	Green	89.2	12.9	= median	**Severe (bilateral pitting oedema)**

WRAP-UP AND MODULE EVALUATION

SUGGESTED METHOD: REVIEW THE LEARNING OBJECTIVES AND COMPLETE THE EVALUATION FORM

- Review the learning objectives of the module. In this module you have:
  1. Discussed causes and consequences of undernutrition, as well as undernutrition terminology
  2. Identified the clinical signs of SAM
  3. Calculated and classified acute malnutrition

- Place the following questions in a basket. Ask volunteers to pick a question and answer it. Discuss answers.
  1. What are some basic causes of undernutrition?
  2. What kinds of actions are being taken in your community to address undernutrition?
  3. What is acute malnutrition? How is SAM defined?
  4. How do you measure bilateral pitting oedema?
  5. What does the red colour mean on a MUAC tape?

- Let participants know that they will have an opportunity to assess for bilateral pitting oedema, use MUAC tapes and measure WFH during field visits.

- Ask participants to complete the evaluation form.

COMMUNITY-BASED MANAGEMENT OF ACUTE MALNUTRITION

MODULE TWO

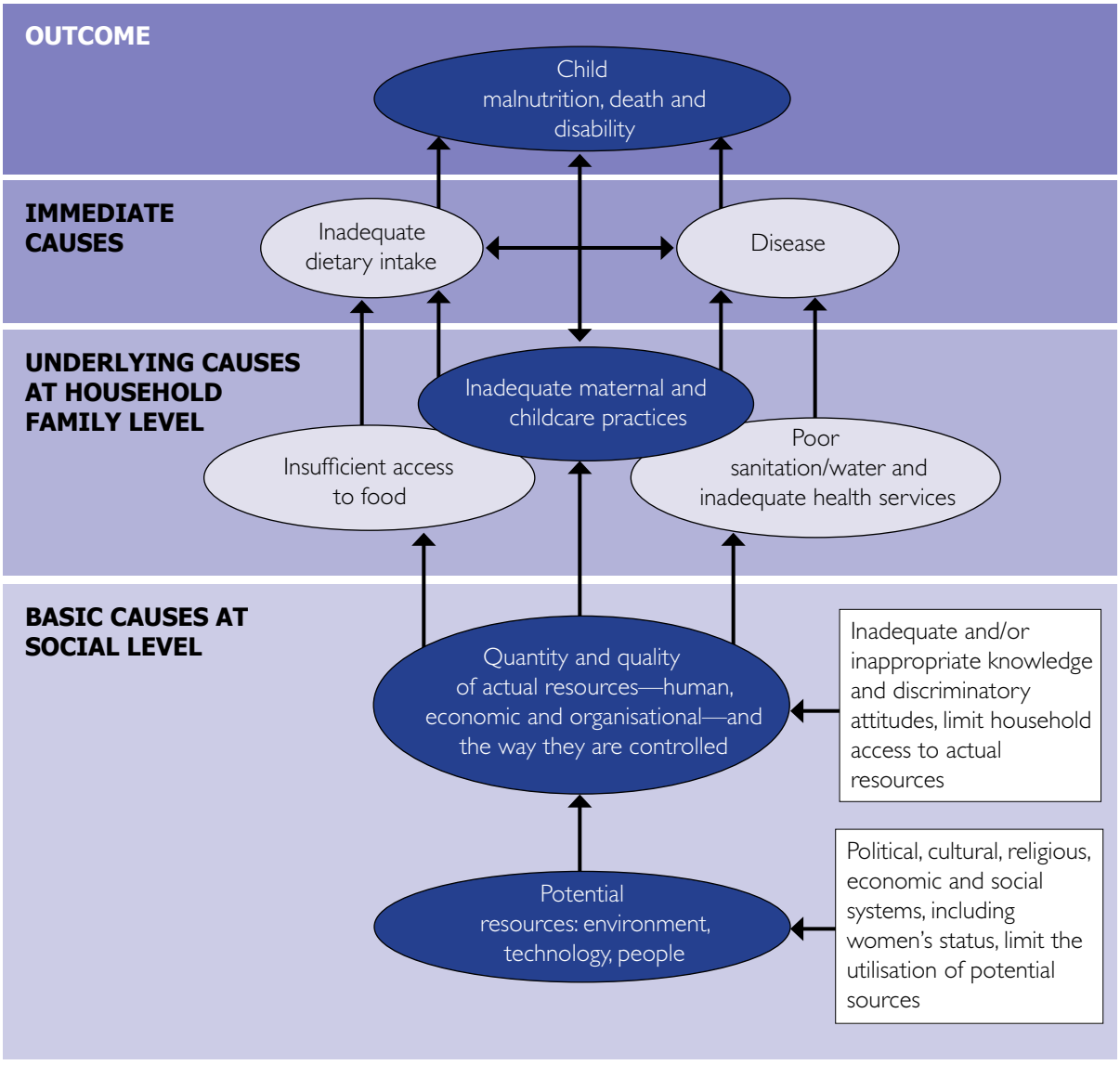
Defining and Measuring Acute Malnutrition

LEARNING OBJECTIVES	HANDOUTS AND EXERCISES
1. Discuss Causes and Consequences of Undernutrition and Undernutrition Terminology	Handout 2.1 Causal Framework of Undernutrition Handout 2.2 Undernutrition Definitions, Indices, Indicators and Indicator Cutoffs
2. Identify the Clinical Signs of Acute Malnutrition	Handout 2.3 Clinical Manifestations of Acute Malnutrition
3. Measure, Calculate and Classify Acute Malnutrition	Handout 2.4 Assessing Age, Bilateral Pitting Oedema, MUAC, Weight and Height Handout 2.5 Weight-for-Height Tables for Field Use Exercise 2.1 Grades of Bilateral Pitting Oedema Exercise 2.2 Calculating WFH and Classifying Acute Malnutrition
Wrap-Up and Module Evaluation	

HANDOUT 2.1
CAUSAL FRAMEWORK OF UNDERNUTRITION

CAUSES OF UNDERNUTRITION

The United Nations Children's Fund (UNICEF) has developed a framework showing the immediate, underlying and basic causes of undernutrition and how they contribute to and influence one another. The framework can be used at national, district and local levels for assessment and analysis to gain a better understanding of causes of undernutrition. This can help improve nutrition and reduce child mortality and disability.



