GUIDE TO ANTHROPOMETRY

A Practical Tool for Program Planners, Managers, and Implementers

Kristen Cashin and Lesley Oot

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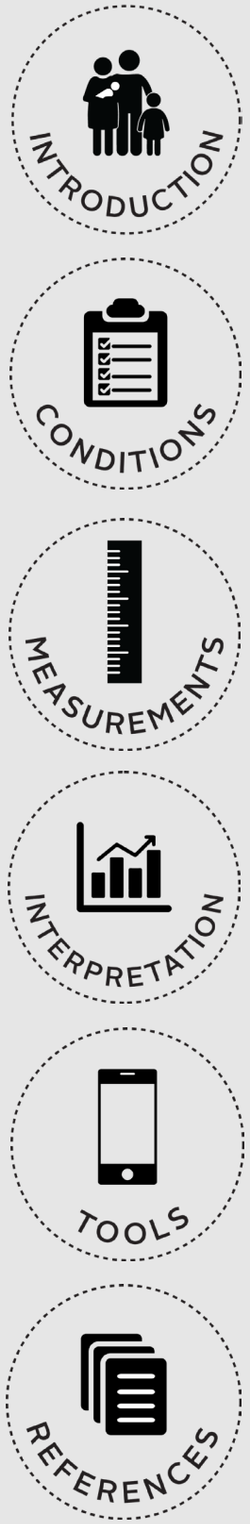

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Abbreviations and Acronyms

BMI	body mass index
CDC	U.S. Centers for Disease Control and Prevention
CMAM	community-based management of acute malnutrition
DHS	Demographic and Health Survey
FANTA	Food and Nutrition Technical Assistance III Project
GDP	gross domestic product
HFA	height-for-age
HIV	human immunodeficiency virus
INTER-GROWTH 21st	International Fetal and Newborn Growth Consortium for the 21st Century
IOM	Institute of Medicine
IPC	Integrated Food Security Phase Classification
LBW	low birth weight
MAM	moderate acute malnutrition
MGRS	Multicentre Growth Reference Study
MICS	Multiple Indicator Cluster Survey
MUAC	mid-upper arm circumference
NCHS	National Center for Health Statistics
NGO	nongovernmental organization
SAM	severe acute malnutrition
SD	standard deviation
SGA	small for gestational age
TB	tuberculosis
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
WFA	weight-for-age
WFH	weight-for-height
WHO	World Health Organization

What Is the FANTA Guide to Anthropometry?

The FANTA *Guide to Anthropometry* is a user-friendly reference that provides up-to-date information on anthropometry—the measurement of the human body—and how to use it to assess and understand the nutritional status of individuals and populations. It replaces the *Anthropometric Indicators Measurement Guide*, published in 2003, and provides comprehensive information on the importance of good nutrition, common nutrition conditions, anthropometric measurements, indices, and indicators; and data interpretation as well as measurement protocols and information on equipment selection. The new guide reflects several significant advances, including the release of the World Health Organization (WHO) Child Growth Standards and the WHO Growth Reference for children 5–19 years, the use of mid-upper arm circumference as a key indicator for acute malnutrition, and the increased interest in the nutrition of adolescents and adults in developing countries.

The guide focuses on anthropometric measurements that are commonly used in low-resource settings and that require reasonably affordable and accessible equipment. It does not discuss measurements that require unique or expensive equipment that is not commonly available in low-resource settings (e.g., sonogram equipment to determine gestational age). The guide does not provide information on planning and implementing surveys. Guidance on survey planning and implementation is forthcoming from Feed the Future and WHO. Links to those resources will be added here when available.

Who Is the Audience for the Guide?

The guide helps health and development professionals to better collect, understand, and/or use anthropometric data as part of service provision, surveillance, surveys, monitoring and evaluation, or program design. The guidance here, including the protocols, can be used as part of providing regular health services in a clinic or community setting or to inform the use of anthropometric measurement in population-based surveys. The guide is also useful for anyone engaged in improving or understanding food security, nutrition, or health in developing countries who wishes to better understand the information provided through anthropometry.

What Information Is in the Guide and How Is It Organized?

The guide focuses on anthropometry in low-resource developing countries. There are six modules and a section of annexes:

Module 1 explains anthropometry and its use, defines key nutrition concepts (such as undernutrition and overweight), and includes a summary of all anthropometric measurements, indices, indicators, and cutoffs provided in the guide. Users are encouraged to use Module 1 as a background reference for the more specific content provided for the demographic groups in Modules 2–5.

Modules 2–5 are organized into sections that:

- Describe the module's contents and explain the importance of nutrition for the module's demographic group
- Describe the common nutrition conditions identified by anthropometry that affect the demographic group
- Explain the measurements, indices, and indicators that identify common nutrition conditions
- Explain how to interpret the data and classify nutritional status
- Describe helpful tools for monitoring and classifying nutritional status

Module 6 includes detailed protocols that provide step-by-step directions for conducting and recording the measurements relevant to Modules 2–5. The module also includes basic information on the common types of equipment needed for anthropometry, basic standards to help select equipment, and information on where to purchase it.

Within a module, you can navigate quickly to different sections using the buttons on the right.

To access any module, click on the tabs along the bottom.

MODULE 1
Anthropometry Basics

What Does this Module Cover?

Module 1 provides an overview of anthropometry (measurement of the human body) for nutritional assessment. It explains key concepts that are relevant to all the modules in the guide:

- why nutrition matters
- the definition of anthropometry
- common uses of anthropometry
- commonly used anthropometric measurements, indices, and indicators
- information on how to interpret anthropometric data at the individual and population level

How the Demographic Groups in this Guide Are Defined

Modules 2–5 in this guide focus on anthropometry for specific demographic groups, which are defined as follows:

Children from birth to five years of age (Module 2) aligns with the ages covered by the World Health Organization (WHO) Child Growth Standards and refers to children from birth–60 ***completed*** months of age. At age 5 years and 1 month, they are no longer compared to the WHO Child Growth Standards.

Children and adolescents 5–19 years of age (Module 3) aligns with the WHO Growth Reference and refers to children age 61 months to 19 years (228 completed months). At age 19 years and 1 month, they are no longer compared to the WHO Growth Reference.

Pregnant and postpartum women and girls (Module 4) refers to women and girls of any age from the start of pregnancy until 6 months after delivery.

Adults (Module 5) refers to individuals 18 years of age (i.e., reached their 18th birthday) and older who are not pregnant or less than 6 months postpartum. ***Older adults*** refers to individuals 60 years of age (i.e., have reached their 60th birthday) and older.

Note: There is overlap in age groups between Module 3 (5–19 years of age) and Module 5 (18+ years of age). This is because the WHO Growth Reference includes children/adolescents up to 19 years of age and guidance for adults frequently begins at age 18 (e.g., WHO BMI cutoffs begin at age 18), which is commonly considered the beginning of adulthood. Clinicians should use their judgment on which indices, indicators, and cutoffs to use when measuring individuals who are between 18 and 19 years of age.

Nutrition indicators and/or programs commonly use slightly different age ranges or focus on a subset of the age groups described above. For example, they may focus on children age 6–59 months or 0–23 months.

Why Does Nutrition Matter?

Good nutrition is essential for the health, growth, development, and economic well-being of individuals and populations. Malnutrition—which occurs when an individual has inadequate, excessive, or imbalanced food intake that is not aligned with his/her nutritional needs—is a serious public health issue that contributes to high rates of maternal and child illness and mortality. In addition, malnourished individuals are less likely to achieve their full potential in terms of education and economic productivity, and they earn less income than well-nourished peers, making it difficult to break the cycle of poverty (Victora et al. 2008). When a high proportion of a population is malnourished, it weakens the entire economy, potentially reducing a country's gross domestic product (GDP) by as much as 3 percent (World Bank 2006). Addressing malnutrition is essential to promote development, and measuring nutritional status is crucial to identifying individuals who need nutritional care and support and to monitoring the nutrition situation of a population.

What Are the Main Types of Malnutrition?

Malnutrition can appear as either undernutrition (including micronutrient deficiency) or overweight/obesity. These are defined below.

Undernutrition is a consequence of inadequate nutrient intake and/or absorption, and/or illness or disease. Undernutrition increases the risk of illness and death—45 percent of deaths of children under 5 are attributable to various forms of undernutrition (Black et al. 2013). This is because poor nutrition impairs a person's immune system, making him/her more susceptible to illness and infections and less likely to recover. In addition, undernutrition, particularly early in life, hinders optimal physical growth and cognitive, motor, and socio-emotional development, which may in turn lead to short- and long-term impacts on learning and productivity (Grantham-McGregor 2007). The major types of undernutrition, which can occur alone or in combination, are **acute malnutrition** (wasting, thinness, and/or bilateral pitting edema), **chronic undernutrition** (stunting), **underweight** (a composite of stunting and wasting), and **micronutrient deficiencies** (e.g., deficiencies in vitamin A, iodine, iron, and zinc). Acute malnutrition, stunting, and underweight are in detail in later modules. Micronutrient deficiencies are assessed using biochemical and clinical methods—not by anthropometric measurements—and are therefore not addressed in this guide.

Overweight occurs when a person has too much body fat and weighs more than would be expected for a healthy person of the same height, putting his/her health at risk. **Obesity** is a severe form of overweight. Overweight and obesity are complex conditions with multiple possible causes, including an imbalance between calories consumed and calories expended, low levels of physical activity, medical conditions, and genetics, among others. Overweight and obesity increase the risk of non-communicable diseases including diabetes, heart disease, cancer, and stroke (Victora et al. 2008). Although undernutrition is still the primary concern in developing countries, globally, overweight and obesity are associated with more deaths than underweight (World Health Organization [WHO] 2016a). What was once considered an issue for high-income countries is now an emerging public health threat in countries across the globe, creating a double burden of malnutrition in many developing countries that continue to have a high prevalence of undernutrition.

What Is Anthropometry?

Anthropometry is the measurement of the human body. It is one of several approaches—which also include biochemical, clinical, and dietary assessment—used to assess nutritional status. Anthropometry can help identify the types of malnutrition present in an individual or population and measure progress toward improvement. However, it does not identify specific nutrient deficiencies (e.g., iron or vitamin A deficiency), which must be assessed through other methods. Common anthropometric measurements used in development programs include height/length, weight, and mid-upper arm circumference (MUAC). These and other measurements are discussed in detail later in relevant modules in this guide.

Anthropometry is used by health providers to identify individuals who are malnourished and refer them for proper care and treatment. At the population level, anthropometric data measured on multiple individuals (selected based on a representative sample) can be aggregated to provide an estimate of the nutritional status of a population, which can help inform program and policy decisions.

BOX 1.1 SCREENING VS. ASSESSMENT

Nutrition screening is a rapid process to identify people who may be malnourished and refer them for more detailed assessment and care. It can be done in a health facility or in a community setting through growth monitoring and promotion programs, community events, household visits, or group meetings.

Nutrition assessment involves collecting detailed information to identify specific nutrition problems and their causes and to develop an appropriate action plan to prevent or treat malnutrition or help manage other health conditions, such as HIV and tuberculosis (TB).

How Are Anthropometric Data Used?

Anthropometric data provide information on the nutritional status of individuals and/or populations. This information helps to determine nutrition trends, whether there is a nutrition problem, what to do about that problem, and whether the actions taken are working.

How Are Anthropometric Data Used for Individuals?

Nutrition Assessment and Screening

As part of nutrition assessment and screening, anthropometry is commonly used to assess the growth pattern and nutritional status of individuals, to identify at-risk or malnourished people so they can be referred to appropriate care, to tailor nutritional counseling and treatment to an individual's nutritional status, and to monitor the response of malnourished individuals to interventions. Anthropometry remains a key method of determining eligibility for certain care and support programs and is critical in determining what services are needed.

EXAMPLE *Assessing the MUAC of children to determine if they have acute malnutrition, and referring acutely malnourished children to appropriate treatment programs.*

How Are Anthropometric Data Used for Populations?

Nutrition Surveillance

This is the regular and systematic collection, analysis, and interpretation of data to track the nutrition trends of a population in a timely manner. Anthropometric data from nutrition surveillance help to inform policy decisions, target and design programs and interventions, and identify and raise awareness about deteriorating nutrition situations before they reach crisis levels.

EXAMPLE *Assessing the nutritional status of children in a food insecure region through quarterly surveys to monitor the nutrition situation and identify when extra support is needed.*

Influencing Policy and Strategy Development and Funding Levels

Anthropometric data have been used widely to raise awareness and gain political support to improve the nutrition situation in countries. Population-level anthropometric data can help governments, policymakers, and donors understand and prioritize nutrition issues, identify vulnerable populations, design policies and strategies, and set aside funding to implement the policies and strategies.

EXAMPLE

In response to data from a Demographic and Health Survey (DHS) indicating that stunting affects 38 percent of children under 5, a government develops a new nutrition policy and invests resources in malnutrition prevention.

Program Targeting, Design, and Planning

Anthropometric data, along with other key information, can help public health officials and nongovernmental organization (NGO) staff better define and understand the nutrition problems facing a population, enabling them to target interventions to the most nutritionally vulnerable—including specific age groups, sexes, ethnicities, socioeconomic groups, or regions—and develop an appropriate program to improve the situation.

EXAMPLE

While developing a nutrition action plan for a specific district, a public health official reviews the available anthropometric data and finds that acute malnutrition is elevated in the district. Based on these data, s/he includes community-based management of acute malnutrition as part of the nutrition action plan to address the problem.

Monitoring and Evaluation

Anthropometric data are frequently used to monitor the implementation and measure the effectiveness of food security and nutrition interventions and programs. Changes in specific population-level anthropometric indicators over the project's life are often used to measure a program's impact.

EXAMPLE

A food security program measures the percentage of children under 5 with stunting at baseline and endline to report on the change over time.

Global Tracking of Development Status

The development community uses anthropometric data to track a country's or population's health and/or nutritional status over an extended period of time. Anthropometry data are also used to compare the nutrition situation among countries and track nutrition-related global goals.

EXAMPLE

The Sustainable Development Goals for United Nations member states include anthropometric indicators for stunting, wasting, and overweight that countries report on as part of tracking progress on Goal 2, which aims to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

Anthropometric Measurements and Indices

When measuring individuals, anthropometry uses measurements and indices (in **Box 1.2**) and compares these to standards, references, or cutoffs (discussed in more detail in the **Interpretation** section) to determine the nutritional status of an individual or population.

The anthropometric measurements discussed in this guide are weight (including birth weight), height/length, knee height (which can serve as a proxy for height), MUAC, head circumference, waist circumference, and calf circumference. Some of these measurements (e.g., adult height) can be used alone to assess nutritional status. Others, such as children's height, do not provide enough information on their own and must be used in conjunction with age or another anthropometric measurement to provide meaningful information about nutritional status. The indices discussed in the guide include height/length-for-age, weight-for-height/length, weight-for-age, head circumference-for-age, body mass index (BMI), and BMI-for-age. The guide also provides information on bilateral pitting edema, a clinical sign of severe acute malnutrition (SAM), that is commonly assessed along with anthropometric measurements of undernutrition.

A variety of anthropometric measurements and indices are used to assess nutritional status. The appropriate anthropometric measurement and index to assess a given nutritional condition varies by condition and demographic group. **Table 1.1** presents a summary of the anthropometric measurements and indices in this guide, along with information about the nutritional condition each measurement/index can be used to identify and the appropriate demographic group for its use. More detail about each anthropometric measurement and index is provided in the demographic-specific Modules 2–5.

BOX 1.2 MEASUREMENT VS. INDEX

Anthropometric **measurements** assess the size, shape, and proportions of the human body. Commonly used anthropometric measurements include length/height, weight, and MUAC.

When two or more anthropometric measurements are combined with each other or with age, it is called an anthropometric **index**. This combination of information can be used to identify some nutritional conditions. Common anthropometric indices include weight-for-height, weight-for-age, height-for-age, BMI (combination of weight and height), and BMI-for-age.

TABLE 1.1 Summary of Measurements and Indices in this Guide

	Module 2 Children birth to 5 years	**Module 3** Children and adolescents 5–19 years	**Module 4** Pregnant/postpartum women and girls (up to 6 months after birth)	**Module 5** Adults 18 years and older (not pregnant or < 6 months postpartum)
Birth Weight [Low birth weight]	✓ (only for newborns)			
Length/Height-for-Age [Stunting]	✓	✓	✓ (girls < 19 years of age)	
Weight-for-Age [Underweight]	✓	✓ (5–10 years of age only)		
Weight-for-Length/Height [Wasting/acute malnutrition, overweight/obesity]	✓			
BMI-for-Age [Wasting (acute malnutrition) (0–59 months of age)/thinness (5–19 years of age), overweight/obesity]	✓	✓		
Head Circumference-for-Age [Microcephaly, which can result from chronic undernutrition]	✓			
MUAC [Acute malnutrition]	✓ (6–59 months only)	✓	✓	✓
BMI [Thinness/underweight, overweight/obesity]			✓ (pre-pregnancy only)	✓
Waist Circumference [Overweight/obesity]				✓
Height (Knee height) [Short stature]			✓	✓
Weight [Gestational weight gain, postpartum weight loss, and weight loss]			✓	✓
Calf Circumference [Proxy for thinness among older adults]				✓
Bilateral Pitting Edema [Severe acute malnutrition]	✓	✓	✓	✓

Interpreting Anthropometric Data and Classifying Nutritional Status

Correct interpretation of anthropometric data is critical to understanding whether an individual is at risk of malnutrition or is malnourished and what proportion of a population is affected by malnutrition. This helps ensure the right actions are taken both at the individual and population level. This section provides guidance on how to interpret and classify an individual's nutritional status using the various measurements/indices in this guide and discusses how to determine population-level concern.

Interpreting Anthropometric Data and Classifying Nutritional Status for Individuals

Once anthropometric measurements are collected for an individual, the data are compared to an accepted reference (growth standard, growth reference, or cutoff) to classify an individual's nutritional status (see **Box 1.3**). Based on these references—many of which are sex-specific because males and females grow differently—an individual may be classified as having normal nutritional status or as undernourished, overweight, or at risk of malnutrition. The classification also indicates how severely undernourished or overweight he or she is.

This guide seeks to be broadly applicable across countries. Whenever possible, the interpretation guidance provided is drawn from WHO or other internationally applicable resources that are frequently used in developing countries. International growth

BOX 1.3
KEY DEFINITIONS

A **growth standard** is prescriptive. It demonstrates how healthy children grow under ideal circumstances.

A **growth reference** describes how a specific population has grown but does not necessarily reflect optimal growth.