Adapted from UNICEF 1990

HANDOUT 2.2
UNDERNUTRITION DEFINITIONS, INDICES, INDICATORS AND INDICATOR CUTOFFS

UNDERNUTRITION

There are four forms of undernutrition:

- Acute malnutrition
- Stunting
- Underweight
- Micronutrient deficiency

Undernutrition is defined based on anthropometric indicators, clinical signs and clinical tests. The four forms often overlap in one child or in a population. The focus of these training modules is on acute malnutrition.

ACUTE MALNUTRITION

Acute malnutrition is caused by a decrease in food consumption and/or illness resulting in bilateral pitting oedema or sudden weight loss. It is defined by the presence of bilateral pitting oedema or by wasting.

a. **Severe acute malnutrition (SAM)** is defined by the presence of bilateral pitting oedema or severe wasting. A child with SAM is highly vulnerable and has a high mortality risk.

   Note: SAM can also be used as a population-based indicator defined by the prevalence of bilateral pitting oedema and severe wasting (based on the weight-for-height [WFH] indicator using the World Health Organization [WHO] standards or the National Centre for Health Statistics [NCHS] references). The prevalence of wasting based on mid-upper arm circumference (MUAC) is useful for estimating case load.

b. **Moderate acute malnutrition (MAM)** is defined by moderate wasting.

   Note: MAM can also be used as a population-level indicator defined by moderate wasting (based on the WFH indicator using the WHO standards or the NCHS references).

INDICES

When body measurements are compared to a reference value, they are called nutrition indices. Three commonly used nutrition indices are WFH which is used to assess wasting, height-for-age (HFA) which is used to assess stunting, and weight-for-age (WFA) which is used to assess underweight.

The WFH index is used to assess wasting, a clinical manifestation of acute malnutrition. It shows how a child's weight compares to the weight of a child of the same height and sex in the WHO standard or NCHS reference populations. The index reflects a child's current nutritional status.

INDICATORS

Nutrition indicators are an interpretation of nutrition indices based on cutoff points. Nutrition indicators measure the clinical phenomena of malnutrition and are used for making a judgement or assessment. A good nutrition indicator detects as many people at risk as possible (sensitivity) without including too many people who are not at risk (specificity). A good nutrition indicator should also be functionally meaningful (i.e., related to the risk of morbidity and mortality), and be sensitive to change.

Standard cutoff points are used internationally to define undernutrition in children ages 6-59 months. The cutoff points for nutrition indicators are derived from the WHO child growth standard population (WHO standards) or NCHS reference population (NCHS references).

Note: Cutoffs may vary according to the context, agency and national guidelines.

Bilateral Pitting Oedema
Bilateral pitting oedema is a clinical manifestation of acute malnutrition caused by an abnormal infiltration and excess accumulation of serous fluid in connective tissue or in a serous cavity. Bilateral pitting oedema (also called kwashiorkor) is verified when thumb pressure applied on top of both feet for three seconds leaves a pit (indentation) in the foot after the thumb is lifted.

MUAC Indicator
Low MUAC is an indicator for wasting, to be used for a child age 6-59 months. The indicator is relatively easy to measure; it involves measuring the circumference of a child's left mid-upper arm. MUAC < 110 mm for children ages 6-59 months indicates SAM (cutoff being debated). MUAC ≥ 110 mm and < 125 mm for children ages 6-59 months indicates MAM (cutoffs being debated). MUAC is a better indicator of mortality risk associated with acute malnutrition than WFH z-score (WHO) or WFH as a percentage of the median (NCHS).

WFH Indicator
Low WFH is an indicator for wasting. A WFH standard deviation (SD) below -2 z-score of the median (WFH < -2 z-score) of the WHO standards or a WFH < 80% of the median (WFH < 80%) of the NCHS references indicate wasting. Severe wasting is indicated by a WFH < -3 z-score (WHO standards) or a WFH < 70% of the median (NCHS references). Moderate wasting is indicated by a WFH ≥ -3 and < -2 z-score (WHO standards) or a WFH ≥ 70% and < 80% (NCHS references).

SUMMARY TABLE: INDICATORS OF ACUTE MALNUTRITION WITH CUTOFF FOR SAM AND MAM

	Bilateral Pitting Oedema	**MUAC***	**WFH z-score** (WHO standards or NCHS references)	**WFH as a percentage of the median** (NCHS references)
SAM:	Present	< 110 mm* or red	< -3	< 70%
MAM:	Not present	> 110 mm* and < 125 mm* or yellow	≥ -3 and < -2	≥ 70% and < 80%

*cutoffs being debated

Note on the WHO child growth standards and NCHS child growth references:
The NCHS child growth references were developed in 1978 from a cohort of American children and used as an international reference until 2006. The WHO 2006 Child Growth Standards were developed from a multicentre growth reference study that followed optimal child growth of a cohort of children in Oman, Norway, Ghana, India and the United States. The principal measures used in CTC/CMAM services are bilateral pitting oedema and MUAC. A measure commonly used in therapeutic and supplementary feeding is WFH as a percentage of the median based on the NCHS references. A transition to using WFH z-score of the median of the WHO standards was recommended but not yet accomplished before this document was published.

HANDOUT 2.3
CLINICAL MANIFESTATIONS OF ACUTE MALNUTRITION

Acute malnutrition is defined by the presence of **bilateral pitting oedema and wasting (defined by low mid-upper arm circumference [MUAC] or weight-for-height [WFH]**). Acute malnutrition is caused by a decrease in food consumption and/or illness.

- The following terms are used to describe the clinical manifestations of severe acute malnutrition (SAM):
  - Marasmus (severe wasting)
  - Kwashiorkor (bilateral pitting oedema)
  - Marasmic kwashiorkor (bilateral pitting oedema and severe wasting)
- Familiarity with these clinical signs will help health care providers triage cases efficiently – even before measurements are made.
- In most cases the anthropometric measurements will confirm these clinical diagnoses, but in a few cases there might be clinical but no anthropometric confirmation (e.g., observing that the skin on the buttocks has a "baggy pants" look.)

TABLE OF CLINICAL MANIFESTATIONS OF ACUTE MALNUTRITION

CLINICAL SIGNS OF MARASMUS

A child with marasmus might have these characteristics:

- Thin appearance, "old man" face
- Apathy: the child is very quiet and does not cry
- The ribs and bones are easily seen
- The skin under the upper arms appears loose
- On the back, the ribs and shoulder bones are easily seen
- In extreme cases of wasting, the skin on the buttocks has a "baggy pants" look
- No bilateral pitting oedema

These children have lost fat and muscle and will weigh less than other children of similar height.