A **cutoff** is a threshold beyond which an individual is determined to be malnourished. It also identifies the severity of undernutrition or overweight/obesity in an individual. Cutoffs can be used at the population level to signify when a nutrition situation is considered to be of public health concern. See **Table 1.11**, Public Health Prevalence Thresholds, for cutoffs that indicate public health concern.

standards and growth references (see **Box 1.4**) exist and are useful for assessing and monitoring the growth and classifying the nutritional status of infants, children, and adolescents for some measurements. This includes the WHO Child Growth Standards for children from birth to 5 years and the WHO Growth Reference for children and adolescents 5–19 years. The guide also provides information on the INTERGROWTH-21st standards for fetal, newborn, and preterm infant growth.

However, while universally accepted international guidance exists for several of the measurements/indices and demographic groups in this guide (e.g., all measurements/indices of children from birth to 5 years of age), there is limited global guidance for others (e.g., MUAC for individuals 5 years of age and older, waist circumference). For measurements with no global guidance, some countries have created their own cutoffs, which are discussed in Modules 2–5.

When using anthropometry to assess an individual's nutritional status, it is helpful to consider additional information, such as dietary practices, results of other medical assessments, and household socioeconomic status to better understand the situation. This additional information provides insight into the direct and underlying causes of the individual's nutritional status, helping to establish an effective treatment plan and/or refer an individual to other needed services.

The WHO Growth Standards and WHO Growth Reference described in **Box 1.4** provide information on how to classify and interpret anthropometric data.

BOX 1.4 GUIDANCE FOR INTERPRETING INFANT, CHILD, AND ADOLESCENT ANTHROPOMETRIC DATA

The internationally applicable standards and references in this guide include:

INTERGROWTH-21ST Global Perinatal Package (2014) WEBSITE

This set of international, globally validated standards allows for comparisons across populations for fetuses, newborns, and preterm infants during the postnatal growth period. The standards are meant to complement the WHO Child Growth Standards. Since the INTERGROWTH-21st standards have not yet been widely adopted in developing countries and require ultrasound technology to measure fetuses—which is not practical in most low-resource settings—they are only discussed in limited detail in Module 2.

WHO Child Growth Standards (Children from Birth to 5 Years) (2006) WEBSITE

This set of internationally accepted standards describes healthy growth of all children, regardless of ethnicity or socioeconomic status, under optimal conditions. It includes sex-specific growth standards for length/height-for-age, weight-for-age, weight-for-length/height, BMI-for-age, and head circumference-for-age, among other measures. These standards replaced the 1977 National Center for Health Statistics (NCHS)/WHO Growth Reference as the international standards. They are described in detail in Module 2.

WHO Growth Reference (Children 5–19 Years) (2007) WEBSITE

Constructed using statistical methods that adjust the 1977 NCHS/WHO reference for children and young people 1–24 years of age, the 2007 reference is aligned with the 2006 WHO Child Growth Standards for children under 5 and with adult BMI cutoffs. This is a reference, not a standard, and it is used for **BMI-for-age**, **height-for-age**, and **weight-for-age** for children 5–19 years. This reference is described in detail in Module 3.

Note: The U.S. Centers for Disease Control and Prevention (CDC) also has guidelines, created in 2000, for assessing the nutritional status of infants, children, and adolescents from birth to 20 years of age in the United States. However, since they are not commonly used in international settings, they have not been included in this guide.

WEBSITE

Global Anthropometric Cutoffs for Classifying an Individual's Nutritional Status

Tables 1.2–1.9 present universally accepted international cutoffs for classifying an individual's nutritional status, organized according to demographic group. More information on each measurement, index, indicator, and cutoff, as well as guidance for measurements/indices that do not have globally accepted cutoffs, can be found in Modules 2–5. These modules also include information on tools (e.g., growth charts, calculators, and assessment materials) that may be used in program settings to more easily classify nutritional status. There are two commonly used systems to interpret and classify anthropometric data: z-scores and percentiles.[1] This guide focuses on z-scores, following WHO recommendations. See **Box 1.5** for more information on z-scores.

BOX 1.5 MAKING SENSE OF THE DATA: Z-SCORES

What Are Z-Scores and What Do They Tell Us?

Anthropometric z-scores describe how far and in what direction an individual's measurement is from the reference populations' median value. For the WHO Growth Standards, the reference population is children of the same sex and age (depending on the measure). Z-scores that fall outside of the normal range indicate a nutritional issue (undernutrition or overweight). The further away from the normal range, the more severe the nutritional issue. Z-scores provide information on current nutritional status and can also be used to follow an individual child's growth over time.

Who Needs to Understand Z-Scores and Why?

Z-score cutoffs are used to define malnutrition according to anthropometric indices and measures. Therefore, health care workers and nutrition program staff need to understand what z-scores are, how to interpret them, and what they mean at individual and population levels to make informed decisions.

How Is a Z-Score Determined?

Z-scores can be estimated using growth charts/tables and/or calculated using computer software.

See Annex 2 for more details on z-scores.

[1] A percentile is similar to a rank; percentile refers to an individual's position on a given reference distribution, ranked in order of magnitude. For example, if 90 percent of children (grouped by age and sex) weigh less than 20 kg, then a child who weighs exactly 20 kg is in the 90th percentile for his/her age and sex (Gibson 2005).

Children from Birth to 5 Years of Age

The table below identifies universally accepted international cutoffs for children from birth to 5 years of age based on the WHO Child Growth Standards for several nutrition conditions: stunting, wasting, underweight, overweight/obesity, and small head circumference.

TABLE 1.2 WHO Child Growth Standards Classification

ANTHROPOMETRIC INDICATOR	AGE		Z-SCORE						
	0–23 months	24–60 months	< -3	≥ -3 to < -2	≥ -2 to < -1	≥-1 to ≤ +1	> +1 to ≤ +2	> +2 to ≤+3	> +3
Length-for-age Stunting	✓		Severe stunting	Moderate stunting	Normal				Extreme tallness is not usually a nutrition issue. May indicate endocrine disorder.
Height-for-age Stunting		✓							
Weight-for-age Underweight	✓	✓	Severe underweight	Moderate underweight	Normal		Do not use weight-for-age to determine overweight. Weight-for-length/height (0–60 months) and BMI-for-age (all ages) are better for assessing overweight in children.		
Weight-for-length Wasting, overweight, obesity	✓		Severe wasting/ severe acute malnutrition (SAM)	Moderate wasting/ moderate acute malnutrition (MAM)	Normal		Possible risk of overweight	Overweight	Obesity
Weight-for-height Wasting, overweight, obesity		✓							
BMI-for-age Wasting, overweight, obesity *Less commonly used than weight-for-height in children from birth to 5 years of age in developing countries*	✓	✓	Severe wasting/SAM	Moderate wasting/MAM	Normal		Possible risk of overweight	Overweight	Obesity
Head-circumference-for-age Small/large head size	✓	✓	Very small head circumference (severe microcephaly)	Small head circumference (microcephaly)	Normal			Large head circumference (macrocephaly) Not related to nutritional status.	

Sources: WHO 2008; CDC 2016; WHO 2016b

TABLE 1.3 Mid-Upper Arm Circumference

The table below identifies universally accepted international MUAC cutoffs for children 6–59 months of age based on WHO guidance. There is insufficient evidence to recommend a MUAC cutoff for children under 6 months of age.

Age Group	Nutritional Status	
	SAM	**MAM**
6–59 months	<115 mm	≥115 mm to <125 mm

Source: WHO/UNICEF/WFP 2014; WHO 2013.

TABLE 1.4 Birth Weight

The table below identifies universally accepted international low birth weight (LBW) cutoffs for newborns, based on WHO guidance. LBW is an outcome of intrauterine growth retardation and/or preterm birth and often reflects poor maternal nutrition and health before and during pregnancy. Birth weight measurements can reflect that a child was born preterm, is small for gestational age, or both.

Age Group	Low Birth Weight	Normal Birth Weight
Newborns, within 24 hours of birth	< 2,500 grams	≥ 2,500 grams

Source: WHO 2014.

Children and Adolescents 5–19 Years of Age

The table below identifies universally accepted international cutoffs for children 5–19 years of age based on the WHO Growth Reference for several nutrition conditions: stunting, wasting, underweight/thinness, and overweight/obesity.

TABLE 1.5 WHO Growth Reference Classification

ANTHROPOMETRIC INDICATOR	AGE	Z-SCORE						
		< -3	≥ -3 to < -2	≥ -2 to < -1	≥-1 to ≤ +1	> +1 to ≤ +2	> +2 to ≤+3	> +3
Height-for-age Stunting	5–19 years	Severe stunting	Moderate stunting	Normal				Extreme tallness is not usually a nutrition issue. May indicate endocrine disorder.
Weight-for-age Underweight	5–10 years	Severe underweight	Moderate underweight	Normal		Do not use weight-for-age to determine overweight. A child or adolescent is best assessed by BMI-for-age.		
BMI-for-age Thinness, overweight, obesity	5–19 years	Severe thinness	Moderate thinness	Normal		Overweight		Obesity

Source: 2007 WHO Growth Reference.

Pregnant and Postpartum Women and Girls

The table below identifies the commonly used cutoffs for short stature in adult women and WHO guidance for stunting among adolescent girls. Please note: while a universally accepted international cutoff for short stature among adult women has not been established, the cutoff below is commonly used in surveys such as the DHS and was also used in the Lancet's 2008 Maternal and Child Undernutrition and 2013 Maternal and Child Nutrition series. The cutoff below was selected based on an increased risk of obstetric complications. However, various risks to mother and child have been associated with cutoffs ranging from approximately 140–156 cm (WHO 1995; Ververs et al. 2013).

TABLE 1.6 Short Stature and Stunting

Age Group	Condition	Cutoff
Adult women (age 18 years and older)	Short stature	< 145 cm
Adolescent girls to age 19	Stunting (height-for-age)	
	--Severe	< - 3 z-score
	--Moderate	≥ - 3 and < - 2 z-score

Source: ICF 2012; WHO 2007.

Adults (18 Years of Age and Older)

TABLE 1.7 BMI

The table below identifies the standard cutoffs for underweight (thinness) and overweight/obesity based on WHO guidance.

Classification	BMI (kg /m^2) Cutoff Points
Underweight	<18.50
Severe thinness	<16.00
Moderate thinness	16.00–16.99
Mild thinness	17.00–18.49
Normal range	18.50–24.99
Overweight	≥25.00
Obese	≥30.00
Obese class I	30.00–34.99
Obese class II	35.00–39.99
Obese class III	≥40.00

Source: WHO Expert Consultation 2004.

TABLE 1.8 Short Stature (Women)

While a universally accepted international cutoff for short stature among adult women has not been established, the cutoff listed below is commonly used in surveys such as the DHS and was also used in the Lancet's 2008 Maternal and Child Undernutrition and 2013 Maternal and Child Nutrition series.

Condition	Cutoff
Short stature	< 145 cm

Source: ICF 2012

Clinical Assessment: Bilateral Pitting Edema

Although not an anthropometric measurement, bilateral pitting edema is a clinical sign of SAM ("severe malnutrition" in adults) that is often assessed along with anthropometry and therefore included in this guide.

Bilateral pitting edema is identified using the internationally accepted classification system in **Table 1.9**. The classification system is used across all age groups. Modules 2–5 provide additional information on how to identify and classify bilateral pitting edema.

NOTE

In pregnancy, edema is common and may be normal or a symptom of other medical conditions besides severe malnutrition.

TABLE 1.9 Nutritional Status Classification of Bilateral Pitting Edema (applicable to all age groups)

Description	Grade of Edema	Nutritional Status
No bilateral pitting edema	Absent (O)	Does not have edematous malnutrition
Present in both feet/ankles	Mild (+)	SAM/severe malnutrition
Present in both feet/ankles, plus lower legs, hands, or lower arms	Moderate (++)	SAM/severe malnutrition
Generalized, including both feet, legs, hands, arms, and face	Severe (+++)	SAM/severe malnutrition

Sources: WHO 2013; WHO e-Library of Evidence for Nutrition Actions (eLENA) n.d. (a); WHO eLENA n.d. (b).

Interpreting Anthropometric Data and Classifying Nutritional Status for Populations

Interpreting Public Health Prevalence Thresholds using Anthropometric Data

While the above cutoffs help determine an individual's anthropometric status, it is also important to understand the nutritional status of a given population. Advocacy groups, government agencies, international bodies, and aid agencies use population-level anthropometric data—often in combination with trend data, information on the local context, and other indicators—to understand the type and magnitude of nutrition problems in a population.

BOX 1.6 ANTHROPOMETRIC INDICATORS

An anthropometric indicator is an objectively verifiable, quantitative measurement that reflects the nutritional status of an individual or population. An indicator can be used to track changes in a situation over time or demonstrate whether a program is achieving its objectives. Anthropometric indicators are constructed from anthropometric measures or indices.

An example of a population-level anthropometric indicator is: the percentage of children under 5 who are stunted (height-for-age < -2 z-scores).

TABLE 1.10 Examples of Population-Level Anthropometric Indicators

Below are anthropometric indicators that are commonly used in program settings and by donors and development groups to understand and track nutritional status at the population level.

	USAID Food for Peace	USAID Feed the Future	Sustainable Development Goals	WHO Nutrition Landscape Information System	Demographic and Health Surveys
Prevalence of Malnutrition					
% of children under 5 stunted (< -2 z-score)	X	X	X	X	X
% of children under 5 underweight (< -2 z-score)	X	X		X	X
% of children under 5 wasted (< -2 z-score)	X	X	X	X	X
% of children under 5 overweight (> +2 z-score)			X	X	X
% of women age 15–49 who are underweight (BMI < 18.5)	X	X		X	X
% of women age 15–49 who are overweight (BMI ≥ 25.0)				X	X
% of women age 15–49 of short stature (<145 cm)					X

In 2017, WHO and UNICEF established guidance (shown in **Table 1.11**) on public health prevalence thresholds for three child anthropometric indicators: stunting, wasting, and overweight. The new guidance can help identify populations at risk and can be used for targeting and planning interventions (e.g., a response when wasting is approaching 10 percent [high] among children under 5).

The 2017 guidance updates the previous significance levels for stunting and wasting that were first published in 1995, excludes underweight, and introduces thresholds for overweight. The approach to developing the 2017 thresholds was slightly different than that used in 1995. The 1995 wasting prevalence classifications were based on increases in the crude mortality rate. The stunting and underweight thresholds were somewhat arbitrary groupings based on categorizing the prevalences in 79 low- and middle-income countries into four levels (low, medium, high, very high) based on quartiles. The thresholds did not reflect the relationship between the prevalences and population-level outcomes or note how far the prevalences deviated from normal. They were not intended to serve as public health significance levels (WHO and UNICEF 2017).

The 2017 thresholds were developed to clarify the terminology around public health prevalence thresholds, harmonize labeling (very low, low, medium, high, very high), and establish a standard approach to develop the cutoffs (WHO 1995; WHO and UNICEF 2017). The 2017 thresholds are based on how far a prevalence level deviates from a normal prevalence based on the WHO Child Growth Standards. For example, "very low" indicates a country whose stunting, wasting, or overweight prevalence is within the "normal" range (i.e., less than 2.5 percent). The other categories (low, medium, high, and very high) are multipliers of the "very low" level (e.g., a country whose stunting prevalence is up to four times higher than the "very low" prevalence is categorized as "low") (WHO and UNICEF 2017).

Table 1.11 provides the updated prevalence thresholds and also includes the public health significance level for adults with low BMI and the public health trigger point for LBW as these are both relevant anthropometric indicators to track on a global level (WHO 2010; WHO 1995). All of the indicators should be interpreted in context. For example, consideration of the economy, climate conditions, food security trends, and migration in conjunction with anthropometry can help clarify the scope and magnitude of the situation.

TABLE 1.11 Public Health Prevalence Thresholds

Anthropometric Indicator	Prevalence Thresholds (%)				
	Very Low	Low	Medium	High	Very High
Stunting: Percentage of children age 0–59 months (height-for-age < -2 z-score)	< 2.5	2.5–9	10–19	20–29	≥30
Wasting: Percentage of children age 0–59 months (weight-for-height < -2 z-score)	<2.5	2.5 – < 5	5–9	10–14	≥15
Overweight: Percentage of children age 0–59 months (weight-for-height >+ 2 z-score)	<2.5	2.5 – < 5	5–9	10–14	≥15
	Public Health Significance Level (%)				
	Low	Medium	High	Very High	
Percentage of adults with low BMI (< 18.5)	5–9	10–19	20–39	≥40	
	Public Health Trigger Point for Action (%)				
Percentage of newborns with low birth weight (< 2,500 grams)	≥ 15				

Another resource for population-level decision-making is the Integrated Food Security Phase Classification (IPC). The IPC is a set of tools to assess and classify the severity and magnitude of food insecurity in several countries and includes anthropometric indicators. Due to the increasing need for countries to use and interpret various nutrition measurements, work is also underway to develop an IPC Nutrition Phase Classification, with tools and procedures for conducting a comprehensive nutrition assessment. The tools and procedures will be adaptable to the country context relative to data systems in place, methodological approach to nutrition assessment, and policies and systems used to guide nutrition activities.

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MODULE 2

Children from Birth to Five Years of Age

What Does this Module Cover?

Module 2 focuses on anthropometry of children from birth to 5 years of age (0–60 completed months). It is broken into specific sections that describe the importance of nutrition for children in this age group:

- common nutrition-related conditions identified by anthropometry
- the measurements and indices used to identify nutrition-related conditions
- interpretation of anthropometric measures and classification of nutritional status
- helpful tools

Users are encouraged to review Module 1 alongside this module because it explains key concepts that are relevant to all modules.

Who Is the Focus of Module 2?

Module 2 aligns with the age ranges used in the World Health Organization (WHO) Child Growth Standards. In this module, "children from birth to 5 years of age" refers to **children from birth to 60 completed months of age**. When the child completes 60 months (i.e., the child turns 5 years and 1 month of age), he or she moves into the 5–19-year age group (discussed in Module 3).

Nutrition from Birth to 5 Years of Age: Why Does It Matter?

Good nutrition, adequate health care, and a nurturing environment all contribute to children reaching their full growth and development potential. This is especially important during the 1,000 days from the beginning of the mother's pregnancy to the child's second birthday, when children are growing and developing most rapidly. To support this growth, young children have relatively high nutritional needs and are more vulnerable to malnutrition and its consequences than other age groups. Malnourished children are at higher risk of illness and death than well-nourished children; undernutrition is associated with 45 percent of deaths of children under 5 (Black et al. 2013). In addition, nutritional deficits during this period can have lifelong and often irreversible consequences, including impaired cognitive development, lower school performance and achievement, reduced economic productivity, and increased risk of certain chronic diseases in adulthood (UNICEF 2013). While undernutrition in developing countries remains a problem, at the same time, the worldwide increase in infant and childhood overweight and obesity also has both short- and long-term consequences. Overweight and obese children are at higher risk of developing diabetes, high blood pressure, respiratory problems, and of being obese in adulthood, with the associated increased risks of noncommunicable disease, disability, and premature death (WHO 2014c).

Nutrition from Birth to 5 Years of Age: Why Does It Matter? (continued)

Preventing and treating malnutrition in young children can substantially reduce deaths and ensure that children grow optimally, both physically and mentally. Children in this age group, particularly under the age of 2, are very responsive to nutrition interventions, making this a critical period to act (Bhutta et al. 2013).

Anthropometry is a key tool in the design and implementation of nutrition interventions seeking to address child malnutrition. It is helpful in determining and monitoring the nutritional status of individual children and the wider population, which provides information for the care and treatment of individuals, as well as for policy, program design, and resource allocation at the population level. In addition, population-level data can be used to evaluate trends in nutritional status, help determine whether a large-scale intervention is needed, and monitor a nutrition intervention's impact on a population.

What Nutrition-Related Conditions Are Identified through Anthropometry?

This section provides a brief description of the most common nutrition-related conditions affecting children from birth to 5 years of age that can be identified using anthropometry. The anthropometric measurements and indices used to identify these nutrition conditions are described in the **Measurements** section.

CONDITIONS IN THIS SECTION

- Low birth weight
- Small head size/circumference
- Stunting
- Underweight
- Overweight and obesity
- Acute malnutrition
- Wasting
- Moderate acute malnutrition (MAM)
- Severe acute malnutrition (SAM)

Already familiar with nutrition-related conditions?

Jump ahead to the Measurements section.

CONDITION: **Low Birth Weight**

Low birth weight refers to an infant who weighs less than 2,500 grams (5.5 lbs.) at birth. Low birth weight can occur in infants who are born early (before 37 weeks of gestation), are small for their gestational age and born at term, or are both small for gestational age and born early (preterm) (WHO 2014a). Low birth weight is associated with increased risk of infant death, childhood stunting, and reduced brain development in early childhood; children who are both small for their gestational age and born early are at highest risk (Black et al. 2013; Lundgren and Tuvemo 2008). Pregnant women's nutritional and health status before and during pregnancy affects both the growth of the fetus in the womb and the risk of preterm birth. Babies of mothers who are short (height <145 cm) and underweight (low pre-pregnancy body mass index [BMI] [<18.5]) are at higher risk of being small for gestational age (Black et al. 2013).

TIP

Gestational age refers to the length of a pregnancy and is measured in weeks. An infant born small for gestational age weighs less than would be expected for a newborn of the same sex born from a pregnancy of the same length. A child who is born early (e.g., before 37 weeks gestation) may be at an appropriate weight for his/her gestational age but still have low birth weight. An infant who is small for gestational age is defined as being below the 10th percentile for sex-specific weight for gestational age (WHO 1995).

LINKS TO RELATED CONTENT

Measurement: **Birth weight** Interpretation: **Cutoffs for birth weight**

CONDITION: **Small Head Size/Circumference**

Small head size/circumference, also referred to as microcephaly, occurs when a child's head is significantly smaller than expected for his/her age and sex. Microcephaly has been linked with poor cognition and lower academic test scores and often indicates that the child's brain has developed abnormally (Ivanovic et al. 2004). Microcephaly may be present at birth (congenital) or develop after birth (acquired) and may result from genetic disorders, infections, exposure to drugs or chemicals, poor fetal growth, or severe malnutrition, among other reasons (U.S. Centers for Disease Control and Prevention [CDC] 2016; Ivanovic et al. 2004). Small head size is determined using the head circumference-for-age index for a child's sex. While macrocephaly (large head size) is also of medical concern and can be identified through anthropometry, it is not related to nutritional status and therefore is not discussed in this guide.

LINKS TO RELATED CONTENT

Measurement: Head-circumference-for-age

Interpretation: Cutoffs for head-circumference-for-age

CONDITION: **Stunting**

Stunting, a reflection of chronic undernutrition, occurs when a child does not grow to his/her potential because of the long-term cumulative effects of inadequate dietary intake, frequent illness/infection, or both (WHO 2014b). Stunting often begins with poor growth in utero because of maternal undernutrition. The result is that the child is shorter than would be expected for a healthy child of his/her age and sex. Stunted children are more likely to die of infectious diseases such as diarrhea, pneumonia, and measles (Black et al. 2013). Stunting is also associated with poor cognitive and motor development and lower school achievement (Grantham-McGregor et al. 2007; Hoddinott et al. 2008). The first 1,000 days is the time when children are most vulnerable to stunting. Lost growth and development during this time are difficult to recover after age 2 (WHO 2014b). Stunting is identified using the length/height-for-age index specific to a child's sex.

LINKS TO RELATED CONTENT

Measurement: **Length/height-for-age** Interpretation: **Cutoffs for length/height-for-age**

CONDITION: **Acute Malnutrition**

Acute malnutrition is caused by an inadequate amount or quality of food, severe and/or repeated infections (e.g., diarrhea and pneumonia), or a combination of these, which results in a child who loses weight rapidly, does not gain enough weight relative to his/her growth in height, and/or experiences bilateral pitting edema. It may be classified as either moderate or severe. Children with acute malnutrition are at higher risk of death from infectious diseases (Black et al. 2013) and require treatment based on the severity of the condition.

There is a lot of terminology used in reference to acute malnutrition that may be confusing to readers. For simplicity, this guide has provided key terminology associated with acute malnutrition:

- **Wasting**
- **Moderate acute malnutrition (MAM)**
- **Severe acute malnutrition (SAM)**

TIP

Severe wasting is also referred to as severe acute malnutrition, marasmus, emaciation, extreme wasting, and nutritional marasmus.

CONDITION: Acute Malnutrition → CONDITION: **Wasting**

Wasting occurs when a child is too thin for his/her height. It is defined using the sex-specific weight-for-length/height or BMI-for-age index. A child with wasting has either moderate or severe acute malnutrition, depending on the severity of wasting.

LINKS TO RELATED CONTENT

Measurement: **Weight-for-length/height**

Measurement: **BMI-for-age**

Interpretation: **Cutoffs for weight-for-length/height and BMI-for-age**

CONDITION: Acute Malnutrition
↳ CONDITION: **Moderate Acute Malnutrition (MAM)**

Moderate acute malnutrition (MAM) occurs when a child is moderately wasted or has low mid-upper arm circumference (MUAC) and does not have bilateral pitting edema. A child with MAM is three times more likely to die of infectious diseases than a well-nourished child. MAM accounts for over 5 percent of child deaths (Black et al. 2008; Black et al. 2013). MAM is identified using the weight-for-height index for a child's sex and/or MUAC.

LINKS TO RELATED CONTENT

- Measurement: Weight-for-length/height
- Measurement: MUAC
- Interpretation: Cutoffs for weight-for-length/height
- Interpretation: Cutoffs for MUAC

CONDITION: Acute Malnutrition
↳ CONDITION: **Severe Acute Malnutrition (SAM)**

Severe acute malnutrition (SAM) occurs when a child is severely wasted, and/or has very low MUAC, and/or has bilateral pitting edema (nutritional edema). Bilateral pitting edema is a clinical sign of SAM and is explained in greater detail in the Measurements section. Children with SAM are up to nine times more likely to die than well-nourished children (Black et al. 2008; WHO and UNICEF 2009). Children with SAM need urgent medical treatment and specialized therapeutic foods to recover. Children under 6 months of age were once considered to be at low risk for SAM because of breastfeeding, so many treatment programs focused only on children age 6 months or older. However, because of poor feeding practices and diseases such as diarrhea, it is now recognized that young infants are at risk for SAM. They are also vulnerable to death and therefore it is important to assess all children under 5 years of age for SAM (WHO n.d.). SAM is identified in children under 6 months of age by using the sex-specific weight-for-length/height index. SAM is identified in children 6–59 months of age by assessing for bilateral pitting edema and using the sex-specific weight-for-length/height index or MUAC cutoffs.

LINKS TO RELATED CONTENT

- Measurement: **Weight-for-length/height**
- Measurement: **MUAC**
- Measurement: **Bilateral pitting edema**
- Interpretation: **Cutoffs for weight-for-length/height**
- Interpretation: **Cutoffs for MUAC**
- Interpretation: **Classification of bilateral pitting edema**

CONDITION: **Underweight**

Underweight occurs when a child weighs less than would be expected for a healthy, well-nourished child of the same age and sex. Underweight may indicate that the child is stunted, wasted, or both, but does not differentiate between the two. It may be caused by a child losing weight or not growing or not gaining weight at the expected pace and is often associated with illness and/or inadequate dietary intake. Underweight is identified using the weight-for-age index appropriate to a child's sex.

LINKS TO RELATED CONTENT

Measurement: Weight-for-age

Interpretation: Cutoffs for weight-for-age

CONDITION: **Overweight and Obesity**

Overweight and obesity (severe overweight) occur when a child has too much body fat and weighs more than would be expected for a healthy child of the same height and sex, putting his/her health at risk. Overweight and obesity are complex conditions with multiple causes, including an imbalance between calories consumed and calories used, low levels of physical activity, medical conditions, and genetics, among others. As of 2016, as many as 41 million children worldwide were overweight or obese (UNICEF, WHO, and World Bank 2015). Childhood overweight/obesity is associated with health risks in childhood and adulthood. Children who are overweight/obese are at increased risk for type 2 diabetes, asthma, and high blood pressure, among other diseases (WHO 2014c); and because overweight/obese children are more likely to become overweight adults, they are also at increased risk of the poor health outcomes associated with adult obesity or overweight, including diabetes, heart disease, cancer, and stroke (Freedman et al. 2005). Overweight/obesity in children from birth to 5 years of age is identified using the BMI-for-age index or weight-for-length/height index specific to that child's sex.

LINKS TO RELATED CONTENT

Measurement: **BMI-for-age**

Measurement: **Weight-for-length/height**

Interpretation: **Cutoffs for BMI-for-age and weight-for-length/height**

What Anthropometric Measurements and Indices Are Used for Children from Birth to 5 Years of Age?

This section describes the various anthropometric measurements and indices used to identify nutrition conditions in young children: birth weight, length/height-for-age, weight-for-age, weight-for-length/height, BMI-for-age, MUAC, and head circumference-for-age. This guide also includes bilateral pitting edema, which is a clinical indicator, because it is frequently assessed along with anthropometry in children from birth to 5 years of age to identify SAM. **Table 2.1** summarizes the nutritional measurements and indices described in this module and the nutrition conditions they identify.

Already familiar with measurements and indices? Jump ahead to the Interpretation section.

TABLE 2.1 Selected Anthropometric Measurements and Indices in this Module

	Birth Weight (only for newborns)	**Length/ Height-for-Age**	**Weight-for-Age**	**Weight-for-Length / Height**	**BMI-for-Age**	**MUAC** (6–59 months only)	**Head Circumference-for-Age**	**Bilateral Pitting Edema**
Nutritional condition that the measurement/ index identifies	Low birth weight	Stunting	Underweight	Wasting, acute malnutrition, overweight, obesity	Wasting, acute malnutrition, overweight, obesity	Acute malnutrition	Microcephaly, which can result from undernutrition	Severe acute malnutrition

MEASUREMENT: **Birth Weight**

Birth weight is measured as soon after birth as possible and within 24 hours of birth (WHO 2007; WHO and UNICEF 2004; MEASURE Evaluation n.d.).

LINKS TO RELATED CONTENT

Condition: Low birth weight Interpretation: Cutoffs for birth weight

MEASUREMENT: **Length/Height-for-Age**

Length/height-for-age considers a child's length or height relative to his/her age and sex. It is used to identify stunting. In developing countries, it has traditionally been used at the population level for evaluation and benchmarking. However, recently, there have been efforts to use length/height-for-age in regular clinical nutrition assessment and growth monitoring to track children's linear growth.

BOX 2.1 MEASURING LENGTH AND HEIGHT

Length, measured with the child lying down, is used for children under 24 months of age.

Height, measured while the child is standing, is used for children 24 months of age and older.

If the age is unknown, children under 87 cm are measured lying down, and those 87 cm or taller are measured standing.

Source: WHO and UNICEF 2009.

LINKS TO RELATED CONTENT

Condition: Stunting Interpretation: Cutoffs for length/height-for-age

MEASUREMENT: **Weight-for-Age**

Weight-for-age considers a child's weight relative to his/her age and sex and identifies underweight. It may reflect wasting, stunting, or both. Weight-for-age has been frequently used in growth promotion programs but has limitations because of its inability to distinguish between wasting and stunting.

LINKS TO RELATED CONTENT

Condition: **Underweight**

Interpretation: **Cutoffs for weight-for-age**

MEASUREMENT: **Weight-for-Length/Height**

Weight-for-length/height can be used to identify a child whose weight is too low for his/her length or height (wasting, or acute malnutrition) or who is overweight or obese. It considers a child's weight relative to his/her length or height and sex. In program settings, weight-for-height is one method used to determine admission and discharge criteria for community-based management of acute malnutrition (CMAM) programs.*

LINKS TO RELATED CONTENT

Condition: **Wasting**

Interpretation: **Cutoffs for weight-for-length/height**

Condition: **Acute malnutrition**

Condition: **Overweight/obesity**

* For more information on CMAM programs, visit http://www.severemalnutrition.org.

NOTE

It may not be possible to compare the weight-for-length measurement of recently born stunted children against the WHO Child Growth Standards as they will be shorter than the smallest length WHO provides.

MEASUREMENT: **BMI-for-Age**

BMI-for-age identifies both wasting and overweight/obesity. It is a ratio of weight relative to length/height—calculated using the formula (weight in kilograms)/(length/height in meters)^2 —that is interpreted according to age and sex. The age- and sex-specific interpretation is necessary because this age group is still growing and the relationship between weight, height, and fat changes based on stage of development and sex. BMI-for-age is an appropriate index for children from birth to 5 years of age but is less commonly used in developing countries than weight-for-height.

LINKS TO RELATED CONTENT

- Condition: Wasting
- Condition: Acute malnutrition
- Condition: Overweight/obesity
- Interpretation: Cutoffs for BMI-for-age

MEASUREMENT: **MUAC**

MUAC is used to identify wasting (acute malnutrition) in children 6–59 months of age by measuring the circumference of the mid-upper arm and comparing it to an established cutoff. There is insufficient evidence to recommend a MUAC cutoff for children under 6 months of age. MUAC was previously used mostly for screening. However, it is now also used for diagnosis, admission, and discharge of children with MAM and SAM, particularly in CMAM programs, because it is a simple measurement and a good predictor of risk of death.* Whether using weight-for-length/height or MUAC, the same indicator used to confirm SAM should also be used to assess whether a child has reached nutritional recovery (WHO 2013).

LINKS TO RELATED CONTENT

Condition: Acute malnutrition

Interpretation: Cutoffs for MUAC

* Both MUAC and weight-for-length/height, either alone or in combination, are used by programs to identify children at risk of acute malnutrition and admit them to treatment. Some programs use MUAC to identify and refer at-risk children and use weight-for-length/height to admit them for treatment. Some use either MUAC or weight-for-height for identification and admission for treatment, while others strictly use MUAC as the admission criterion. There is ongoing debate over whether MUAC or weight-for-length/height is best and whether they should both be used independently, as research indicates that MUAC and weight-for-length/height capture overlapping but not identical groups of children (Grellety and Golden 2016; Roberfroid et al. 2015; Walters et al. 2012).

NOTE

Although the WHO Child Growth Standards include a sex-specific index that considers MUAC in relation to age for children 3–60 months, it has not been widely adopted. Instead, a single, non-sex-specific set of MUAC cutoffs is more commonly used for all children 6–59 months of age. It has similar accuracy to MUAC-for-age in predicting mortality risk and is more likely than MUAC-for-age to select younger children, who are at highest risk of death (Walters et al. 2012).

MEASUREMENT: **Head Circumference-for-Age**

Head circumference-for-age compares a child's head circumference measurement to the expected circumference for healthy children of the same age and sex. Measured as part of infant health screening to identify potential neurological or developmental deficits, it can also indicate chronic protein-energy deficiency in children under 2 (WHO Multicentre Growth Reference Study [MGRS] Group 2007; Gibson 2005). Associated with brain volume, head circumference is affected by nutrition during pregnancy (in utero) and during the first months of life (Bartholomeusz et al. 2002). Head circumference should first be measured within the first 24 hours of birth and continued until at least age 2 because this is the period of most rapid growth. However, WHO Child Growth Standards cover children up to age 5 years and continued monitoring of head circumference after age 2 is possible (WHO 2016a).

LINKS TO RELATED CONTENT

Condition: Small head size/circumference Interpretation: Cutoffs for head-circumference-for-age

MEASUREMENT: **Bilateral Pitting Edema**

Bilateral pitting edema is a clinical sign of a specific form of SAM known as nutritional edema, edematous malnutrition, SAM with edema, or kwashiorkor. Bilateral pitting edema is an abnormal accumulation of fluid in body tissues that causes swelling beginning in both feet in its mild form and is generalized to both feet, legs, hands, arms, and face in its most severe form. It is characterized by a lasting pitting (indentation) of the skin when pressure is applied to both feet for 3 seconds. Even mild bilateral pitting edema indicates SAM or another serious medical condition. Cases should be referred for further assessment and treatment, and a child with severe bilateral pitting edema requires inpatient care.

LINKS TO RELATED CONTENT

Condition: Severe acute malnutrition Interpretation: Classification of bilateral pitting edema

How to Interpret Anthropometric Indicators and Classify Nutritional Status

This section provides guidance for how to interpret child growth measurements and indices and classify a child's nutritional status. For children from birth to 5 years of age, the WHO Child Growth Standards provide guidance for interpreting most of the anthropometric measurements and indices described in this guide, including cutoffs to classify children's nutritional status. Recently, fetal and newborn growth standards have also been released by the International Fetal and Newborn Growth Consortium for the 21st Century (INTERGROWTH-21st). Both standards provide information on how to classify anthropometric data based on two commonly used systems: z-scores and percentiles (see **Box 2.2**). This guide focuses on z-scores (in detail on page 47) to align with WHO recommendations. Universal internationally accepted cutoffs have also been established for MUAC and low birth weight, which are not included in the WHO Child Growth Standards.

BOX 2.2 Z-SCORES AND PERCENTILES

A **z-score** indicates how far and in what direction an individual's anthropometric measurement deviates from the median of the reference population and is expressed in standard deviations. For example, if a girl's weight-for-age z-score is -2, her weight-for-age is two standard deviations below the median weight-for-age of other girls her age.