INDICATOR
Severe wasting :

MUAC < 110 mm
Z-score < -3 (WHO)
WFH < 70% of median (NCHS)

PICTURE

CLINICAL SIGNS OF KWASHIORKOR (BILATERAL PITTING OEDEMA)

A child with kwashiorkor (bilateral pitting oedema) might have these characteristics:

- "Moon face"
- Dermatosis: flaky skin or patches of abnormally light or dark skin (in severe cases)
- Apathy, little energy
- Loss of appetite
- Hair changes
- Irritable, cries easily

INDICATOR
Bilateral pitting oedema

PICTURE

CLINICAL SIGNS OF MARASMIC KWASHIORKOR

A child with marasmic kwashiorkor has these characteristics:

- Bilateral pitting oedema
- Severe wasting

PICTURE

INDICATOR

Bilateral pitting oedema
And
Severe Wasting

MUAC < 110 mm
Z-score < -3 (WHO)
WFH < 70% of median (NCHS)

HANDOUT 2.4

ASSESSING AGE, BILATERAL PITTING OEDEMA, MUAC, WEIGHT AND HEIGHT

1. AGE

In CMAM, estimating a child's age is relevant for a number of reasons. CMAM outpatient care targets children between 6-59 months. A child under 6 months with severe acute malnutrition (SAM) and no medical complications is not eligible for outpatient care as older children would be. Mid-upper arm circumference (MUAC) is only used for children 6-59 months. And measuring height for WFH calculations is carried out differently for children under the age of two.

If birth dates are not recorded on a child health card (CHC) or immunisation card and it is necessary to determine the age, the recall of the mother/caregiver is used to estimate the child's age.

Age is easy to estimate for younger children but is often difficult to determine for older children. The mother/caregiver's recall is valid for assessing the age of a young infant in case of absence of proof. Otherwise, the child's ability to swallow semi-solids will be tested using ready-to-use therapeutic food (RUTF). If the child eats the RUTF (passes the appetite test) then the child is considered to be 6 months and the MUAC measurement is valid as an admission criterion for CMAM.

Other methods of estimating age include:

- Asking the mother/caregiver if the child was born before or after certain major local events until a fairly accurate age is pinpointed. It might be helpful to develop a local event calendar. The World Health Organization (WHO) Child Age Calculator, a rotating disk mounted on a calendar, has been developed as a job aid for health workers to calculate a child's age. The calculators might be available at regional WHO offices. Also, the Food and Agriculture Organisation of the United Nations (FAO) has developed guidelines to estimate the month and year of birth (Draft, 2008).

- Estimating age based on height. The standard international height proxy for children 59 months is 110 cm. Note that while the standard international height proxy for children 6 months is 65 cm, it is not recommended to use this height cutoff in stunted populations. The mother/caregiver's recall is much more accurate in these cases.

2. BILATERAL PITTING OEDEMA

Bilateral pitting oedema, or kwashiorkor, can be verified when thumb pressure applied on top of both feet for three seconds leaves a pit (indentation) in the foot after the thumb is lifted. The pit will remain in both feet for several seconds. Bilateral pitting oedema usually starts in the feet and ankles. It is important to test both feet; if the pitting is not bilateral, the oedema is not of nutritional origin. The presence of bilateral pitting oedema should be confirmed by a second person who repeats the test.

There are three grades of bilateral pitting oedema. When there is no bilateral pitting oedema, the grade is "absent." Grades of bilateral pitting oedema are classified by plus signs.

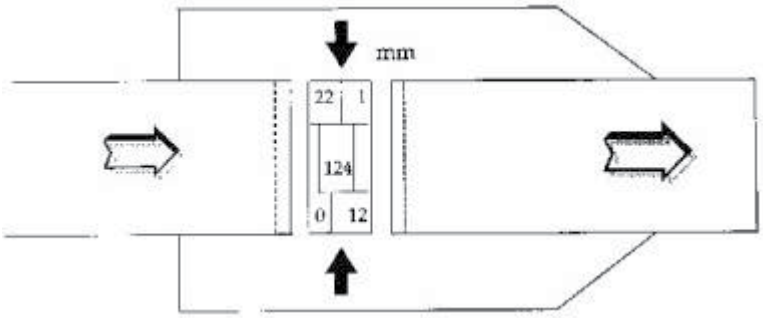
Grades of bilateral pitting oedema	Definition
Absent	Absent
Grade +	Mild: Both feet/ankles
Grade ++	Moderate: Both feet, plus lower legs, hands or lower arms
Grade +++	Severe: Generalised bilateral pitting oedema, including both feet, legs, arms and face

3. MUAC

MUAC is used for children age 6-59 months (see **Age** section above).

MUAC should be measured on the left upper arm while the arm is hanging down the side of the body and relaxed. The tape should be placed at the midpoint between the shoulder and the tip of the elbow. It is recommended to use a string instead of the MUAC tape to find the midpoint.

For the numbered tapes, feed the end of the tape down through the first opening and up through the third opening. The measurement is read from the middle window where the arrows point inward. MUAC can be recorded with a precision of 1 mm. Read the number in the box that is completely visible in the middle window. For the example below, it is 124 mm.



For the simple three-colour tape (red, yellow, green), slide the end through the first opening and then through the second opening. Read the colour that shows through the window at the point the two arrows indicate.

Photo Credit: WHO-Tanzania, training on the management of severe acute malnutrition, September 2006 (Valid International)

4. WEIGHT

To increase accuracy and precision, two people are always needed to measure weight. Weight may be measured using a Salter-type hanging spring scale (as is commonly found in the field) or an electronic scale such as the United Nations Children's Fund (UNICEF) UNISCALE, which is more precise and allows a child to be measured in the mother/caregiver's arms.

Hanging Spring (Salter) Scale
A 25-kg hanging spring scale, graduated by 0.100 kg, is most commonly used. In the field setting, the scale is hooked to a tree, a tripod or a stick held by two people. In a clinic, it is attached to the ceiling or a stand.

Weighing pants (or a weighing hammock for smaller infants) are attached to the scale. However, culturally adapted solutions, such as a mother's wrap, basin or grass basket, are preferable to use to weigh the child; these are suspended from the lower hook of the scale, and the scale is readjusted to zero. The child's clothes are removed, and the child is placed in the weighing pants (or alternative). The scale should be read at eye level.