A **percentile** indicates where an individual's anthropometric measurement falls relative to other people of the same age and sex in the reference population. For example, if a girl's weight-for-age is in the 85th percentile, she weighs more than 85 percent of other girls her age.

It is possible to convert z-scores to percentiles and vice versa. For example:

- A z-score of +2 is equivalent to the 97.7th percentile.
- A z-score of 0 is equivalent to the 50th percentile.
- A z-score of -2 is equivalent to the 2.3rd percentile.

However, the cutoffs used in each system are not exactly equivalent. For example, while a child in the 5th percentile would likely be identified as having a growth problem, the equivalent z-score of -1.65 would still be considered to be in the normal range.

Source: Wang and Chen 2012.

Putting Anthropometry in Context: Infant and Child Growth Standards

The WHO Child Growth Standards, released in 2006, describe the range of growth that is considered normal in healthy children raised with good feeding practices, health care, and in a healthy environment, regardless of ethnicity, socioeconomic status, or location.

The WHO standards are based on the 1997–2003 Multicentre Growth Reference Study (MGRS), which followed the growth of 8,440 children of diverse cultural and ethnic backgrounds in six countries—Brazil, Ghana, India, Norway, Oman, and the United States. The study specifically selected children who were from healthy environments where recommended health behaviors were practiced (including breastfeeding and standard pediatric care) and whose mothers did not smoke. Growth measurements were taken by carefully trained personnel, using standardized methods, robust and precise equipment, and strict adherence to methods and procedures (de Onis et al. 2004).

The standards include growth charts and tables to assess growth and development from birth to age 5 using key growth indicators (see below). Since girls and boys grow differently, the standards and accompanying growth charts and tables are sex-specific.

The following WHO Child Growth Standards indicators, which are commonly used in developing countries, are discussed in this guide:

- **Length/height-for-age**
- **Weight-for-age**
- **Weight-for-length**/**height**
- **BMI-for-age**
- **Head circumference-for-age**

BOX 2.3 KEY DEFINITIONS

A **growth standard** is prescriptive. It demonstrates how healthy children grow under ideal circumstances.

A **growth reference** describes how a specific population has grown but does not necessarily reflect optimal growth.

A **cutoff** is a threshold beyond which an individual is determined to be malnourished. It also identifies the severity of undernutrition or overweight/obesity in an individual. Cutoffs can be used at the population level to signify when a nutrition situation is considered to be of public health concern.

The WHO Child Growth Standards also include several other indicators that are not frequently used in developing countries (arm circumference-for-age; sub-scapular skinfold-for-age; triceps skinfold-for-age; weight, length, and head circumference velocity) or do not involve anthropometric measurements (motor development milestones—sitting, standing, crawling, walking alone/assisted). These indicators are not discussed in this guide.

Adopted by over 140 countries, the 2006 standards replace the National Center for Health Statistics (NCHS)/WHO Child Growth Reference that had been in use since 1977 (WHO 2011). For more information on the WHO Child Growth Standards, see the WHO website.

BOX 2.4 INTERGROWTH-21ST STANDARDS

In 2008, INTERGROWTH-21st launched a multi-country project to extend the WHO Child Growth Standards into the fetal and neonatal period by developing prescriptive standards for fetuses, newborns, and the postnatal growth of preterm infants.

The INTERGROWTH-21st standards provide information on how fetuses and newborns are expected to grow (from 9 weeks post-conception until birth), irrespective of nationality or ethnicity, when they are born to healthy, well-nourished mothers; experience minimal environmental impacts that would constrain growth; have had access to adequate health care; and are breastfed. Using the same conceptual framework as the WHO Child Growth Standards, INTERGROWTH-21st pooled information from eight countries to produce prescriptive growth standards and a new way to classify preterm and small-for-gestational-age babies (Villar et al. 2014). INTERGROWTH-21st provides a new opportunity to understand whether a child is small due to preterm birth, impaired fetal growth, or both (Hughes et al. 2017). New sex-specific standards were developed on measurements of newborn size at birth, birth length, head circumference, biparietal diameter, occipitofrontal diameter, femur length, and abdominal circumference.

Since the INTERGROWTH-21st standards have not yet been widely adopted in developing countries and require use of ultrasound technology to determine gestational age—which is not practical in most low-resource settings—they are not covered in this guide. However, they are important standards to be aware of and can be used if ultrasound technology is available.

More information is available on the INTERGROWTH-21st Standards website.

Making Sense of the Data: Z-Scores

What Are Z-Scores and What Do They Tell Us?

Anthropometric z-scores describe how far and in what direction an individual's measurement is from the reference populations' median value. Z-scores that fall outside of the normal range indicate a nutritional issue (undernutrition or overweight). If a z-score is outside the normal range, its distance from the median indicates the severity of the nutritional issue; the further away, the more severe. When a high proportion of individuals in a given population have z-scores outside of the "normal" range, there is a population-level nutrition problem. See Module 1 for guidance on how to understand the nutrition situation at the population level.

NOTE

The **reference population** used in the WHO Child Growth Standards is composed of children from birth to 5 years who were raised in optimal environmental conditions. An individual child's z-score is based on a comparison with children of the same sex and, depending on the measure, age.

In addition to providing information on current nutritional status, z-scores can be used to follow an individual child's growth over time. This helps health care providers see whether a child is growing well, is at risk of undernutrition or overweight, or is on the path to recovery from malnutrition (see **Box 2.5**).

BOX 2.5 PLOTTING A CHILD'S GROWTH OVER TIME USING GROWTH CHARTS

It is not possible to fully understand the pattern of a child's growth by looking at his/her z-score at one single point in time. Rather, it is important to consider the child's growth trend over time (Is he gaining or losing weight? Has she grown taller or stopped growing?). For example, consider a child with a weight-for-height z-score of -1, which falls in the "normal" range. If that child's previous z-score was also normal and close to -1, there would be no cause for concern; however, if his/her z-score was higher in a previous measurement, the child's weight is lower relative to his/her height than before and his/her growth may be faltering. Likewise, a z-score below -2 may raise concern unless comparisons with previous z-scores show that the child is improving from previous weight loss.

Health workers use growth charts (often based on the WHO Child Growth Standards for children 0–60 months) to track a child's growth over time. The growth chart contains z-score lines that relate a child's measurements to the standard. Marking where the child's individual measurements fall at certain points in time allows growth to be tracked and indicates whether the child is growing at a healthy pace.

For more information on plotting measurements and interpreting growth pattern, see **Annex 1**.

Why Z-Scores?

A major advantage of z-scores is that at the population level, they can be used to calculate summary statistics such as means, which allows the entire population's nutritional status to be assessed. They are also very useful for identifying individual children with extreme measurements that differ substantially from those of normal, healthy children. This is especially important in populations with high levels of malnutrition because children at the extreme ends of the distribution have the most severe forms of malnutrition (Gorstein et al. 1994; WHO 1995; Gibson 2005).

Who Needs to Understand Z-Scores and Why?

Z-score cutoffs are used to define malnutrition according to anthropometric indices (e.g., weight-for-length/height). Therefore, health care workers and nutrition program staff need to understand what z-scores are, how to interpret them, and what they mean to make informed decisions at both the individual level (e.g., for growth monitoring and entry into/graduation from feeding programs) and population level (e.g., for nutrition assessments or situational reports for a population and monitoring and evaluation of programs).

TIP

In clinic or community settings, health workers are not expected to discuss z-scores with patients. Instead, they should talk about the individual's nutritional status (e.g., MAM) and growth pattern (e.g., growing well, growing too slowly, or lagging far behind).

How Is a Z-Score Determined?

Z-scores can be estimated using growth charts/tables (see the Tools section), obtained using computer software, or calculated by hand. In a clinical context such as during health facility visits or growth monitoring, sex-specific growth charts or tables are used to estimate a child's z-score and classify nutritional status, based on anthropometric measurements and often age. In a research or survey setting, where exact z-scores are needed, special software programs such as WHO Anthro[2] and Epi-Info can calculate z-scores. The WHO website also provides macros for the SPSS, Stata, SAS, S-Plus, and R statistical software packages to calculate z-scores for the anthropometric indicators in the growth standards. For specific guidance on how a z-score is calculated, see Annex 2.

[2] WHO Anthro is used to calculate z-scores for children 0–60 months of age only. For older children (5–19 years of age), WHO AnthroPlus is used. WHO Anthro and AnthroPlus are available on the WHO website at: http://www.who.int/childgrowth/software/en/ and http://www.who.int/growthref/tools/en/, respectively.

Using Anthropometry to Classify Nutritional Status of Children from Birth to 5 Years of Age

Tables 2.3 to 2.6 provide information on classifying a child's nutritional status using the measurements and indices described in this module.

TABLE 2.3 WHO Child Growth Standards Classification

ANTHROPOMETRIC INDICATOR AND CONDITION	AGE		Z-SCORE						
	0–23 months	24–60 months	< -3	≥ -3 to < -2	≥ -2 to < -1	≥-1 to ≤ +1	> +1 to ≤ +2	> +2 to ≤+3	> +3
Length-for-age Stunting	✓		Severe stunting	Moderate stunting	Normal				Extreme tallness is not usually a nutrition issue. May indicate endocrine disorder.
Height-for-age Stunting		✓							
Weight-for-age Underweight	✓	✓	Severe underweight	Moderate underweight	Normal		Do not use weight-for-age to determine overweight. Weight-for-length/height (0–60 months) and BMI-for-age (all ages) are better for assessing overweight in children.		
Weight-for-length Wasting, overweight/obesity	✓		Severe wasting/ severe acute malnutrition (SAM)	Moderate wasting/ moderate acute malnutrition (MAM)	Normal		Possible risk of overweight	Overweight	Obesity
Weight-for-height Wasting, overweight/obesity		✓							
BMI-for-age* Wasting, overweight/obesity	✓	✓	Severe wasting/SAM	Moderate wasting/MAM	Normal		Possible risk of overweight	Overweight	Obesity
Head-circumference-for-age Small head circumference	✓	✓	Very small head circumference (severe microcephaly)	Small head circumference (microcephaly)	Normal			Large head circumference (macrocephaly) Not related to nutritional status.	

Sources: WHO 2008; CDC 2016; WHO 2016b.

** Less commonly used than weight-for-height in children from birth to 5 years of age in developing countries.*

TABLE 2.4 Mid-Upper Arm Circumference

The table below identifies universally accepted international MUAC cutoffs for children 6–59 months of age based on WHO guidance. There is insufficient evidence to recommend a MUAC cutoff for children under 6 months of age.

Age Group	Nutritional Status (identifies wasting/acute malnutrition)	
	SAM	MAM
6–59 months	<115 mm	≥115 mm to <125 mm

Source: WHO/UNICEF/WFP 2014; WHO 2013.

LINKS TO RELATED CONTENT

Measurement: MUAC Condition: Moderate acute malnutrition Condition: Severe acute malnutrition

TABLE 2.5 Birth Weight

The table below identifies universally accepted international low birth weight (LBW) cutoffs for newborns, based on WHO guidance.

Age Group	Low Birth Weight	Normal Birth Weight
Newborns, within 24 hours of birth	< 2,500 grams	≥ 2,500 grams

Source: WHO 2014.

LINKS TO RELATED CONTENT

Measurement: Birth weight Condition: Low birth weight

Clinical Assessment: Bilateral Pitting Edema

Bilateral pitting edema is a clinical sign of SAM.

TABLE 2.6 Nutritional Status Classification of Bilateral Pitting Edema

Description	Grade of Edema	Nutritional Status
No bilateral pitting edema	Absent (O)	Does not have edematous malnutrition
Present in both feet/ankles	Mild (+)	SAM
Present in both feet/ankles, plus lower legs, hands, or lower arms	Moderate (++)	SAM
Generalized, including both feet, legs, hands, arms, and face	Severe (+++)	SAM

Sources: WHO 2013; WHO e-Library of Evidence for Nutrition Actions (eLENA) n.d. (a); WHO eLENA n.d. (b).

LINKS TO RELATED CONTENT

Measurement: **Bilateral pitting edema** Condition: **Severe acute malnutrition**

BOX 2.6 SPECIAL CONDITIONS

Certain developmental, neurologic, and genetic conditions, such as Down syndrome, achondroplasia, and cerebral palsy, may alter an individual's body composition, size, growth pattern, and/or overall growth potential. In addition, it can be challenging to accurately measure individuals with conditions that affect the ability to stand; straighten their arms, legs, or back; or hold their head steady. In addition, comparing the weight of amputees to a reference population of non-amputees is problematic. When assessing people with special needs, it is important to be aware of the implications of their condition and potential explanations for their altered growth.

There is limited guidance on applying anthropometry to individuals with special needs. While the CDC has provided some alternative measurement options for individuals, WHO has not issued specific guidelines or references. However, alternative anthropometric references exist for certain conditions. The alternative charts have been developed from small, homogeneous samples and may not have used standardized measurement techniques or accounted for secondary conditions that affect growth. Therefore, although they may be a useful reference to understand how a condition may affect growth or anthropometric measurements, they should be used with caution and in conjunction with the WHO standards and references.

For more information on the CDC's alternative approaches for measuring an individual with special needs, see The CDC Growth Charts for Children with Special Health Care Needs.

For alternative anthropometric references, see:

Amputation: Mini Nutritional Assessment (Appendix 3: Determining BMI for Amputees)

Down syndrome: UK Down Syndrome 0–18 years

Cerebral palsy: The Life Expectancy Project charts, according to gross motor function classification system

Cornelia de Lange syndrome: Girls Boys

Additional resources: The Greenwood Genetic Center in the United States published a set of references (1998) from age 25 weeks through adulthood for several conditions, including achondroplasia, Marfan syndrome, and Turner syndrome, among others. They are available for purchase.

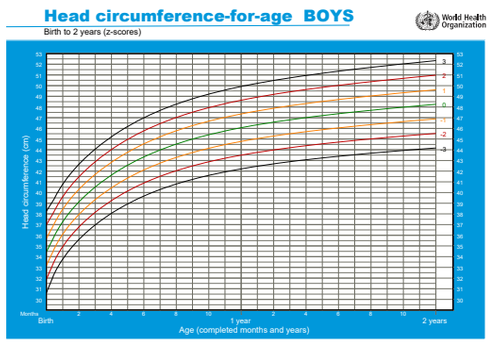
Source: Gibson 2005; U.S. Department of Health and Human Services n.d.; CDC 2013; Life Expectancy Project 2011; Nestle Nutrition Institute n.d.

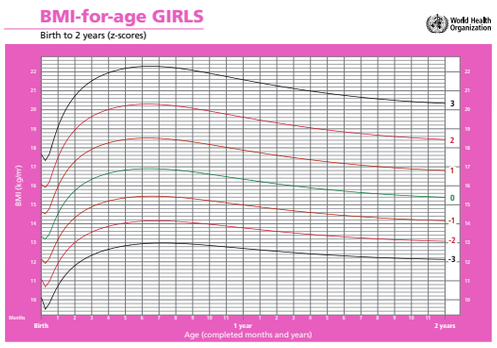
Tools to Assess, Classify, and/or Monitor Nutritional Status of Children from Birth to 5 Years of Age

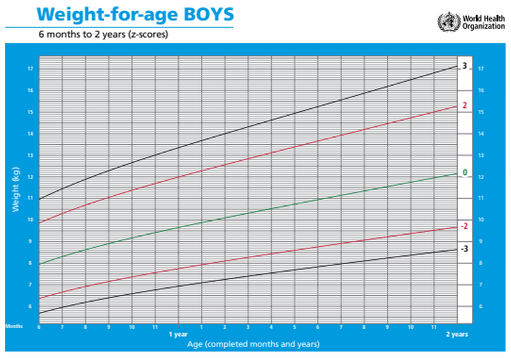
This section describes the various anthropometric tools (growth charts and reference tables) that support the assessment, classification, and monitoring of a child's nutritional status.

TOOL: **Growth Charts**[2]

When anthropometric measurements, such as height and weight, are used as part of individual assessment or screening in a community, clinic, or facility, health workers will typically plot the measurements on a sex-specific growth chart included in the child's health card. Measuring and plotting a child's measurements over time allows growth to be tracked and indicates whether the child is growing at a healthy pace. In most developing countries, the growth charts are based on the WHO Child Growth Standards. Examples of growth charts and more information on how to interpret the plotted data from the growth charts can be found in Annex 1.







Growth charts for the WHO Child Growth Standards are accessible on the WHO website.

TOOL: **Quick Reference Tables**

Simple sex-specific reference tables can also be used to classify a child's nutritional status. Although they do not provide precise z-scores, they can quickly estimate a child's approximate z-score and nutritional status. WHO has developed simplified sex-specific field tables,[3] which show the z-score value corresponding to the cutoff for each classification (mild, moderate, severe malnutrition) for the weight-for-length/height, length/height-for-age, weight-for-age, and BMI-for-age indices. FANTA has further adapted the WHO tables for weight-for-length/height to provide the weight and z-score ranges corresponding to each nutritional status category. Instructions for the FANTA reference tables are here with the full set beginning on the next page.

Instructions with Example:

John, a boy age 18 months, is 82 cm long and weighs 13.5 kg. What is his nutritional status, based on the tables on the next page?

Steps:

1. Find the correct table for the child's age (0–23 months or 24–59 months) and sex (boy or girl).

   Use the "Boys 0-23 months, Weight-for-Length" table for John.

2. Find the value closest to the child's measured length/height in the left column.

   82 cm

3. Move your finger to the right to the range that includes the child's weight in kilograms.

   12.9-14.0 kg

4. Classify the child's nutritional status according to the label on top of the column that includes the child's weight.

   Answer: John is overweight.

NOTE

Looking for a full set of simplified sex-specific field tables with instructions?