Considerations:

- Make sure the child is safely in the weighing pants or hammock with one arm in front and one arm behind to help maintain balance.
- In cold climates or in certain cultures, it might be impossible or impractical to undress a child completely. The average weight of the clothes should be estimated and deducted from the measure. It is helpful to retain similar clothing for girls and boys during weighing to help to standardize the weight deductions.
- When the child is steady and settled, the weight is recorded to the nearest 100 grams. If the child is moving and the needle does not stabilise, the weight should be estimated by recording the value at the midpoint of the range of oscillations. The measurer announces the value read from the scale, the assistant repeats it for verification and records it on the clinic form or CHC. The child is then dressed.
- The scale should be checked daily against a known weight. To do this, set the scale to zero and weigh objects of known weight (e.g., 5, 10 or 15 kg). If the measure does not match the weight to within 10 grams, the scale should be replaced or the springs must be changed.

Electronic Scale (e.g., UNISCALE)
The UNISCALE, which is very precise, is powered by a lithium battery good for one million weighings and a solar switch that turns the device on in daylight or a normally lit room. It is designed to allow a mother/caregiver to hold the child while the child is being weighed. The scale comes with instructions.

To use the UNISCALE:

- Place the scale on a flat surface in a well-lit area, making sure that all four of the scale's feet are on the ground.
- Remove as much clothing as possible from the child.
- Wave a hand over the solar switch to turn on the scale. The scale indicates that it is ready to weigh an adult. (A picture of an adult is shown.)

- The mother/caregiver stands on the scale first, without the child. The weight is shown. The adult remains on the scale. The scale stores this weight in its memory.
- Wave a hand over the solar switch again. The scale indicates that it is ready to weigh an adult with a child. (A picture of an adult holding a child is shown.)
- Pass the child to be weighed to the adult on the scale (the adult should remain still).
- The scale indicates the child's weight.

Note: Infants under 6 months with SAM are referred to inpatient care for SAM with medical complications where specific infant scales with a precision of **10 g or 20 g** should be available.

5. LENGTH AND HEIGHT

To increase accuracy and precision, two people are always needed to measure length and height.

Children age 2 or older are measured standing up, while those under 2 are measured lying down. If the age is difficult to assess, children at least 85 cm (National Centre for Health Statistics [NCHS] references) or 87 cm tall (WHO standards) are measured standing, and those under 85 cm (NCHS) or 87 cm (WHO) are measured lying down. If children age 2 or older or at least 85 cm (NCHS) or 87 cm tall (WHO) are measured lying down, 0.5 cm is subtracted from the measurement.

For children age 2 or older or with a height of 85 cm (NCHS) / 87 cm (WHO) or more:
The child's shoes are removed. The child is placed on the height board, standing upright in the middle of the board. The child's ankles and knees should be firmly pressed against the board by the assistant while the measurer positions the head and the sliding board. The child's head, shoulders, buttocks and heels should be touching the board. The measurer reads out loud the measurement to the nearest 0.1 cm. The assistant repeats the measurement for verification and records it on the anthropometric form or health card. A height stick or tape secured against a wall also can be used to quickly measure a child's length or height.

For children under age 2 or with a height below 85 cm (NCHS) / 87 cm (WHO):
The height board is placed on the ground. The child's shoes are removed. The child is gently placed on his/her back on the middle of the board. The assistant holds the sides of the child's head and positions the head touching the board. The measurer places his/her hands on the child's ankles or knees. While positioning the child's legs, the measurer positions the sliding board up against the bottom of the child's feet, which should be at right angles. The measurer reads the measurement to the nearest 0.1 cm out loud. The assistant repeats the measurement for verification and records it on the anthropometric form or health card.

HANDOUT 2.5
WEIGHT-FOR-HEIGHT TABLES FOR FIELD USE

WHO SEX-SPECIFIC CHILD GROWTH STANDARDS (2006), EXPRESSED AS Z-SCORE (SD) ASSESSED SUPINE UP TO 86.9 CM (LENGTH) AND STANDING FROM 87.0 CM (HEIGHT)

Length is measured for children below 87 cm. For children 87 cm or more, height is measured. Recumbent length is on average 0.5 cm greater than standing height, although the difference is of no importance to individual children, a correction may be made by subtracting 0.5 cm from all lengths above 86.9 cm if standing height can not be measured.

BOYS' WEIGHT (kg)						GIRLS' WEIGHT (kg)				
-4 SD	-3 SD	-2 SD	-1 SD	Median	LENGTH (cm)	Median	-1 SD	-2 SD	-3 SD	-4 SD
1.7	1.9	2.0	2.2	2.4	**45.0**	2.5	2.3	2.1	1.9	1.7
1.8	2.0	2.2	2.4	2.6	**46.0**	2.6	2.4	2.2	2.0	1.9
2.0	2.1	2.3	2.5	2.8	**47.0**	2.8	2.6	2.4	2.2	2.0
2.1	2.3	2.5	2.7	2.9	**48.0**	3.0	2.7	2.5	2.3	2.1
2.2	2.4	2.6	2.9	3.1	**49.0**	3.2	2.9	2.6	2.4	2.2
2.4	2.6	2.8	3.0	3.3	**50.0**	3.4	3.1	2.8	2.6	2.4
2.5	2.7	3.0	3.2	3.5	**51.0**	3.6	3.3	3.0	2.8	2.5
2.7	2.9	3.2	3.5	3.8	**52.0**	3.8	3.5	3.2	2.9	2.7
2.9	3.1	3.4	3.7	4.0	**53.0**	4.0	3.7	3.4	3.1	2.8
3.1	3.3	3.6	3.9	4.3	**54.0**	4.3	3.9	3.6	3.3	3.0
3.3	3.6	3.8	4.2	4.5	**55.0**	4.5	4.2	3.8	3.5	3.2
3.5	3.8	4.1	4.4	4.8	**56.0**	4.8	4.4	4.0	3.7	3.4
3.7	4.0	4.3	4.7	5.1	**57.0**	5.1	4.6	4.3	3.9	3.6
3.9	4.3	4.6	5.0	5.4	**58.0**	5.4	4.9	4.5	4.1	3.8
4.1	4.5	4.8	5.3	5.7	**59.0**	5.6	5.1	4.7	4.3	3.9
4.3	4.7	5.1	5.5	6.0	**60.0**	5.9	5.4	4.9	4.5	4.1
4.5	4.9	5.3	5.8	6.3	**61.0**	6.1	5.6	5.1	4.7	4.3
4.7	5.1	5.6	6.0	6.5	**62.0**	6.4	5.8	5.3	4.9	4.5
4.9	5.3	5.8	6.2	6.8	**63.0**	6.6	6.0	5.5	5.1	4.7
5.1	5.5	6.0	6.5	7.0	**64.0**	6.9	6.3	5.7	5.3	4.8
5.3	5.7	6.2	6.7	7.3	**65.0**	7.1	6.5	5.9	5.5	5.0
5.5	5.9	6.4	6.9	7.5	**66.0**	7.3	6.7	6.1	5.6	5.1
5.6	6.1	6.6	7.1	7.7	**67.0**	7.5	6.9	6.3	5.8	5.3
5.8	6.3	6.8	7.3	8.0	**68.0**	7.7	7.1	6.5	6.0	5.5
6.0	6.5	7.0	7.6	8.2	**69.0**	8.0	7.3	6.7	6.1	5.6
6.1	6.6	7.2	7.8	8.4	**70.0**	8.2	7.5	6.9	6.3	5.8
6.3	6.8	7.4	8.0	8.6	**71.0**	8.4	7.7	7.0	6.5	5.9
6.4	7.0	7.6	8.2	8.9	**72.0**	8.6	7.8	7.2	6.6	6.0
6.6	7.2	7.7	8.4	9.1	**73.0**	8.8	8.0	7.4	6.8	6.2
6.7	7.3	7.9	8.6	9.3	**74.0**	9.0	8.2	7.5	6.9	6.3
6.9	7.5	8.1	8.8	9.5	**75.0**	9.1	8.4	7.7	7.1	6.5
7.0	7.6	8.3	8.9	9.7	**76.0**	9.3	8.5	7.8	7.2	6.6
7.2	7.8	8.4	9.1	9.9	**77.0**	9.5	8.7	8.0	7.4	6.7
7.3	7.9	8.6	9.3	10.1	**78.0**	9.7	8.9	8.2	7.5	6.9
7.4	8.1	8.7	9.5	10.3	**79.0**	9.9	9.1	8.3	7.7	7.0
7.6	8.2	8.9	9.6	10.4	**80.0**	10.1	9.2	8.5	7.8	7.1
7.7	8.4	9.1	9.8	10.6	**81.0**	10.3	9.4	8.7	8.0	7.3
7.9	8.5	9.2	10.0	10.8	**82.0**	10.5	9.6	8.8	8.1	7.5
8.0	8.7	9.4	10.2	11.0	**83.0**	10.7	9.8	9.0	8.3	7.6
8.2	8.9	9.6	10.4	11.3	**84.0**	11.0	10.1	9.2	8.5	7.8
8.4	9.1	9.8	10.6	11.5	**85.0**	11.2	10.3	9.4	8.7	8.0
8.6	9.3	10.0	10.8	11.7	**86.0**	11.5	10.5	9.7	8.9	8.1
8.7	9.5	10.2	11.1	12.0	**87.0**	11.7	10.7	9.9	9.1	8.3
8.9	9.7	10.5	11.3	12.2	**88.0**	12.0	11.0	10.1	9.3	8.5
9.1	9.9	10.7	11.5	12.5	**89.0**	12.2	11.2	10.3	9.5	8.7
9.3	10.1	10.9	11.8	12.7	**90.0**	12.5	11.4	10.5	9.7	8.8
9.5	10.3	11.1	12.0	13.0	**91.0**	12.7	11.7	10.7	9.9	9.0
9.7	10.5	11.3	12.2	13.2	**92.0**	13.0	11.9	10.9	10.1	9.2
9.8	10.7	11.5	12.4	13.4	**93.0**	13.2	12.1	11.1	10.2	9.4
10.0	10.8	11.7	12.6	13.7	**94.0**	13.5	12.3	11.3	10.4	9.5
10.2	11.0	11.9	12.8	13.9	**95.0**	13.7	12.6	11.5	10.6	9.7
10.3	11.2	12.1	13.1	14.1	**96.0**	14.0	12.8	11.7	10.8	9.9
10.5	11.4	12.3	13.3	14.4	**97.0**	14.2	13.0	12.0	11.0	10.1
10.7	11.6	12.5	13.5	14.6	**98.0**	14.5	13.3	12.2	11.2	10.2
10.8	11.8	12.7	13.7	14.9	**99.0**	14.8	13.5	12.4	11.4	10.4
11.0	12.0	12.9	14.0	15.2	**100.0**	15.0	13.7	12.6	11.6	10.6

WHO SEX-SPECIFIC CHILD GROWTH STANDARDS (2006), EXPRESSED AS Z-SCORE (SD) ASSESSED SUPINE UP TO 86.9 CM (LENGTH) AND STANDING FROM 87.0 CM (HEIGHT)

Length is measured for children below 87 cm. For children 87 cm or more, height is measured. Recumbent length is on average 0.5 cm greater than standing height, although the difference is of no importance to individual children, a correction may be made by subtracting 0.5 cm from all lengths above 86.9 cm if standing height can not be measured.