Download FANTA's field tables

[3] WHO field tables: Weight-for-height, Length/height-for-age, Weight-for-age, BMI-for-age

BOYS 0–23 months, Weight-for-Length

Length (cm)	SAM < -3	MAM ≥ -3 to < -2	Normal ≥ -2 to ≤ +2	Overweight > +2 to ≤ +3	Obesity > +3
45	0–1.8	1.9	2.1–3.0	3.1–3.3	> 3.3
46	0–1.9	2.0–2.1	2.2–3.1	3.2–3.5	> 3.5
47	0–2.0	2.1–2.2	2.3–3.3	3.4–3.7	> 3.7
48	0–2.2	2.3–2.4	2.5–3.6	3.7–3.9	> 3.9
49	0–2.3	2.4–2.5	2.6–3.8	3.9–4.2	> 4.2
50	0–2.5	2.6–2.7	2.8–4.0	4.1–4.4	> 4.4
51	0–2.6	2.7–2.9	3.0–4.2	4.3–4.7	> 4.7
52	0–2.8	2.9–3.1	3.2–4.5	4.6–5.0	> 5.0
53	0–3.0	3.1–3.3	3.4–4.8	4.9–5.3	> 5.3
54	0–3.2	3.3–3.5	3.6–5.1	5.2–5.6	> 5.6
55	0–3.5	3.6–3.7	3.8–5.4	5.5–6.0	> 6.0
56	0–3.7	3.8–4.0	4.1–5.8	5.9–6.3	> 6.3
57	0–3.9	4.0–4.2	4.3–6.1	6.2–6.7	> 6.7
58	0–4.2	4.3–4.5	4.6–6.4	6.5–7.1	> 7.1
59	0–4.4	4.5–4.7	4.8–6.8	6.9–7.4	> 7.4
60	0–4.6	4.7–5.0	5.1–7.1	7.2–7.8	> 7.8
61	0–4.8	4.9–5.2	5.3–7.4	7.5–8.1	> 8.1
62	0–5.0	5.1–5.5	5.6–7.7	7.8–8.5	> 8.5
63	0–5.2	5.3–5.7	5.8–8.0	8.1–8.8	> 8.8
64	0–5.4	5.5–5.9	6.0–8.3	8.4–9.1	> 9.1
65	0–5.6	5.7–6.1	6.2–8.6	8.7–9.4	> 9.4
66	0–5.8	5.9–6.3	6.4–8.9	9.0–9.7	> 9.7
67	0–6.0	6.1–6.5	6.6–9.2	9.3–10.0	> 10.0
68	0–6.2	6.3–6.7	6.8–9.4	9.5–10.3	> 10.3
69	0–6.4	6.5–6.9	7.0–9.7	9.8–10.6	> 10.6
70	0–6.5	6.6–7.1	7.2–10.0	10.1–10.9	> 10.9
71	0–6.7	6.8–7.3	7.4–10.2	10.3–11.2	> 11.2
72	0–6.9	7.0–7.5	7.6–10.5	10.6–11.5	> 11.5

Length (cm)	SAM < -3	MAM ≥ -3 to < -2	Normal ≥ -2 to ≤ +2	Overweight > +2 to ≤ +3	Obesity > +3
73	0–7.1	7.2–7.6	7.7–10.8	10.9–11.8	> 11.8
74	0–7.2	7.3–7.8	7.9–11.0	11.1–12.1	> 12.1
75	0–7.4	7.5–8.0	8.1–11.3	11.4–12.3	> 12.3
76	0–7.5	7.6–8.2	8.3–11.5	11.6–12.6	> 12.6
77	0–7.7	7.8–8.3	8.4–11.7	11.8–12.8	> 12.8
78	0–7.8	7.9–8.5	8.6–12.0	12.1–13.1	> 13.1
79	0–8.0	8.1–8.6	8.7–12.2	12.3–13.3	> 13.3
80	0–8.1	8.2–8.8	8.9–12.4	12.5–13.6	> 13.6
81	0–8.3	8.4–9.0	9.1–12.6	12.7–13.8	> 13.8
82	0–8.4	8.5–9.1	9.2–12.8	12.9–14.0	> 14.0
83	0–8.6	8.7–9.3	9.4–13.1	13.2–14.3	> 14.3
84	0–8.8	8.9–9.5	9.6–13.3	13.4–14.6	> 14.6
85	0–9.0	9.1–9.7	9.8–13.6	13.7–14.9	> 14.9
86	0–9.2	9.3–9.9	10.0–13.9	14.0–15.2	> 15.2
87	0–9.4	9.5–10.1	10.2–14.2	14.3–15.5	> 15.5
88	0–9.6	9.7–10.4	10.5–14.5	14.6–15.8	> 15.8
89	0–9.8	9.9–10.6	10.7–14.7	14.8–16.1	> 16.1
90	0–10.0	10.1–10.8	10.9–15.0	15.1–16.4	> 16.4
91	0–10.2	10.3–11.0	11.1–15.3	15.4–16.7	> 16.7
92	0–10.4	10.5–11.2	11.3–15.6	15.7–17.0	> 17.0
93	0–10.6	10.7–11.4	11.5–15.8	15.9–17.3	> 17.3
94	0–10.7	10.8–11.6	11.7–16.1	16.2–17.6	> 17.6
95	0–10.9	11.0–11.8	11.9–16.4	16.5–17.9	> 17.9
96	0–11.1	11.2–12.0	12.1–16.7	16.8–18.2	> 18.2
97	0–11.3	11.4–12.2	12.3–17.0	17.1–18.5	> 18.5
98	0–11.5	11.6–12.4	12.5–17.3	17.4–18.9	> 18.9
99	0–11.7	11.8–12.6	12.7–17.6	17.7–19.2	> 19.2
100	0–11.9	12.0–12.8	12.9–18.0	18.1–19.6	> 19.6

GIRLS 0–23 months, Weight-for-Length

Length (cm)	SAM < -3	MAM ≥ -3 to < -2	Normal ≥ -2 to ≤ +2	Overweight > +2 to ≤ +3	Obesity > +3
45	0–1.8	1.9–2.0	2.1–3.0	3.1–3.3	> 3.3
46	0–1.9	2.0–2.1	2.2–3.2	3.3–3.5	> 3.5
47	0–2.1	2.2–2.3	2.4–3.4	3.5–3.7	> 3.7
48	0–2.2	2.3–2.4	2.5–3.6	3.7–4.0	> 4.0
49	0–2.3	2.4–2.5	2.6–3.8	3.9–4.2	> 4.2
50	0–2.5	2.6–2.7	2.8–4.0	4.1–4.5	> 4.5
51	0–2.7	2.8–2.9	3.0–4.3	4.4–4.8	> 4.8
52	0–2.8	2.9–3.1	3.2–4.6	4.7–5.1	> 5.1
53	0–3.0	3.1–3.3	3.4–4.9	5.0–5.4	> 5.4
54	0–3.2	3.3–3.5	3.6–5.2	5.3–5.7	> 5.7
55	0–3.4	3.5–3.7	3.8–5.5	5.6–6.1	> 6.1
56	0–3.6	3.7–3.9	4.0–5.8	5.9–6.4	> 6.4
57	0–3.8	3.9–4.2	4.3–6.1	6.2–6.8	> 6.8
58	0–4.0	4.1–4.4	4.5–6.5	6.6–7.1	> 7.1
59	0–4.2	4.3–4.6	4.7–6.8	6.9–7.5	> 7.5
60	0–4.4	4.5–4.8	4.9–7.1	7.2–7.8	> 7.8
61	0–4.6	4.7–5.0	5.1–7.4	7.5–8.2	> 8.2
62	0–4.8	4.9–5.2	5.3–7.7	7.8–8.5	> 8.5
63	0–5.0	5.1–5.4	5.5–8.0	8.1–8.8	> 8.8
64	0–5.2	5.3–5.6	5.7–8.3	8.4–9.1	> 9.1
65	0–5.4	5.5–5.8	5.9–8.6	8.7–9.5	> 9.5
66	0–5.5	5.6–6.0	6.1–8.8	8.9–9.8	> 9.8
67	0–5.7	5.8–6.2	6.3–9.1	9.2–10.0	> 10.0
68	0–5.9	6.0–6.4	6.5–9.4	9.5–10.3	> 10.3
69	0–6.0	6.1–6.6	6.7–9.6	9.7–10.6	> 10.6
70	0–6.2	6.3–6.8	6.9–9.9	10.0–10.9	> 10.9
71	0–6.4	6.5–6.9	7.0–10.1	10.2–11.1	> 11.1
72	0–6.5	6.6–7.1	7.2–10.3	10.4–11.4	> 11.4

Length (cm)	SAM < -3	MAM ≥ -3 to < -2	Normal ≥ -2 to ≤ +2	Overweight > +2 to ≤ +3	Obesity > +3
73	0–6.7	6.8–7.3	7.4–10.6	10.7–11.7	> 11.7
74	0–6.8	6.9–7.4	7.5–10.8	10.9–11.9	> 11.9
75	0–7.0	7.1–7.6	7.7–11.0	11.1–12.2	> 12.2
76	0–7.1	7.2–7.7	7.8–11.2	11.3–12.4	> 12.4
77	0–7.3	7.4–7.9	8.0–11.5	11.6–12.6	> 12.6
78	0–7.4	7.5–8.1	8.2–11.7	11.8–12.9	> 12.9
79	0–7.6	7.7–8.2	8.3–11.9	12.0–13.1	> 13.1
80	0–7.7	7.8–8.4	8.5–12.1	12.2–13.4	> 13.4
81	0–7.9	8.0–8.6	8.7–12.4	12.5–13.7	> 13.7
82	0–8.0	8.1–8.7	8.8–12.6	12.7–13.9	> 13.9
83	0–8.2	8.3–8.9	9.0–12.9	13.0–14.2	> 14.2
84	0–8.4	8.5–9.1	9.2–13.2	13.3–14.5	> 14.5
85	0–8.6	8.7–9.3	9.4–13.5	13.6–14.9	> 14.9
86	0–8.8	8.9–9.6	9.7–13.8	13.9–15.2	> 15.2
87	0–9.0	9.1–9.8	9.9–14.1	14.2–15.5	> 15.5
88	0–9.2	9.3–10.0	10.1–14.4	14.5–15.9	> 15.9
89	0–9.4	9.5–10.2	10.3–14.7	14.8–16.2	> 16.2
90	0–9.6	9.7–10.4	10.5–15.0	15.1–16.5	> 16.5
91	0–9.8	9.9–10.6	10.7–15.3	15.4–16.9	> 16.9
92	0–10.0	10.1–10.8	10.9–15.6	15.7–17.2	> 17.2
93	0–10.1	10.2–11.0	11.1–15.9	16.0–17.5	> 17.5
94	0–10.3	10.4–11.2	11.3–16.2	16.3–17.9	> 17.9
95	0–10.5	10.6–11.4	11.5–16.5	16.6–18.2	> 18.2
96	0–10.7	10.8–11.6	11.7–16.8	16.9–18.6	> 18.6
97	0–10.9	11.0–11.9	12.0–17.1	17.2–18.9	> 18.9
98	0–11.1	11.2–12.1	12.2–17.5	17.6–19.3	> 19.3
99	0–11.3	11.4–12.3	12.4–17.8	17.9–19.6	> 19.6
100	0–11.5	11.6–12.5	12.6–18.1	18.2–20.0	> 20.0

BOYS 24–59 months, Weight-for-Height

Height (cm)	SAM < -3	MAM ≥ -3 to < -2	Normal ≥ -2 to ≤ +2	Overweight > +2 to ≤ +3	Obesity > +3
65	0–5.8	5.9–6.2	6.3–8.8	8.9–9.6	> 9.6
66	0–6.0	6.1–6.4	6.5–9.1	9.2–9.9	> 9.9
67	0–6.1	6.2–6.6	6.7–9.4	9.5–10.2	> 10.2
68	0–6.3	6.4–6.8	6.9–9.6	9.7–10.5	> 10.5
69	0–6.5	6.6–7.0	7.1–9.9	10.0–10.8	> 10.8
70	0–6.7	6.8–7.2	7.3–10.2	10.3–11.1	> 11.1
71	0–6.8	6.9–7.4	7.5–10.4	10.5–11.4	> 11.4
72	0–7.0	7.1–7.6	7.7–10.7	10.8–11.7	> 11.7
73	0–7.2	7.3–7.8	7.9–11.0	11.1–12.0	> 12.0
74	0–7.3	7.4–7.9	8.0–11.2	11.3–12.2	> 12.2
75	0–7.5	7.6–8.1	8.2–11.4	11.5–12.5	> 12.5
76	0–7.6	7.7–8.3	8.4–11.7	11.8–12.8	> 12.8
77	0–7.8	7.9–8.4	8.5–11.9	12.0–13.0	> 13.0
78	0–7.9	8.0–8.6	8.7–12.1	12.2–13.3	> 13.3
79	0–8.1	8.2–8.7	8.8–12.3	12.4–13.5	> 13.5
80	0–8.2	8.3–8.9	9.0–12.6	12.7–13.7	> 13.7
81	0–8.4	8.5–9.1	9.2–12.8	12.9–14.0	> 14.0
82	0–8.6	8.7–9.2	9.3–13.0	13.1–14.2	> 14.2
83	0–8.7	8.8–9.4	9.5–13.3	13.4–14.5	> 14.5
84	0–8.9	9.0–9.6	9.7–13.5	13.6–14.8	> 14.8
85	0–9.1	9.2–9.9	10.0–13.8	13.9–15.1	> 15.1
86	0–9.3	9.4–10.1	10.2–14.1	14.2–15.4	> 15.4
87	0–9.5	9.6–10.3	10.4–14.4	14.5–15.7	> 15.7
88	0–9.7	9.8–10.5	10.6–14.7	14.8–16.0	> 16.0
89	0–9.9	10.0–10.7	10.8–14.9	15.0–16.3	> 16.3
90	0–10.1	10.2–10.9	11.0–15.2	15.3–16.6	> 16.6
91	0–10.3	10.4–11.1	11.2–15.5	15.6–16.9	> 16.9
92	0–10.5	10.6–11.3	11.4–15.8	15.9–17.2	> 17.2

Height(cm)	SAM < -3	MAM ≥ -3 to < -2	Normal ≥ -2 to ≤ +2	Overweight > +2 to ≤ +3	Obesity > +3
93	0–10.7	10.8–11.5	11.6–16.0	16.1–17.5	> 17.5
94	0–10.9	11.0–11.7	11.8–16.3	16.4–17.8	> 17.8
95	0–11.0	11.1–11.9	12.0–16.6	16.7–18.1	> 18.1
96	0–11.2	11.3–12.1	12.2–16.9	17.0–18.4	> 18.4
97	0–11.4	11.5–12.3	12.4–17.2	17.3–18.8	> 18.8
98	0–11.6	11.7–12.5	12.6–17.5	17.6–19.1	> 19.1
99	0–11.8	11.9–12.8	12.9–17.9	18.0–19.5	> 19.5
100	0–12.0	12.1–13.0	13.1–18.2	18.3–19.9	> 19.9
101	0–12.2	12.3–13.2	13.3–18.5	18.6–20.3	> 20.3
102	0–12.4	12.5–13.5	13.6–18.9	19.0–20.7	> 20.7
103	0–12.7	12.8–13.7	13.8–19.3	19.4–21.1	> 21.1
104	0–12.9	13.0–13.9	14.0–19.7	19.8–21.6	> 21.6
105	0–13.1	13.2–14.2	14.3–20.1	20.2–22.0	> 22.0
106	0–13.3	13.4–14.4	14.5–20.5	20.6–22.5	> 22.5
107	0–13.6	13.7–14.7	14.8–20.9	21.0–22.9	> 22.9
108	0–13.8	13.9–15.0	15.1–21.3	21.4–23.4	> 23.4
109	0–14.0	14.1–15.2	15.3–21.8	21.9–23.9	> 23.9
110	0–14.3	14.4–15.5	15.6–22.2	22.3–24.4	> 24.4
111	0–14.5	14.6–15.8	15.9–22.7	22.8–25.0	> 25.0
112	0–14.8	14.9–16.1	16.2–23.1	23.2–25.5	> 25.5
113	0–15.1	15.2–16.4	16.5–23.6	23.7–26.0	> 26.0
114	0–15.3	15.4–16.7	16.8–24.1	24.2–26.6	> 26.6
115	0–15.6	15.7–17.0	17.1–24.6	24.7–27.2	> 27.2
116	0–15.9	16.0–17.3	17.4–25.1	25.2–27.8	> 27.8
117	0–16.1	16.2–17.6	17.7–25.6	25.7–28.3	> 28.3
118	0–16.4	16.5–17.9	18.0–26.1	26.2–28.9	> 28.9
119	0–16.7	16.8–18.2	18.3–26.6	26.7–29.5	> 29.5
120	0–17.0	17.1–18.5	18.6–27.2	27.3–30.1	> 30.1

GIRLS 24–59 months, Weight-for-Height

Height (cm)	SAM < -3	MAM ≥ -3 to < -2	Normal ≥ -2 to ≤ +2	Overweight > +2 to ≤ +3	Obesity > +3
65	0–5.5	5.6–6.0	6.1–8.7	8.8–9.7	> 9.7
66	0–5.7	5.8–6.2	6.3–9.0	9.1–10.0	> 10.0
67	0–5.8	5.9–6.3	6.4–9.3	9.4–10.2	> 10.2
68	0–6.0	6.1–6.5	6.6–9.5	9.6–10.5	> 10.5
69	0–6.2	6.3–6.7	6.8–9.8	9.9–10.8	> 10.8
70	0–6.3	6.4–6.9	7.0–10.0	10.1–11.1	> 11.1
71	0–6.5	6.6–7.0	7.1–10.3	10.4–11.3	> 11.3
72	0–6.6	6.7–7.2	7.3–10.5	10.6–11.6	> 11.6
73	0–6.8	6.9–7.4	7.5–10.7	10.8–11.8	> 11.8
74	0–6.9	7.0–7.5	7.6–11.0	11.1–12.1	> 12.1
75	0–7.1	7.2–7.7	7.8–11.2	11.3–12.3	> 12.3
76	0–7.2	7.3–7.9	8.0–11.4	11.5–12.6	> 12.6
77	0–7.4	7.5–8.0	8.1–11.6	11.7–12.8	> 12.8
78	0–7.5	7.6–8.2	8.3–11.8	11.9–13.1	> 13.1
79	0–7.7	7.8–8.3	8.4–12.1	12.2–13.3	> 13.3
80	0–7.8	7.9–8.5	8.6–12.3	12.4–13.6	> 13.6
81	0–8.0	8.1–8.7	8.8–12.6	12.7–13.9	> 13.9
82	0–8.2	8.3–8.9	9.0–12.8	12.9–14.1	> 14.1
83	0–8.4	8.5–9.1	9.2–13.1	13.2–14.5	> 14.5
84	0–8.5	8.6–9.3	9.4–13.4	13.5–14.8	> 14.8
85	0–8.7	8.8–9.5	9.6–13.7	13.8–15.1	> 15.1
86	0–8.9	9.0–9.7	9.8–14.0	14.1–15.4	> 15.4
87	0–9.1	9.2–9.9	10.0–14.3	14.4–15.8	> 15.8
88	0–9.3	9.4–10.1	10.2–14.6	14.7–16.1	> 16.1
89	0–9.5	9.6–10.3	10.4–14.9	15.0–16.4	> 16.4
90	0–9.7	9.8–10.5	10.6–15.2	15.3–16.8	> 16.8
91	0–9.9	10.0–10.8	10.9–15.5	15.6–17.1	> 17.1
92	0–10.1	10.2–11.0	11.1–15.8	15.9–17.4	> 17.4