BOYS' WEIGHT (kg)						GIRLS' WEIGHT (kg)				
-4 SD	-3 SD	-2 SD	-1 SD	Median	HEIGHT (cm)	Median	-1 SD	-2 SD	-3 SD	-4 SD
5.4	5.9	6.3	6.9	7.4	**65.0**	7.2	6.6	6.1	5.6	5.1
5.6	6.1	6.5	7.1	7.7	**66.0**	7.5	6.8	6.3	5.8	5.3
5.7	6.2	6.7	7.3	7.9	**67.0**	7.7	7.0	6.4	5.9	5.4
5.9	6.4	6.9	7.5	8.1	**68.0**	7.9	7.2	6.6	6.1	5.6
6.1	6.6	7.1	7.7	8.4	**69.0**	8.1	7.4	6.8	6.3	5.7
6.2	6.8	7.3	7.9	8.6	**70.0**	8.3	7.6	7.0	6.4	5.9
6.4	6.9	7.5	8.1	8.8	**71.0**	8.5	7.8	7.1	6.6	6.0
6.5	7.1	7.7	8.3	9.0	**72.0**	8.7	8.0	7.3	6.7	6.1
6.7	7.3	7.9	8.5	9.2	**73.0**	8.9	8.1	7.5	6.9	6.3
6.8	7.4	8.0	8.7	9.4	**74.0**	9.1	8.3	7.6	7.0	6.4
7.0	7.6	8.2	8.9	9.6	**75.0**	9.3	8.5	7.8	7.2	6.6
7.1	7.7	8.4	9.1	9.8	**76.0**	9.5	8.7	8.0	7.3	6.7
7.3	7.9	8.5	9.2	10.0	**77.0**	9.6	8.8	8.1	7.5	6.8
7.4	8.0	8.7	9.4	10.2	**78.0**	9.8	9.0	8.3	7.6	7.0
7.5	8.2	8.8	9.6	10.4	**79.0**	10.0	9.2	8.4	7.8	7.1
7.7	8.3	9.0	9.7	10.6	**80.0**	10.2	9.4	8.6	7.9	7.2
7.8	8.5	9.2	9.9	10.8	**81.0**	10.4	9.6	8.8	8.1	7.4
8.0	8.7	9.3	10.1	11.0	**82.0**	10.7	9.8	9.0	8.3	7.6
8.1	8.8	9.5	10.3	11.2	**83.0**	10.9	10.0	9.2	8.5	7.7
8.3	9.0	9.7	10.5	11.4	**84.0**	11.1	10.2	9.4	8.6	7.9
8.5	9.2	10.0	10.8	11.7	**85.0**	11.4	10.4	9.6	8.8	8.1
8.7	9.4	10.2	11.0	11.9	**86.0**	11.6	10.7	9.8	9.0	8.3
8.9	9.6	10.4	11.2	12.2	**87.0**	11.9	10.9	10.0	9.2	8.4
9.1	9.8	10.6	11.5	12.4	**88.0**	12.1	11.1	10.2	9.4	8.6
9.3	10.0	10.8	11.7	12.6	**89.0**	12.4	11.4	10.4	9.6	8.8
9.4	10.2	11.0	11.9	12.9	**90.0**	12.6	11.6	10.6	9.8	9.0
9.6	10.4	11.2	12.1	13.1	**91.0**	12.9	11.8	10.9	10.0	9.1
9.8	10.6	11.4	12.3	13.4	**92.0**	13.1	12.0	11.1	10.2	9.3
9.9	10.8	11.6	12.6	13.6	**93.0**	13.4	12.3	11.3	10.4	9.5
10.1	11.0	11.8	12.8	13.8	**94.0**	13.6	12.5	11.5	10.6	9.7
10.3	11.1	12.0	13.0	14.1	**95.0**	13.9	12.7	11.7	10.8	9.8
10.4	11.3	12.2	13.2	14.3	**96.0**	14.1	12.9	11.9	10.9	10.0
10.6	11.5	12.4	13.4	14.6	**97.0**	14.4	13.2	12.1	11.1	10.2
10.8	11.7	12.6	13.7	14.8	**98.0**	14.7	13.4	12.3	11.3	10.4
11.0	11.9	12.9	13.9	15.1	**99.0**	14.9	13.7	12.5	11.5	10.5
11.2	12.1	13.1	14.2	15.4	**100.0**	15.2	13.9	12.8	11.7	10.7
11.3	12.3	13.3	14.4	15.6	**101.0**	15.5	14.2	13.0	12.0	10.9
11.5	12.5	13.6	14.7	15.9	**102.0**	15.8	14.5	13.3	12.2	11.1
11.7	12.8	13.8	14.9	16.2	**103.0**	16.1	14.7	13.5	12.4	11.3
11.9	13.0	14.0	15.2	16.5	**104.0**	16.4	15.0	13.8	12.6	11.5
12.1	13.2	14.3	15.5	16.8	**105.0**	16.8	15.3	14.0	12.9	11.8
12.3	13.4	14.5	15.8	17.2	**106.0**	17.1	15.6	14.3	13.1	12.0
12.5	13.7	14.8	16.1	17.5	**107.0**	17.5	15.9	14.6	13.4	12.2
12.7	13.9	15.1	16.4	17.8	**108.0**	17.8	16.3	14.9	13.7	12.4
12.9	14.1	15.3	16.7	18.2	**109.0**	18.2	16.6	15.2	13.9	12.7
13.2	14.4	15.6	17.0	18.5	**110.0**	18.6	17.0	15.5	14.2	12.9
13.4	14.6	15.9	17.3	18.9	**111.0**	19.0	17.3	15.8	14.5	13.2
13.6	14.9	16.2	17.6	19.2	**112.0**	19.4	17.7	16.2	14.8	13.5
13.8	15.2	16.5	18.0	19.6	**113.0**	19.8	18.0	16.5	15.1	13.7
14.1	15.4	16.8	18.3	20.0	**114.0**	20.2	18.4	16.8	15.4	14.0
14.3	15.7	17.1	18.6	20.4	**115.0**	20.7	18.8	17.2	15.7	14.3
14.6	16.0	17.4	19.0	20.8	**116.0**	21.1	19.2	17.5	16.0	14.5
14.8	16.2	17.7	19.3	21.2	**117.0**	21.5	19.6	17.8	16.3	14.8
15.0	16.5	18.0	19.7	21.6	**118.0**	22.0	19.9	18.2	16.6	15.1
15.3	16.8	18.3	20.0	22.0	**119.0**	22.4	20.3	18.5	16.9	15.4
15.5	17.1	18.6	20.4	22.4	**120.0**	22.8	20.7	18.9	17.3	15.6

NCHS/CDC/WHO SEX-COMBINED CHILD GROWTH REFERENCES (1982), WEIGHT FOR HEIGHT INDEX EXPRESSED AS A PERCENTAGE OF THE MEDIAN WITH HEIGHT ASSESSED SUPINE UP TO 84.5 CM (LENGTH) AND STANDING FROM 85.0 CM (HEIGHT)

				MALNUTRITION		
				Moderate		Severe
Height in cm	100% in Kg	85% in Kg	80% in Kg	75% in Kg	70% in Kg	60% in Kg
49,0	3,2	2,7	2,6	2,4	2,2	1,9
49,5	3,3	2,8	2,6	2,5	2,3	2,0
50,0	3,4	2,9	2,7	2,6	2,4	2,0
50,5	3,4	2,9	2,7	2,6	2,4	2,0
51,0	3,5	3,0	2,8	2,6	2,5	2,1
51,5	3,6	3,1	2,9	2,7	2,5	2,2
52,0	3,7	3,1	3,0	2,8	2,6	2,2
52,5	3,8	3,2	3,0	2,9	2,7	2,3
53,0	3,9	3,3	3,1	2,9	2,7	2,3
53,5	4,0	3,4	3,2	3,0	2,8	2,4
54,0	4,1	3,5	3,3	3,1	2,9	2,5
54,5	4,2	3,6	3,4	3,2	2,9	2,5
55,0	4,3	3,7	3,5	3,2	3,0	2,6
55,5	4,4	3,8	3,5	3,3	3,1	2,6
56,0	4,6	3,9	3,6	3,5	3,2	2,8
56,5	4,7	4,0	3,7	3,5	3,3	2,8
57,0	4,8	4,1	3,8	3,6	3,4	2,9
57,5	4,9	4,2	3,9	3,7	3,4	2,9
58,0	5,1	4,3	4,0	3,8	3,6	3,1
58,5	5,2	4,4	4,2	3,9	3,6	3,1
59,0	5,3	4,5	4,3	4,0	3,7	3,2
59,5	5,5	4,6	4,4	4,1	3,9	3,3
60,0	5,6	4,8	4,5	4,2	3,9	3,4
60,5	5,7	4,9	4,6	4,3	4,0	3,4
61,0	5,9	5,0	4,7	4,4	4,1	3,5
61,5	6,0	5,1	4,8	4,5	4,2	3,6
62,0	6,2	5,2	4,9	4,7	4,3	3,7
62,5	6,3	5,4	5,0	4,7	4,4	3,8
63,0	6,5	5,5	5,2	4,9	4,6	3,9
63,5	6,6	5,6	5,3	5,0	4,6	4,0
64,0	6,7	5,7	5,4	5,0	4,7	4,0
64,5	6,9	5,9	5,5	5,2	4,8	4,1
65,0	7,0	6,0	5,6	5,3	4,9	4,2
65,5	7,2	6,1	5,7	5,4	5,0	4,3
66,0	7,3	6,2	5,9	5,5	5,1	4,4
66,5	7,5	6,4	6,0	5,6	5,3	4,5

				MALNUTRITION		
				Moderate		Severe
Height in cm	100% in Kg	85% in Kg	80% in Kg	75% in Kg	70% in Kg	60% in Kg
67,0	7,6	6,5	6,1	5,7	5,3	4,6
67,5	7,8	6,6	6,2	5,9	5,5	4,7
68,0	7,9	6,7	6,3	5,9	5,5	4,7
68,5	8,0	6,8	6,4	6,0	5,6	4,8
69,0	8,2	7,0	6,6	6,2	5,7	4,9
69,5	8,3	7,1	6,6	6,2	5,8	5,0
70,0	8,5	7,2	6,8	6,4	6,0	5,1
70,5	8,6	7,3	6,9	6,5	6,0	5,2
71,0	8,7	7,4	7,0	6,5	6,1	5,2
71,5	8,9	7,6	7,1	6,7	6,2	5,3
72,0	9,0	7,7	7,2	6,8	6,3	5,4
72,5	9,1	7,7	7,3	6,8	6,4	5,5
73,0	9,2	7,8	7,4	6,9	6,4	5,5
73,5	9,4	8,0	7,5	7,1	6,6	5,6
74,0	9,5	8,1	7,6	7,1	6,7	5,7
74,5	9,6	8,2	7,7	7,2	6,7	5,8
75,0	9,7	8,2	7,8	7,3	6,8	5,8
75,5	9,8	8,3	7,8	7,4	6,9	5,9
76,0	9,9	8,4	7,9	7,4	6,9	5,9
76,5	10,0	8,5	8,0	7,5	7,0	6,0
77,0	10,1	8,6	8,1	7,6	7,1	6,1
77,5	10,2	8,7	8,2	7,7	7,1	6,1
78,0	10,4	8,8	8,3	7,8	7,3	6,2
78,5	10,5	8,9	8,4	7,9	7,4	6,3
79,0	10,6	9,0	8,5	8,0	7,4	6,4
79,5	10,7	9,1	8,6	8,0	7,5	6,4
80,0	10,8	9,2	8,6	8,1	7,6	6,5
80,5	10,9	9,3	8,7	8,2	7,6	6,5
81,0	11,0	9,4	8,8	8,3	7,7	6,6
81,5	11,1	9,4	8,9	8,3	7,8	6,7
82,0	11,2	9,5	9,0	8,4	7,8	6,7
82,5	11,3	9,6	9,0	8,5	7,9	6,8
83,0	11,4	9,7	9,1	8,6	8,0	6,8
83,5	11,5	9,8	9,2	8,6	8,1	6,9
84,0	11,5	9,8	9,2	8,6	8,1	6,9
84,5	11,6	9,9	9,3	8,7	8,1	7,0

NCHS/CDC/WHO SEX-COMBINED CHILD GROWTH REFERENCES (1982), WEIGHT FOR HEIGHT INDEX EXPRESSED AS A PERCENTAGE OF THE MEDIAN WITH HEIGHT ASSESSED SUPINE UP TO 84.5 CM (LENGTH) AND STANDING FROM 85.0 CM (HEIGHT)

				MALNUTRITION		
				moderate		severe
Height in cm	100% in Kg	85% in Kg	80% in Kg	75% in Kg	70% in Kg	60% in Kg
85,0	12,0	10,2	9,6	9,0	8,4	7,2
85,5	12,1	10,3	9,7	9,1	8,5	7,3
86,0	12,2	10,4	9,8	9,2	8,5	7,3
86,5	12,3	10,5	9,8	9,2	8,6	7,4
87,0	12,4	10,5	9,9	9,3	8,7	7,4
87,5	12,5	10,6	10,0	9,4	8,8	7,5
88,0	12,6	10,7	10,1	9,5	8,8	7,6
88,5	12,8	10,9	10,2	9,6	9,0	7,7
89,0	12,9	11,0	10,3	9,7	9,0	7,7
89,5	13,0	11,1	10,4	9,8	9,1	7,8
90,0	13,1	11,1	10,5	9,8	9,2	7,9
90,5	13,2	11,2	10,6	9,9	9,2	7,9
91,0	13,3	11,3	10,6	10,0	9,3	8,0
91,5	13,4	11,4	10,7	10,1	9,4	8,0
92,0	13,6	11,6	10,9	10,2	9,5	8,2
92,5	13,7	11,6	11,0	10,3	9,6	8,2
93,0	13,8	11,7	11,0	10,4	9,7	8,3
93,5	13,9	11,8	11,1	10,4	9,7	8,3
94,0	14,0	11,9	11,2	10,5	9,8	8,4
94,5	14,2	12,1	11,4	10,7	9,9	8,5
95,0	14,3	12,2	11,4	10,7	10,0	8,6
95,5	14,4	12,2	11,5	10,8	10,1	8,6
96,0	14,5	12,3	11,6	10,9	10,2	8,7
96,5	14,7	12,5	11,8	11,0	10,3	8,8
97,0	14,8	12,6	11,8	11,1	10,4	8,9
97,5	14,9	12,7	11,9	11,2	10,4	8,9
98,0	15,0	12,8	12,0	11,3	10,5	9,0
98,5	15,2	12,9	12,2	11,4	10,6	9,1
99,0	15,3	13,0	12,2	11,5	10,7	9,2
99,5	15,4	13,1	12,3	11,6	10,8	9,2
100,0	15,6	13,3	12,5	11,7	10,9	9,4
100,5	15,7	13,3	12,6	11,8	11,0	9,4
101,0	15,8	13,4	12,6	11,9	11,1	9,5
101,5	16,0	13,6	12,8	12,0	11,2	9,6
102,0	16,1	13,7	12,9	12,1	11,3	9,7
102,5	16,2	13,8	13,0	12,2	11,3	9,7
103,0	16,4	13,9	13,1	12,3	11,5	9,8
103,5	16,5	14,0	13,2	12,4	11,6	9,9
104,0	16,7	14,2	13,4	12,5	11,7	10,0
104,5	16,8	14,3	13,4	12,6	11,8	10,1
105,0	16,9	14,4	13,5	12,7	11,8	10,1