Height(cm)	SAM < -3	MAM ≥ -3 to < -2	Normal ≥ -2 to ≤ +2	Overweight > +2 to ≤ +3	Obesity > +3
93	0–10.3	10.4–11.2	11.3–16.1	16.2–17.8	> 17.8
94	0–10.5	10.6–11.4	11.5–16.4	16.5–18.1	> 18.1
95	0–10.7	10.8–11.6	11.7–16.7	16.8–18.5	> 18.5
96	0–10.8	10.9–11.8	11.9–17.0	17.1–18.8	> 18.8
97	0–11.0	11.1–12.0	12.1–17.4	17.5–19.2	> 19.2
98	0–11.2	11.3–12.2	12.3–17.7	17.8–19.5	> 19.5
99	0–11.4	11.5–12.4	12.5–18.0	18.1–19.9	> 19.9
100	0–11.6	11.7–12.7	12.8–18.4	18.5–20.3	> 20.3
101	0–11.9	12.0–12.9	13.0–18.7	18.8–20.7	> 20.7
102	0–12.1	12.2–13.2	13.3–19.1	19.2–21.1	> 21.1
103	0–12.3	12.4–13.4	13.5–19.5	19.6–21.6	> 21.6
104	0–12.5	12.6–13.7	13.8–19.9	20.0–22.0	> 22.0
105	0–12.8	12.9–13.9	14.0–20.3	20.4–22.5	> 22.5
106	0–13.0	13.1–14.2	14.3–20.8	20.9–23.0	> 23.0
107	0–13.3	13.4–14.5	14.6–21.2	21.3–23.5	> 23.5
108	0–13.6	13.7–14.8	14.9–21.7	21.8–24.0	> 24.0
109	0–13.8	13.9–15.1	15.2–22.1	22.2–24.5	> 24.5
110	0–14.1	14.2–15.4	15.5–22.6	22.7–25.1	> 25.1
111	0–14.4	14.5–15.7	15.8–23.1	23.2–25.7	> 25.7
112	0–14.7	14.8–16.1	16.2–23.6	23.7–26.2	> 26.2
113	0–15.0	15.1–16.4	16.5–24.2	24.3–26.8	> 26.8
114	0–15.3	15.4–16.7	16.8–24.7	24.8–27.4	> 27.4
115	0–15.6	15.7–17.1	17.2–25.2	25.3–28.1	> 28.1
116	0–15.9	16.0–17.4	17.5–25.8	25.9–28.7	> 28.7
117	0–16.2	16.3–17.7	17.8–26.3	26.4–29.3	> 29.3
118	0–16.5	16.6–18.1	18.2–26.9	27.0–29.9	> 29.9
119	0–16.8	16.9–18.4	18.5–27.4	27.5–30.6	> 30.6
120	0–17.2	17.3–18.8	18.9–28.0	28.1–31.2	> 31.2

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MODULE 3

Children and Adolescents 5–19 Years of Age

What Does this Module Cover?

Module 3 focuses on anthropometry of children and adolescents 5–19 years of age (61–228 completed months). It is broken into specific sections that describe the importance of nutrition for children in this age group:

- common nutrition-related conditions identified by anthropometry
- the measurements and indices used to identify nutrition-related conditions
- interpretation of anthropometric measurements and classification of nutritional status
- and tools to assess child and adolescent nutritional status.

Users are encouraged to review Module 1 alongside this module because it explains key concepts that are relevant to all modules.

Who Is the Focus of Module 3?

Module 3 aligns with the age ranges in the WHO Growth Reference. In this module, "children and adolescents 5–19 years of age" refers to children age 61 months to 19 years (228 completed months). At age 19 years and 1 month, the WHO Growth Reference no longer applies to them.

Nutrition during Childhood and Adolescence: Why Does It Matter?

Children and adolescents 5–19 years of age have high nutritional needs because they are growing rapidly. This is especially true for adolescents (10–19 years of age[1]), whose growth can be as rapid as that of infants (Spear 2002). Adolescent boys and girls have higher calorie and nutrient needs than any other age group—with boys needing more overall calories— to meet the demands of growth spurts and the onset of puberty (Spear 2002; Salam and Bhutta 2015). Meeting these needs can be particularly challenging in poor and food insecure environments.

Undernutrition in this age group can delay sexual maturation, slow growth (Story 1992; Salam and Bhutta 2015), and reduce a child/adolescent's ability to learn, lowering school performance and achievement (Grantham-McGregor et al. 2007). Meanwhile overweight and obesity at this age are likely to persist into adulthood and increase the risk of chronic disease in the short and long term (U.S. Centers for Disease Control and Prevention [CDC] 2015). There is also evidence that obesity may be related to early puberty in girls and delayed puberty in boys (Burt Solorzano and McCartney 2011). In addition, pregnancy and lactation during adolescence can negatively impact a girl's nutritional status by stunting the girl's growth and lowering her nutritional stores as her needs compete with those of the fetus, increasing risk of pregnancy complications (Rah et al. 2008; WHO 2005). Malnutrition also affects pregnancy outcomes in adolescent girls. Underweight adolescents face higher risk of

[4] As defined by the World Health Organization

Nutrition during Childhood and Adolescence: Why Does It Matter? (continued)

complications such as preterm birth and delivering a child with low birth weight, while overweight/obese adolescents are more likely to suffer pre-eclampsia and gestational diabetes and to require cesarean delivery (Sukavich et al. 2006; Luder and Alton 2005; WHO 2005). These complications have been found to contribute to the intergenerational cycle of malnutrition (Black 2013).

Adolescence is a transitional time in the life cycle, and the 2013 Maternal and Child Nutrition Lancet Series highlighted the importance of good adolescent nutrition for achieving a healthy and productive adult population (Black et al. 2013; Bhutta et al. 2013). However, addressing the needs of children and adolescents 5–19 years of age has not been a key area of focus among the nutrition community, and regular growth monitoring or nutritional assessment of this age group is uncommon. Anthropometric measurements of children and adolescents age 5–19 years are usually done only when they seek treatment for illnesses and/or show clinical signs of acute malnutrition. One reason for this lack of focus on children and adolescents 5–19 years of age is that they have lower morbidity and mortality risks associated with malnutrition compared to preschool children and therefore the limited resources for anthropometric measurement are rarely focused on this age group. However, adolescence presents a great opportunity to promote optimal nutrition behaviors because lifelong habits that can significantly influence health are formed during this period. To help address adolescent nutrition challenges, the World Health Organization (WHO) has recommended that anthropometric measurements be collected among adolescents "at every opportunity," including in primary health services to prevent both undernutrition and overweight (WHO 2005). Unfortunately, there is limited evidence and experience on the best anthropometric measurements to use and how to classify nutritional status among adolescents. In addition, interpretation of anthropometric measurements in this age group is complicated by puberty and differences among ethnic groups (Woodruff and Duffield 2000; Gong and Spear 1986; WHO 2005). Despite these challenges, increased focus on addressing the nutrition needs of this age group, in which anthropometric assessment is a useful tool, could not only improve health in the adolescent years, but also improve their health and nutrition in adulthood and help prevent malnutrition in their offspring, breaking the cycle of intergenerational malnutrition.

What Nutrition-Related Conditions Are Identified through Anthropometry?

This section provides a brief description of common nutrition-related conditions that can be identified in children and adolescents 5–19 years of age using anthropometry. The anthropometric measurements and indices used to determine these nutrition conditions are described in the **Measurements** section.

CONDITIONS IN THIS SECTION

- Stunting
- Underweight
- Acute malnutrition
- Overweight and obesity
- Thinness
- Moderate acute malnutrition (MAM)
- Severe acute malnutrition (SAM)

Already familiar with nutrition-related conditions?

Jump ahead to the **Measurements** section.

CONDITION: **Stunting**

Stunting, reflecting chronic undernutrition, occurs when a child or adolescent does not grow to his/her potential because of the long-term cumulative effects of inadequate dietary intake, frequent illness/infection, or both. The result is that the child or adolescent is shorter than would be expected for a healthy child of his/her age and sex. Stunting identified during adolescence is usually a result of poor growth during the first 1,000 days from pregnancy through age 2, after which it is difficult to regain lost growth and fully recover from the effects of stunting (Victora et al. 2010; Martorell et al. 1994). Stunting can not only impair an individual's health but is also associated with poor cognitive and motor development and lower school achievement (Grantham-McGregor et al. 2007; Hoddinott et al. 2008). The rapid growth of the adolescent years may be an opportunity to catch up on some lost growth, but it is still unclear when and how much linear growth can be regained (Leroy et al. 2015; Prentice et al. 2013) and whether the cognitive and productivity losses due to undernutrition in early childhood are reversible. Stunting is identified using the sex-specific height-for-age index.

LINKS TO RELATED CONTENT

Measurement: **Height-for-age** Interpretation: **Cutoffs for height-for-age**

CONDITION: **Acute Malnutrition**

Acute malnutrition is caused by an inadequate amount or quality of food, severe and/or repeated infections, or a combination of these, which results in a child or adolescent who loses weight rapidly, does not gain enough weight relative to his/her height, and/or experiences bilateral pitting edema. Acute malnutrition may be classified as either moderate or severe, and treatment is based on the severity of the condition.

There is a lot of terminology used in reference to acute malnutrition that may be confusing to readers. For simplicity, this guide has provided key terminology associated with acute malnutrition:

- **Thinness**
- **Moderate acute malnutrition (MAM)**
- **Severe acute malnutrition (SAM)**

CONDITION: **Acute Malnutrition**
↳ CONDITION: **Thinness**

Thinness is used to describe a child or adolescent whose weight is too low for his/her height. It is defined using the sex-specific BMI-for-age index. A child or adolescent with low BMI-for-age has either "severe thinness" or "moderate thinness," depending on the severity. This low BMI-for-age index is also referred to as "wasting."

LINKS TO RELATED CONTENT

Measurement: **BMI-for-age**

Interpretation: **Cutoffs for BMI-for-age**

CONDITION: Acute Malnutrition
↳ CONDITION: **Moderate Acute Malnutrition (MAM)**

Moderate acute malnutrition (MAM) is used to describe thinness according to BMI-for-age (also called moderate wasting) and/or low mid-upper arm circumference (MUAC) (under a certain cutoff).

Note: In children and adolescents 5–19 years of age, the term "moderate malnutrition" is commonly used instead of MAM (dropping the word "acute").

LINKS TO RELATED CONTENT

- Measurement: BMI-for-age
- Interpretation: Cutoffs for BMI-for-age
- Measurement: MUAC
- Interpretation: Cutoffs for MUAC

CONDITION: Acute Malnutrition
↳ CONDITION: **Severe Acute Malnutrition (SAM)**

Severe acute malnutrition (SAM) is used to describe severe thinness according to BMI-for-age (also called severe wasting), low MUAC (under a certain cutoff), and/or the presence of bilateral pitting edema of nutritional origin. Individuals with SAM need urgent medical treatment and specialized therapeutic foods to recover.

Note: In children and adolescents 5–19 years of age, the term "severe malnutrition" is commonly used instead of SAM (dropping the word "acute"). Severe wasting was formerly referred to as marasmus, and bilateral pitting edema was previously known as kwashiorkor. These terms are still occasionally used.

LINKS TO RELATED CONTENT

- Measurement: **BMI-for-age**
- Interpretation: **Cutoffs for BMI-for-age**
- Measurement: **MUAC**
- Interpretation: **Cutoffs for MUAC**
- Measurement: **Bilateral pitting edema**
- Interpretation: **Classification of bilateral pitting edema**

CONDITION: **Underweight**

Underweight occurs when a child 5–10 years of age weighs less than would be expected for a healthy, well-nourished child of the same age and sex. Underweight may indicate that the child is stunted, wasted, or both, but does not differentiate between the two. It may be caused by weight loss or a child's failure to gain weight or to grow in height at the expected pace. It is associated with illness and/or eating inadequate quantity or quality of food. Underweight can be assessed in children up to 10 years of age using the sex-specific weight-for-age index.

LINKS TO RELATED CONTENT

Measurement: Weight-for-age

Interpretation: Cutoffs for weight-for-age

CONDITION: **Overweight and Obesity**

Overweight and obesity (severe overweight) occur when a child or adolescent has too much body fat and weighs more than would be expected for a healthy person of the same age, height, and sex, putting his/her health at risk. Overweight and obesity are complex conditions with multiple causes, including an imbalance between calories consumed and calories expended, low levels of physical activity, medical conditions, and genetics, among others. The prevalence of obese children and adolescents age 5–19 years has been growing worldwide. In 2016, 124 million children worldwide were obese, a more than tenfold increase from 1975, when 11 million children were obese. If trends continue, global prevalence of child and adolescent obesity will surpass prevalence of underweight by 2022 (NCD Risk Factor Collaboration 2017). Overweight and obese children and adolescents are at increased risk for type 2 diabetes, asthma, and high blood pressure, among other diseases, and may experience psychological consequences including depression (WHO 2014). They are also more likely to be overweight/obese as adults, with increased risk of heart disease, stroke, diabetes, some cancers, and other chronic diseases (Freedman et al. 2005; WHO 2005; CDC 2015). Overweight and obesity can be identified in children and adolescents 5–19 years of age using the sex-specific BMI-for-age index.

LINKS TO RELATED CONTENT

Measurement: **BMI-for-age** Interpretation: **Cutoffs for BMI-for-age**

What Anthropometric Measurements and Indices Are Used for Children and Adolescents 5–19 Years of Age?

Several anthropometric measurements and indices are used to identify nutrition conditions in children and adolescents 5–19 years of age. This section describes the anthropometric measurements and indices most commonly used in development settings for this age group: height-for-age, weight-for-age, BMI-for-age, and MUAC. Bilateral pitting edema, a clinical indicator, is also included because it is commonly assessed along with anthropometry. The measurements and indices should be used along with supporting information such as health status, dietary intake, food security status, stage of puberty, growth trends, and care practices. Please note that **Module 4** addresses anthropometry for adolescents who are pregnant or up to 6 months postpartum; this module addresses anthropometry for non-pregnant adolescents up to 19 years of age.

TABLE 3.1 Selected Anthropometric Measurements and Indices in this Module

	Height-for-Age	Weight-for-Age (5–10 years of age only*)	BMI-for-Age	MUAC	Bilateral Pitting Edema
Nutritional condition that the measurement/index identifies	Stunting	Underweight	Thinness, overweight/ obesity	Acute malnutrition	Severe acute malnutrition

*As defined in the 2007 WHO Growth Reference, children and adolescents 5–10 years of age refers to children 61 to 120 completed months of age (i.e., from 5 years and 1 month until the child has reached his/her 10th birthday). Children and adolescents 10–19 years of age refers to children age 120 to 228 completed months.

Already familiar with measurements and indices? Jump ahead to the **Interpretation** section.

MEASUREMENT: **Height-for-Age (HFA)**

Height-for-age (HFA) considers a child/adolescent's height relative to his/her age and sex and is used to identify stunting.

LINKS TO RELATED CONTENT

Condition: **Stunting** Interpretation: **Cutoffs for height-for-age**

MEASUREMENT: **Weight-for-Age (age 5–10 years)**

Weight-for-age (age 5–10 years) considers a child's weight relative to his/her age and sex and identifies underweight. It may reflect wasting, stunting, or both, but it cannot distinguish between the two. WHO included weight-for-age for children age 5–10 years (i.e., 61 to 120 completed months) in its 2007 WHO Growth Reference so that countries that use weight-for-age in growth monitoring programs may extend growth monitoring for individual children throughout childhood and make comparisons to earlier growth.

In **children 10 years of age and older**, BMI-for-age and height-for-age, especially when used together, provide a better indication of nutritional status than weight-for-age. This is because weight-for-age does not distinguish whether weight reflects relative height or body mass, which is particularly important during an age when children and adolescents are experiencing pubertal growth spurts and may appear to have excess weight when they are simply tall (de Onis et al. 2007).

LINKS TO RELATED CONTENT

Condition: **Underweight** Interpretation: **Cutoffs for weight-for-age**

MEASUREMENT: **BMI-for-age**

BMI-for-age is used to indicate both thinness and overweight/obesity in children and non-pregnant adolescents 5–19 years of age. BMI is not a direct measurement of body fat and does not distinguish between muscle weight and body fat weight. It is a ratio of weight relative to height—calculated using the formula (weight in kilograms)/(height in meters)^2—and is interpreted according to age and sex. This age- and sex-specific interpretation is necessary because this age group is still growing and the relationship among weight, height, and fat depends on their stage of development and sex. In adolescents, BMI-for-age is affected by the stage of sexual maturation, which can vary widely among adolescents of the same age. There are no universal guidelines on how to interpret BMI-for-age based on stage of sexual maturation due to the variability of the pubertal growth spurt. Therefore, clinicians should keep a child/adolescent's growth trajectory and current context (e.g., health, diet, exercise levels) in mind when assessing their nutritional status (see the Interpretation section for more information on how to interpret BMI-for-age, taking into account the stages of puberty).

BOX 3.1 BMI-FOR-AGE AND PREGNANCY/ POSTPARTUM PERIOD

BMI-for-age is not used to assess pregnant/postpartum adolescent girls because it doesn't distinguish between muscle weight, body fat weight, and pregnancy-associated weight gain. However, knowing an adolescent girl's pre-pregnancy BMI-for-age can indicate her nutritional status before conceiving and help guide counseling and nutritional support decisions. This is extremely important as optimal pre-pregnancy weight and weight gain during pregnancy are critical to a healthy pregnancy and birth (see Module 4 for more information).

BOX 3.2 BMI-FOR-AGE IN EMERGENCIES

There are some concerns with using BMI-for-age to collect data on wasting in emergencies as there is some evidence of unrealistically high levels of adolescent wasting found in surveys of populations affected by emergencies. This may be due to inaccurate age data or delayed sexual development, which affects the body proportions of adolescents. (Emergency Nutrition Network 2011).

LINKS TO RELATED CONTENT

Condition: Acute malnutrition Condition: Overweight/obesity Interpretation: Cutoffs for BMI-for-age

MEASUREMENT: **MUAC**

MUAC is used to identify acute malnutrition by measuring the circumference of the mid-upper arm and comparing it to an established cutoff. Commonly used to assess the nutritional status of children under 5 and adults, MUAC is increasingly being used with children over 5 and adolescents, especially those living with HIV, to determine eligibility for support programs (Tang et al. 2013). However, because MUAC measurements are typically compared to a single cutoff for a specific age range, MUAC does not typically account for sex- and age-specific differences. At the time of this guide's publication, there were no universal internationally accepted MUAC cutoffs for children and adolescents, although several countries have established their own cutoffs.