				MALNUTRITION		
				moderate		severe
Height in cm	100% in Kg	85% in Kg	80% in Kg	75% in Kg	70% in Kg	60% in Kg
105,5	17,1	14,5	13,7	12,8	12,0	10,3
106,0	17,2	14,6	13,8	12,9	12,0	10,3
106,5	17,4	14,8	13,9	13,1	12,2	10,4
107,0	17,5	14,9	14,0	13,1	12,3	10,5
107,5	17,7	15,0	14,2	13,3	12,4	10,6
108,0	17,8	15,1	14,2	13,4	12,5	10,7
108,5	18,0	15,3	14,4	13,5	12,6	10,8
109,0	18,1	15,4	14,5	13,6	12,7	10,9
109,5	18,3	15,6	14,6	13,7	12,8	11,0
110,0	18,4	15,6	14,7	13,8	12,9	11,0
110,5	18,6	15,8	14,9	14,0	13,0	11,2
111,0	18,8	16,0	15,0	14,1	13,2	11,3
111,5	18,9	16,1	15,1	14,2	13,2	11,3
112,0	19,1	16,2	15,3	14,3	13,4	11,5
112,5	19,3	16,4	15,4	14,5	13,5	11,6
113,0	19,4	16,5	15,5	14,6	13,6	11,6
113,5	19,6	16,7	15,7	14,7	13,7	11,8
114,0	19,8	16,8	15,8	14,9	13,9	11,9
114,5	19,9	16,9	15,9	14,9	13,9	11,9
115,0	20,1	17,1	16,1	15,1	14,1	12,1
115,5	20,3	17,3	16,2	15,2	14,2	12,2
116,0	20,5	17,4	16,4	15,4	14,4	12,3
116,5	20,7	17,6	16,6	15,5	14,5	12,4
117,0	20,8	17,7	16,6	15,6	14,6	12,5
117,5	21,0	17,9	16,8	15,8	14,7	12,6
118,0	21,2	18,0	17,0	15,9	14,8	12,7
118,5	21,4	18,2	17,1	16,1	15,0	12,8
119,0	21,6	18,4	17,3	16,2	15,1	13,0
119,5	21,8	18,5	17,4	16,4	15,3	13,1
120,0	22,0	18,7	17,6	16,5	15,4	13,2
120,5	22,2	18,9	17,8	16,7	15,5	13,3
121,0	22,4	19,0	17,9	16,8	15,7	13,4
121,5	22,6	19,2	18,1	17,0	15,8	13,6
122,0	22,8	19,4	18,2	17,1	16,0	13,7
122,5	23,1	19,6	18,5	17,3	16,2	13,9
123,0	23,3	19,8	18,6	17,5	16,3	14,0
123,5	23,5	20,0	18,8	17,6	16,5	14,1
124,0	23,7	20,1	19,0	17,8	16,6	14,2
124,5	24,0	20,4	19,2	18,0	16,8	14,4
125,0	24,2	20,6	19,4	18,2	16,9	14,5
125,5	24,4	20,7	19,5	18,3	17,1	14,6

EXERCISE 2.1
GRADES OF BILATERAL PITTING OEDEMA

PHOTO 1

Clinical signs:

Anthropometry:

PHOTO 2

Clinical signs:

Anthropometry:

PHOTO 3

Clinical signs:

Anthropometry:

EXERCISE 2.2
CALCULATING WFH AND CLASSIFYING ACUTE MALNUTRITION

Bilateral Pitting Oedema and Mid-Upper Arm Circumference (MUAC)

Child Name	Age (in years unless noted)	Bilateral Pitting Oedema	MUAC (mm or colour)	Classification
Child 1	3	no	Green	
Child 2	5	no	123	
Child 3	5	++	Yellow	
Child 4	4	no	110	
Child 5	9 months	no	125	
Child 6	4	+++	Yellow	
Child 7	8 months	+	105	
Child 8	1	no	Red	
Child 9	2	no	109	
Child 10	1.5	+	Green	

Bilateral Pitting Oedema, MUAC and Weight-for-height (WFH) Z-score (World Health Organization [WHO])

Child Name	Sex	Age (in years unless noted)	Bilateral Pitting Oedema	MUAC (mm or colour)	Height (cm)	Weight (kg)	WFH Z-Score Category	Classification
Child 1	F	3	no	Green	98.2	12.5		
Child 2	M	5	no	123	110.0	14.8		
Child 3	M	5	++	Yellow	102.2	13.5		
Child 4	F	4	no	110	91.1	9.3		
Child 5	M	9 months	no	125	69.9	6.7		
Child 6	F	4	+++	Yellow	105.2	18		
Child 7	F	8 months	+	105	68.2	5.0		
Child 8	M	1	no	Red	84.3	8.9		
Child 9	F	2	no	109	97.2	11		
Child 10	M	1.5	+	Green	89.7	12.9		

Bilateral Pitting Oedema, MUAC and WFH as a Percentage of the Median (National Centre for Health Statistics [NCHS])

Child Name	Age (in years unless noted)	Bilateral Pitting Oedema	MUAC (mm or colour)	Height (cm)	Weight (kg)	WFH as a Percentage of the Median	Classification
Child 1	3	no	Green	98.2	12.5		
Child 2	5	no	123	110.0	14.8		
Child 3	5	++	Yellow	102.2	13.5		
Child 4	4	no	110	91.1	9.3		
Child 5	9 months	no	125	69.9	6.7		
Child 6	4	+++	Yellow	105.2	18		
Child 7	8 months	+	105	68.2	5.0		
Child 8	1	no	Red	84.3	8.9		
Child 9	2	no	109	97.2	11		
Child 10	1.5	+	Green	89.7	12.9		