LINKS TO RELATED CONTENT

Condition: Acute malnutrition Interpretation: Cutoffs for MUAC

MEASUREMENT: **Bilateral Pitting Edema**

Bilateral pitting edema is a clinical sign of a specific form of SAM known as nutritional edema, edematous malnutrition, SAM with edema, or kwashiorkor. Bilateral pitting edema is an abnormal accumulation of fluid in body tissues that causes swelling beginning in both feet in its mild form and is generalized to both feet, legs, hands, arms, and face in its most severe form. It is characterized by a lasting pitting (indentation) of the skin when pressure is applied to both feet for 3 seconds. Even mild bilateral pitting edema indicates SAM or another serious medical condition; cases should be referred for further assessment and treatment. See the Interpretation section for information on how to classify bilateral pitting edema.

LINKS TO RELATED CONTENT

Condition: Severe acute malnutrition Interpretation: Classification of bilateral pitting edema

How to Interpret Anthropometric Indicators and Classify Nutritional Status

This section provides guidance on how to interpret anthropometric measurements and indices to better understand the nutritional status of children and adolescents 5–19 years of age. For this age group, the WHO Growth Reference provides guidance for interpreting most of the anthropometric measurements and indices described in this guide, including cutoffs to classify child and adolescent nutritional status. For MUAC, which does not have universally accepted cutoffs, the guide provides information on some commonly used cutoffs.

There is limited evidence linking anthropometric indicators to functional or health outcomes in children and adolescents 5–19 years of age. However, interpretation of anthropometric data is still fairly straightforward and age-specific cutoffs are available to help to classify nutritional status for certain indicators. Interpretation becomes more complicated for adolescents who enter puberty and reach sexual maturation—which affects growth and body composition—at different ages and paces. Because of the large variability in the timing of growth spurts for individual children as well as different populations, age is often a poor indicator of physiological maturity and nutritional needs (Spear 2002). In addition to individual variations, there might be differences in growth potential across ethnicities that make it difficult to establish meaningful cutoffs that are applicable internationally. Furthermore, even if there weren't wide variations of what is "normal" at a given age, age-specific cutoffs may be problematic among adolescents who do not know their age (WHO 1995; Woodruff and Duffield 2000; Cogill 2003).

To avoid misclassifying an individual's nutritional status or a population's risk, one must be cautious in interpreting adolescent anthropometric data. Ideally, more than one type of measurement or index would be used[5] (e.g., both height-for-age and BMI-for age), and in addition to using the cutoffs described below, it is important to consider other information such as an individual's growth pattern over time, dietary practices, pubertal stage, health status, food security status, familial growth patterns (e.g., height of parents/siblings), physical activity, and care practices. Also, additional assessments that measure the degree of secondary sexual characteristics, such as Tanner Stages, can be

[5] Note: There is no current guidance on how to interpret different types of measurements together to assess nutritional status. However, using more than one type of measurement could help identify inconsistencies.

How to Interpret Anthropometric Indicators and Classify Nutritional Status (continued)

useful but may be considered intrusive outside of a clinical setting (see **Box 3.3**) (Spear 2002). In population-based surveys, the broader context should be considered, including food security and illness levels in the community and changes in the overall population's nutritional status.

Despite the challenges of interpreting anthropometric data for adolescents, anthropometry remains a key method of determining eligibility for certain care and support programs, promoting healthy growth and development, and preventing nutrition-related chronic disease. Also, tracking the nutritional status of the adolescent population along with other at-risk groups may help to more effectively design nutrition programs and allocate resources.

BOX 3.3 ASSESSING STAGES OF PUBERTY

In population-based surveys, it may be helpful to make statistical adjustments to account for differences in maturational age, requiring additional (and potentially more intrusive) assessments (WHO 1995) such as Tanner Stages. Used for classifying sexual maturity, Tanner Stages are based on the development of sex characteristics on a scale from 1 (pre-puberty) to 5 (adult). In boys, the stages follow development of genitals and pubic hair; in girls, the stages consider the development of breasts and pubic hair (Spear 2002).

Other methods for assessing and interpreting adolescent anthropometric data to address the challenges of variable growth and stages of puberty are available (Spear 2002; Woodruff and Duffield 2000). However, there is limited evidence on the best way to conduct these assessments in program settings.

More information on Tanner Stages is available here (WHO 2010).

Putting Anthropometry in Context: WHO Growth Reference

In 2007, WHO developed a growth reference for children and adolescents 5–19 years of age that serves as the main resource for guidance on interpreting anthropometric measurements and indices among this age group. The 2007 WHO Growth Reference is a reconstruction of the 1977 National Center for Health Statistics (NCHS)/WHO reference (using statistical modeling methods and additional data) and is designed to complement the 2006 WHO Growth Standards, creating a smooth transition from the standards to the reference at age 5 years.

The WHO Growth Reference for children and adolescents 5–19 years does not represent how children and adolescents should grow. Rather, since it is a reference and not a standard, it provides a comparison point for each child to a reference group by age and sex. The reference is not prescriptive and does not indicate functional outcomes.

The reference includes growth charts and tables that can be used to assess growth and development from 5 to 19 years of age (61 to 228 completed months), according to various key growth indicators (listed on the next page). Since girls and boys grow differently, the reference and accompanying growth charts are sex-specific.

For more information on the WHO Growth Reference, see WHO's website.

The WHO Growth Reference uses the following indicators:

- **BMI-for-age (5–19 years)**
- **Height-for-age (5–19 years)**
- **Weight-for-age (5–10 years)**

BOX 3.4 KEY DEFINITIONS

A **growth standard** is prescriptive. It demonstrates how healthy children grow under ideal circumstances.

A **growth reference** describes how a specific population has grown but does not necessarily reflect optimal growth.

A **cutoff** is a threshold beyond which an individual is determined to be malnourished. It also identifies the severity of undernutrition or overweight/obesity in an individual. Cutoffs can be used at the population level to signify when a nutrition situation is considered to be of public health concern.

TIP

For children who are exactly 5 years of age (i.e., their fifth birthday is the day of measurement), the 2006 WHO Growth Standards should be used. When they are age 5 years and 1 month, the 2007 WHO Growth Reference cutoffs should be used.

Making Sense of the Data: Z-Scores

Within the WHO Growth Reference are two different systems that are commonly used to classify nutritional status based on anthropometric measurements: z-scores (or standard deviation scores) and percentiles. This guide focuses on z-scores, which WHO recommends using to interpret anthropometric data (See **Box 3.5**).

What Are Z-Scores and What Do They Tell Us?

Anthropometric z-scores describe how far and in what direction an individual's measurement is from the reference populations' median value. Z-scores that fall outside of the normal range indicate a nutritional issue (undernutrition or overweight). If a z-score is outside the normal range, its distance from the median indicates the severity of the nutritional issue; the further away, the more severe. When a high proportion of individuals in a given population have z-scores outside of the "normal" range, there is a population-level nutrition problem.

In addition to providing information on current nutritional status, z-scores can be used to follow an individual child/adolescent's growth over time. This helps health care providers see whether a child or adolescent is growing well, is at risk of undernutrition or overweight, or is on the path to recovery from malnutrition.

BOX 3.5 Z-SCORES AND PERCENTILES

A **z-score** indicates how far and in what direction an individual's anthropometric measurement deviates from the median of the reference population and is expressed in standard deviations. For example, if a girl's weight-for-age z-score is -2, her weight-for-age is two standard deviations below the median weight-for-age of other girls her age.

A **percentile** indicates where an individual's anthropometric measurement falls relative to other people of the same age and sex in the reference population. For example, if a girl's weight-for-age is in the 85th percentile, she weighs more than 85 percent of other girls her age.

It is possible to convert z-scores to percentiles and vice versa. For example:

- A z-score of +2 is equivalent to the 97.7th percentile.
- A z-score of 0 is equivalent to the 50th percentile.
- A z-score of -2 is equivalent to the 2.3rd percentile.

However, the cutoffs used in each system are not exactly equivalent. For example, while a child in the 5th percentile would likely be identified as having a growth problem, the equivalent z-score of -1.65 would still be considered to be in normal range.

Source: Wang and Chen 2012.

Why Z-Scores?

A major advantage of z-scores is that at the population level, z-scores can be used to calculate summary statistics such as means, which allows the entire population's nutritional status to be assessed. They are also very useful for identifying individual children and adolescents with extreme measurements that differ substantially from those of normal, healthy children and adolescents. This is especially important in populations with high levels of malnutrition because children and adolescents at the extreme ends of the distribution have the most severe forms of malnutrition (Gorstein et al. 1994; WHO 1995; Gibson 2005).

Who Needs to Understand Z-Scores and Why?

Z-score cutoffs are used to define malnutrition according to anthropometric indices and measurements. Therefore, health care workers and nutrition program staff need to understand what z-scores are, how to interpret them, and what they mean at individual and population levels to make informed decisions at both the individual level (e.g., for growth monitoring and entry into/graduation from feeding programs) and population level (e.g., for nutrition assessments or situational reports for a population and monitoring and evaluation of programs).

TIP

In clinic or community settings, health workers are not expected to discuss z-scores with patients. Instead, they should talk about the individual's nutritional status (e.g., MAM) and growth pattern (e.g., growing well, growing too slowly, or lagging far behind).

How Is a Z-Score Determined?

Z-scores can be estimated using growth charts/tables (see below for more detail), obtained using computer software, or calculated by hand. In a clinical context, such as during health facility visits or growth monitoring, sex-specific growth charts or tables are used to estimate a child/adolescent's z-score or percentile and classify nutritional status, based on anthropometric measurements and sometimes age. In a research or survey setting, where exact z-scores are needed, special software programs such as WHO AnthroPlus[6] and Epi-Info can calculate z-scores. The WHO website also provides macros for the SPSS, Stata, SAS, S-Plus, and R statistical software packages to calculate the anthropometric indicators in the growth standards. For specific guidance on how a z-score is calculated, see Annex 2.

[6] WHO Anthro is used to calculate z-scores for children 0–60 months of age only. For older children (5–19 years of age), WHO AnthroPlus is used. WHO Anthro and AnthroPlus are available on the WHO website at: http://www.who.int/childgrowth/software/en/ and http://www.who.int/growthref/tools/en/, respectively.

Using Anthropometry to Classify Nutritional Status of Children and Adolescents 5–19 Years of Age

Tables 3.2 to 3.4 provide information on classifying a child/adolescent's nutritional status using all of the measures and indices described in this module.

TABLE 3.2 WHO Growth Reference Classification

ANTHROPOMETRIC INDICATOR AND CONDITION	AGE	Z-SCORE						
		< -3	≥ -3 to < -2	≥ -2 to < -1	≥-1 to ≤ +1	> +1 to ≤ +2	> +2 to ≤+3	> +3
Height-for-age Stunting	5–19 years	Severe stunting	Moderate stunting	Normal				Extreme tallness is not usually a nutrition issue. May indicate endocrine disorder.
Weight-for-age Underweight	5–10 years	Severe underweight	Moderate underweight	Normal		Do not use weight-for-age to determine overweight. A child or adolescent is best assessed by BMI-for-age.		
BMI-for-age Thinness Overweight/obesity	5–19 years	Severe thinness	Moderate thinness	Normal		Overweight		Obesity

Source: 2007 WHO Growth Reference.

BOX 3.6 OVERWEIGHT AND OBESITY CLASSIFICATION USING BMI-FOR-AGE IN CHILDREN 5–19 YEARS OF AGE

The 2006 WHO Child Growth Standards BMI-for-age z-score cutoffs for overweight and obesity in children 0–60 months of age begin at >+2 for overweight and >+3 for obesity. However, at 61 months of age, children move into the age group where the 2007 Growth Reference is used to determine if they are a healthy weight for their sex and age, and overweight begins at > +1 z-score and obesity at >+2 z-score. This can be confusing to interpret, as it is possible for a child who is 60 months of age to be identified as overweight by the 2006 Growth Standards and then, 1 month later (at 61 months of age), be considered obese under the 2007 Growth Reference, even though his/her z-score has not changed.

It is recommended that clinicians keep in mind the child's individual growth trajectory as they make decisions about the child's health and weight. If necessary (or available), more proximate measurements of body fat, such as triceps and subscapular skinfold measurements (for which WHO references exist but are not discussed in this guide) can be used to support the analysis and make decisions on the child's health.

For more information, see de Onis and Lobstein 2010.

Mid-Upper Arm Circumference and Mid-Upper Arm Circumference-for-Age

To date, universal internationally accepted evidence-based MUAC cutoffs have not been established for children and adolescents 5–19 years of age, and there is limited research examining the relationship between MUAC and adolescent nutritional status or health outcomes (Tang et al. 2013). Because MUAC is simpler to measure than other indicators, many countries and programs use MUAC to assess child and adolescent nutritional status in clinical settings and have established their own cutoffs for SAM and MAM. These cutoffs are not sex-specific and apply to wide age ranges (e.g., 5–9 years, 10–14 years, 15–17 years). FANTA has compiled the age-specific MUAC cutoffs used in FANTA-supported countries as of 2016 (see **Table 3.3** for a summary of the most commonly used cutoffs and **Box 3.7** for sample country-specific MUAC cutoffs). These cutoffs demonstrate the range of cutoffs used by different countries and may be a useful resource for development programs seeking to operate in those locations. However, this list is not exhaustive, and implementers should be aware of the limitations in using these cutoffs as they have not been validated or standardized and are therefore not internationally endorsed. In selecting cutoffs associated with enrollment in nutrition support programs, it will also be important to be aware of available resources. For example, a higher cutoff would qualify more people for enrollment, so it is important to ensure that a program has funds and supplies to provide support for all who qualify (UNHCR and World Food Programme [WFP] 2011).

In 2017, work by Mramba et al. to construct growth curves for MUAC-for-age for children 5–19 years of age provided new evidence that MUAC-for-age is at least as effective as BMI-for-age for assessing mortality risks associated with undernutrition among African school-age children and adolescents. The resulting growth curves, which were developed using data and methods similar to those used to construct the 2007 WHO Growth Reference for BMI-for-age, may potentially provide a universal MUAC-for-age reference for this age group (Mramba et al. 2017). Additional research will help clarify the role of MUAC and MUAC-for-age in assessing nutritional status of children and adolescents 5–19 years of age.

TABLE 3.3 Summary of MUAC Cutoffs for Children and Adolescents

	Nutritional Status (identifies wasting/acute malnutrition)		
	SAM	MAM	Normal
Commonly used country-specific cutoffs (from a sample countries)			
5–9 years	< 135 mm	≥ 135 to < 145 mm	≥ 145 mm
10–14 years	< 160 mm	≥ 160 to < 185 mm	≥ 185 mm
Cutoffs based on the WHO 2009 *Guidelines for an Integrated Approach to the Nutritional Care of HIV-Infected Children (6 months to 14 years)*			
	SAM		
5–10 years*	< 129 mm		
10–14 years**	< 160 mm		

* This cutoff was determined because it is equivalent to -3 z-score of the WHO Growth Standards for boys age 5 years.

** This cutoff is based on the WHO Integrated Management of Adolescent and Adult Illness guidelines.

LINKS TO RELATED CONTENT

Measurement: **MUAC** Condition: **Moderate acute malnutrition** Condition: **Severe acute malnutrition**

BOX 3.7 SAMPLE COUNTRY-SPECIFIC MUAC CUTOFFS FOR CHILDREN AND ADOLESCENTS

The tables here provide MUAC cutoffs used by several countries to define severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) in children and adolescents 5–19 years of age. These cutoffs, which were current as of 2016, vary from country to country. They are categorized according to age ranges, which differ among countries, and are not sex-specific. This list is not exhaustive and is shared here to show the range of cutoffs used. Organizations working in a given country should reach out to the Ministry of Health to find out how acute malnutrition is assessed in that country and what cutoffs are used.

Country/ Age Groups	SAM	MAM	Normal
Democratic Republic of Congo			
5–9 years	< 135 mm	≥ 135 to < 145 mm	≥ 145 mm
10–14 years	< 160 mm	≥ 160 to < 185 mm	≥ 185 mm
Ethiopia			
5–9 years	< 135 mm	≥ 135 to < 145 mm	≥ 145 mm
10–14 years	< 160 mm	≥ 160 to < 180 mm	≥ 180 mm
Malawi			
5–9 years	< 130 mm	_	_
10–11 years	< 160 mm	_	_
12–14 years	< 160 mm	≥ 160 to < 185 mm	≥ 185 mm
15–18 years	< 185 mm	≥ 185 to < 220 mm	≥ 220 mm
Mozambique			
5–10 years	< 130 mm	≥ 130 to < 145 mm	≥ 145 mm
11–14 years	< 160 mm	≥ 160 to < 185 mm	≥ 185 mm
15–18 years	< 210 mm	≥ 210 to < 230 mm	≥ 230 mm
Namibia			
5–9 years	< 135 mm	≥ 135 to < 145 mm	≥ 145 mm
10–14 years	< 160 mm	≥ 160 to < 185 mm	≥ 185 mm

Country/ Age Groups	SAM	MAM	Normal
Tanzania			
5–9 years	< 135 cm	≥ 135 to < 145 cm	≥ 145 mm
10–14 years	< 160 mm	≥ 160 to < 185 mm	≥ 185 mm
≥ 15 years (non-pregnant/non-postpartum)	< 185 mm	≥ 185 to < 220 mm	≥ 220 mm
≥ 15 years (pregnant/ postpartum)	< 190 mm	≥ 190 to < 230 mm	≥ 230 mm
Uganda			
5–9 years	< 135 mm	≥ 135 to < 145 mm	≥ 145 mm
10–14 years	< 160 mm	≥ 160 to < 185 mm	≥ 185 mm
15–17 years	< 185 mm	≥ 185 to < 210 mm	≥ 210 mm
Zambia			
5–9 years	< 135 mm	≥ 135 to < 145 mm	≥ 145 mm
10–14 years	< 160 mm	≥ 160 to < 185 mm	≥ 185 mm
15–17 years	< 185 mm	≥ 185 to < 210 mm	≥ 210 mm

Adapted from: Food and Nutrition Technical Assistance III Project (FANTA). 2016. *Nutrition Assessment, Counseling, and Support (NACS): A User's Guide—Module 2: Nutrition Assessment and Classification, Version 2.* Washington, DC: FHI 360/FANTA.

Clinical Assessment: Bilateral Pitting Edema

The classification system shown in **Table 3.4** is the same one used in children under 5. However, determining the grade and severity of edema and distinguishing between nutritional and non-nutritional causes may be more complicated in older children and adolescents, as some cases of edema may be non-nutrition related.

TABLE 3.4 Nutritional Status Classification of Bilateral Pitting Edema

Description	Grade of Edema	Nutritional Status
No bilateral pitting edema	Absent (O)	Does not have edematous malnutrition
Present in both feet/ankles	Mild (+)	SAM/severe malnutrition
Present in both feet/ankles, plus lower legs, hands, or lower arms	Moderate (++)	SAM/severe malnutrition
Generalized, including both feet, legs, hands, arms, and face	Severe (+++)	SAM/severe malnutrition

Sources: WHO 2013; WHO e-Library of Evidence for Nutrition Actions (eLENA) n.d. (a); WHO eLENA n.d. (b).

LINKS TO RELATED CONTENT

Measurement: Bilateral pitting edema

Condition: Severe acute malnutrition

BOX 3.8 SPECIAL CONDITIONS

Certain developmental, neurologic, and genetic conditions, such as Down syndrome, achondroplasia, and cerebral palsy, may alter an individual's body composition, size, growth pattern, and/or overall growth potential. In addition, it can be challenging to accurately measure individuals with conditions that affect the ability to stand; straighten their arms, legs, or back; or hold their head steady. In addition, comparing the weight of amputees to a reference population of non-amputees is problematic. When assessing people with special needs, it is important to be aware of the implications of their condition and potential explanations for their altered growth.

There is limited guidance on applying anthropometry to individuals with special needs. While the CDC has provided some alternative measurement options for individuals, WHO has not issued specific guidelines or references. However, alternative anthropometric references exist for certain conditions. The alternative charts have been developed from small, homogeneous samples and may not have used standardized measurement techniques or accounted for secondary conditions that affect growth. Therefore, although they may be a useful reference to understand how a condition may affect growth or anthropometric measurements, they should be used with caution and in conjunction with the WHO standards and references.

For more information on the CDC's alternative approaches for measuring an individual with special needs, see The CDC Growth Charts for Children with Special Health Care Needs.

For alternative anthropometric references, see:

Amputation: Mini Nutritional Assessment (Appendix 3: Determining BMI for Amputees)

Down syndrome: UK Down Syndrome 0–18 years

Cerebral palsy: The Life Expectancy Project charts, according to gross motor function classification system

Cornelia de Lange syndrome: Girls Boys

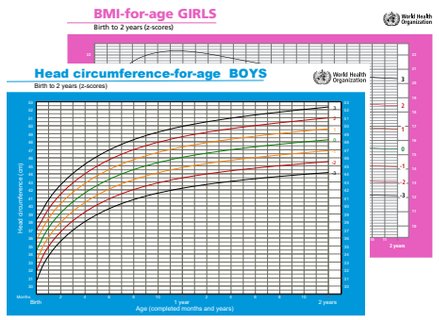
Additional resources: The Greenwood Genetic Center in the United States published a set of references (1998) from age 25 weeks through adulthood for several conditions, including achondroplasia, Marfan syndrome, and Turner syndrome, among others. They are available for purchase.

Source: Gibson 2005; U.S. Department of Health and Human Services n.d.; CDC 2013; Life Expectancy Project 2011; Nestle Nutrition Institute n.d.

Tools to Assess, Classify, and/or Monitor Nutritional Status of Children and Adolescents 5–19 Years of Age

This section provides information on various anthropometric tools (growth charts, reference tables, and a BMI wheel) that can be used to assess, classify, and/or monitor nutritional status of children and adolescents 5–19 years of age.

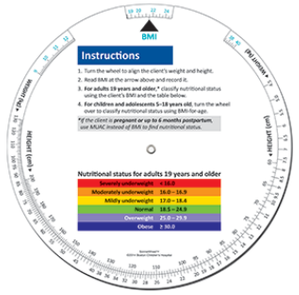
TOOL: **Growth Charts**



WHO has produced growth charts for the Growth Reference so that health workers conducting anthropometric screening or assessment in a community, clinic, or health facility can plot a child/adolescent's weight-for-age, height-for-age, and/or BMI-for-age. The chart shows where a child/adolescent's measurement falls and allows growth to be tracked over time, indicating if s/he is growing at a healthy pace or if there is cause for concern. For more information on how to use growth charts, see Annex 1 and visit WHO's website to access the sex-specific growth charts for weight-for-age (5–10 years), height-for-age, and BMI-for-age.

Visit the WHO website for more information.

TOOL: **BMI Wheel**



Another tool that can be used to calculate and interpret BMI-for-age for children and adolescents 5–19 years of age is the FANTA BMI wheel. This small, hand-held tool is made of sturdy card stock and is portable. On one side of the wheel, health workers can use a child/adolescent's height (cm) and weight (kg) to determine his/her BMI. On the other side, health workers can classify the nutritional status according to the child/adolescent's age and sex. Note that the BMI wheel uses the term "underweight" for low BMI-for-age, while this guide uses the term "thinness." More information on the BMI wheel, including a video on how to use it and how to have it printed is available.

Visit the FANTA website for more information.

TOOL: **Quick Reference Tables**

Simple, sex-specific reference tables are another tool available to interpret anthropometric measures and classify a child/adolescent's nutritional status using weight-for-age, height-for-age, and BMI-for-age. The tables provide a classification based on one point in time and do not provide trend information. The WHO website provides simplified field tables, which include a cutoff for each classification for weight-for-age, height-for-age, and BMI-for-age. FANTA has developed sex-specific quick reference look-up tables for BMI-for-age with ranges for each nutritional status classification. The FANTA BMI-for-age quick reference tables are available on the next page.

- WHO's BMI-for-Age Field Tables
- WHO's Height-for-Age Field Tables
- WHO's Weight-for-Age Field Tables
- FANTA's BMI and BMI-for-Age Look-Up Tables

BMI-for-Age Tables

BOYS

Age (years: months)	SAM Less than –3 (BMI)	MAM –3 to less than –2 (BMI)	Normal –2 to less than +1 (BMI)	Overweight +1 to +2 (BMI)	Obesity Greater than +2 (BMI)
5:1	< 12.1	12.1–12.9	13.0–16.6	16.7–18.3	> 18.3
5:6	< 12.1	12.1–12.9	13.0–16.7	16.8–18.4	> 18.4
6:0	< 12.1	12.1–12.9	13.0–16.8	16.9–18.5	> 18.5
6:6	< 12.2	12.2–13.0	13.1–16.9	17.0–18.7	> 18.7
7:0	< 12.3	12.3–13.0	13.1–17.0	17.1–19.0	> 19.0
7:6	< 12.3	12.3–13.1	13.2–17.2	17.3–19.3	> 19.3
8:0	< 12.4	12.4–13.2	13.3–17.4	17.5–19.7	> 19.7
8:6	< 12.5	12.5–13.3	13.4–17.7	17.8–20.1	> 20.1
9:0	< 12.6	12.6–13.4	13.5–17.9	18.0–20.5	> 20.5
9:6	< 12.7	12.7–13.5	13.6–18.2	18.3–20.9	> 20.9
10:0	< 12.8	12.8–13.6	13.7–18.5	18.6–21.4	> 21.4
10:6	< 12.9	12.9–13.8	13.9–18.8	18.9–21.9	> 21.9
11:0	< 13.1	13.1–14.0	14.1–19.2	19.3–22.5	> 22.5
11:6	< 13.2	13.2–14.1	14.2–19.5	19.6–23.0	> 23.0
12:0	< 13.4	13.4–14.4	14.5–19.9	20.0–23.6	> 23.6
12:6	< 13.6	13.6–14.6	14.7–20.4	20.5–24.2	> 24.2
13:0	< 13.8	13.8–14.8	14.9–20.8	20.9–24.8	> 24.8
13:6	< 14.0	14.0–15.1	15.2–21.3	21.4–25.3	> 25.3
14:0	< 14.3	14.3–15.4	15.5–21.8	21.9–25.9	> 25.9
14:6	< 14.5	14.5–15.6	15.7–22.2	22.3–26.5	> 26.5
15:0	< 14.7	14.7–15.9	16.0–22.7	22.8–27.0	> 27.0
15:6	< 14.9	14.9–16.2	16.3–23.1	23.2–27.4	> 27.4
16:0	< 15.1	15.1–16.4	16.5–23.5	23.6–27.9	> 27.9
16:6	< 15.3	15.3–16.6	16.7–23.9	24.0–28.3	> 28.3
17:0	< 15.4	15.4–16.8	16.9–24.3	24.4–28.6	> 28.6
17:6	< 15.6	15.6–17.0	17.1–24.6	24.7–29.0	> 29.0
18:0	< 15.7	15.7–17.2	17.3–24.9	25.0–29.2	> 29.2

GIRLS

Age (years: months)	SAM Less than –3 (BMI)	MAM –3 to less than –2 (BMI)	Normal –2 to less than +1 (BMI)	Overweight +1 to +2 (BMI)	Obesity Greater than +2 (BMI)
5:1	< 11.8	11.8–12.6	12.7–16.9	17.0–18.9	> 18.9
5:6	< 11.7	11.7–12.6	12.7–16.9	17.0–19.0	> 19.0
6:0	< 11.7	11.7–12.6	12.7–17.0	17.1–19.2	> 19.2
6:6	< 11.7	11.7–12.6	12.7–17.1	17.2–19.5	> 19.5
7:0	< 11.8	11.8–12.6	12.7–17.3	17.4–19.8	> 19.8
7:6	< 11.8	11.8–12.7	12.8–17.5	17.6–20.1	> 20.1
8:0	< 11.9	11.9–12.8	12.9–17.7	17.8–20.6	> 20.6
8:6	< 12.0	12.0–12.9	13.0–18.0	18.1–21.0	> 21.0
9:0	< 12.1	12.1–13.0	13.1–18.3	18.4–21.5	> 21.5
9:6	< 12.2	12.2–13.2	13.3–18.7	18.8–22.0	> 22.0
10:0	< 12.4	12.4–13.4	13.5–19.0	19.1–22.6	> 22.6
10:6	< 12.5	12.5–13.6	13.7–19.4	19.5–23.1	> 23.1
11:0	< 12.7	12.7–13.8	13.9–19.9	20.0–23.7	> 23.7
11:6	< 12.9	12.9–14.0	14.1–20.3	20.4–24.3	> 24.3
12:0	< 13.2	13.2–14.3	14.4–20.8	20.9–25.0	> 25.0
12:6	< 13.4	13.4–14.6	14.7–21.3	21.4–25.6	> 25.6
13:0	< 13.6	13.6–14.8	14.9–21.8	21.9–26.2	> 26.2
13:6	< 13.8	13.8–15.1	15.2–22.3	22.4–26.8	> 26.8
14:0	< 14.0	14.0–15.3	15.4–22.7	22.8–27.3	> 27.3
14:6	< 14.2	14.2–15.6	15.7–23.1	23.2–27.8	> 27.8
15:0	< 14.4	14.4–15.8	15.9–23.5	23.6–28.2	> 28.2
15:6	< 14.5	14.5–15.9	16.0–23.8	23.9–28.6	> 28.6
16:0	< 14.6	14.6–16.1	16.2–24.1	24.2–28.9	> 28.9
16:6	< 14.7	14.7–16.2	16.3–24.3	24.4–29.1	> 29.1
17:0	< 14.7	14.7–16.3	16.4–24.5	24.6–29.3	> 29.4
17:6	< 14.7	14.7–16.3	16.4–24.6	24.7–29.4	> 29.4
18:0	< 14.7	14.7–16.3	16.4–24.8	24.9–29.5	> 29.5

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MODULE 4

Pregnant and Postpartum Women and Girls

What Does this Module Cover?

Module 4 focuses on anthropometry of pregnant and postpartum women and girls. The module is broken into sections that describe:

- the importance of nutrition during pregnancy and the postpartum period
- common nutrition-related conditions identified by anthropometry
- the measurements and indices used to identify nutrition-related conditions
- interpretation of anthropometric measurements and classification of nutritional status
- tools to assess the nutritional status of pregnant and postpartum women and girls

Users are encouraged to review Module 1 alongside this module because it explains key concepts that are relevant to all modules.

Who Is the Focus of Module 4?

In this guide, "pregnant and postpartum women and girls" refers to **women and girls of any age who are pregnant or have delivered a child within the previous 6 months.**

Nutrition during Pregnancy and the Postpartum Period: Why Does it Matter?

The nutritional status of women and girls before and during pregnancy affects their own health as well as the health, nutritional status, growth, and development of their children (Black et al. 2008; Ramakrishnan et al. 2012). Women who are undernourished, particularly those with short stature or iron deficiency, have a higher risk of dying from pregnancy-related causes than well-nourished women. Maternal short stature (often defined as height <145 cm), a reflection of past undernutrition, increases the risk of labor complications and need for assisted delivery, which is often not available in poor, low-resource communities, putting both mother and child at risk (Black et al. 2008; Black et al. 2013). Children born to undernourished women and girls are more likely to be small for their gestational age, be born preterm, die in the first month of life, and be stunted by age 2 (ibid). Being overweight or obese increases a mother's risk of pregnancy complications—including gestational diabetes, pre-eclampsia, and death—and increases her child's risk of preterm birth, neonatal and infant death, and being born larger than average size (which increases delivery complications). The long-term consequences of maternal overweight/obesity at the time of pregnancy include an increased likelihood of the child being overweight/obese into early adulthood (Williams et al. 2014). In addition, poor maternal nutritional status (both before and during pregnancy)—is an important risk factor for poor early child development, affecting a child's physical, social, emotional, and cognitive development (Britto et al. 2017).

Nutrition during Pregnancy and the Postpartum Period: Why Does it Matter? (continued)

These risks are compounded among adolescent mothers, who are already at higher risk of maternal and child mortality, preterm delivery, and having low birth weight babies than their adult counterparts (World Health Organization [WHO] 2011; Harper et al. 2011). In fact, children born to adolescent mothers weigh, on average, about 200 g less than those born to adult women (WHO 2011). In addition, pregnancy during adolescence can negatively impact a girl's own nutritional status, particularly if it impedes the adolescent growth spurt (Ramakrishnan et al. 2012; Black et al. 2013). These challenges are faced by many of the more than 16 million adolescent girls who give birth each year (WHO n.d.).

Improving the nutritional status of pregnant and postpartum women and girls, as well as all women of reproductive age, will contribute to improved health of women and reduce their risk of mortality, while enhancing the health, growth, and development of their children. Weighing and measuring women and adolescent girls early in pregnancy can help determine their nutritional status and how well their bodies can cope with pregnancy. This information can identify women who may benefit from interventions or enhanced clinical care and can guide counseling and support to promote a healthy pregnancy and improve fetal growth. At the population level, anthropometric data can be used to evaluate trends in nutritional status among pregnant and lactating women and girls, helping to determine whether an intervention is needed.

What Nutrition-Related Conditions Are Identified through Anthropometry?

This section provides a brief description of the most common nutrition-related conditions affecting pregnant and postpartum women and girls that can be identified using anthropometry. The anthropometric measurements and indices used to determine these nutrition conditions are described in the **Measurements** section.

CONDITIONS IN THIS SECTION

Already familiar with nutrition-related conditions?

Jump ahead to the **Measurements** section.

CONDITION: **Short Stature**

Short stature refers to a woman who is much shorter than expected and may be an indication that undernutrition prevented her from growing to her full potential during childhood and adolescence. Women of short stature were often stunted as children (meaning they were too short for their age as identified by the length/height-for-age index).

Women of short stature are at increased risk of pregnancy complications such as cephalopelvic disproportion (when the fetus's head is too big to fit through the mother's pelvis) that may require cesarean section or other assistance to safely deliver the child. However, surgical delivery is often not available in low-resource settings and, when available, increases risk of maternal morbidity and mortality (Black et al. 2008; Black et al. 2013). Maternal short stature has also been associated with intrauterine growth restriction (when the fetus doesn't grow at the normal rate in the womb) and low birth weight, as well as increased risk of infant death, although the causal relationship is not clear (Black et al. 2013; Ververs et al. 2013). In areas where home delivery is common, referring pregnant women of short stature to health facilities may help ensure safe labor, delivery, and postpartum care (WHO 1995a). Since short stature reflects past environmental influence on growth, there are no associated dietary recommendations to address short stature since the condition cannot be reversed. However, if a short-statured woman still lives in the same nutritionally poor conditions in which her growth was stunted, she may continue to be nutritionally deprived, and this deprivation during pregnancy could affect her child's growth. Short stature, which commonly refers to women <145 cm tall, is identified through height measurement.

LINKS TO RELATED CONTENT

Measurement: **Height**

Interpretation: **Cutoffs for short stature**

CONDITION: **Stunting in Adolescent Girls**

Stunting in adolescent girls reflects chronic malnutrition and occurs when a girl does not grow to her potential because of the long-term cumulative effects of inadequate dietary intake, frequent illness/infection, or both. The result is that she is shorter than would be expected for a healthy girl of her age.

Stunting detected during adolescence is usually a result of poor growth during the first 1,000 days of life, from pregnancy through age 2, after which it is difficult to regain lost growth and fully recover from the effects of stunting (Victora et al. 2010; Martorell et al. 1994). Stunting can not only impair an individual's health but is also associated with poor cognitive and motor development and lower school achievement (Grantham-McGregor et al. 2007; Hoddinott et al. 2008). A girl's linear growth during adolescence can be negatively affected by pregnancy (Ramakrishnan et al. 2012), and both adolescent pregnancy and short stature in women are known to be associated with higher risk of complications and adverse pregnancy and birth outcomes (Harper et al. 2011; Ramakrishnan et al. 2012; WHO 1995a). As with a woman of short stature, if a girl still lives in the same nutritionally poor conditions in which her growth was stunted, she may be at increased nutritional risk. Dietary or other nutritional assessments may help to determine nutritional risk and delivering in a health facility may help reduce the risks of a complicated delivery. In an adolescent girl, stunting is identified using the height-for-age index for girls, compared against the 2007 WHO Growth Reference. Information on height-for-age cutoffs can be found in the Interpretation section, and information on the WHO Growth Reference is in Module 3.

LINKS TO RELATED CONTENT

Measurement: **Height-for-age**

Interpretation: **Cutoffs for stunting**

CONDITION: **Underweight/Thinness**

Underweight/thinness refers to a woman or girl whose weight is too low for her height, which reflects both nutritional intake and overall health. A woman or adolescent girl may be underweight/thin because of a rapid deterioration in nutritional status over a short time or chronic (long-term) malnutrition. Thinness may be a result of an inadequate diet; severe, repeated, or chronic illness or infection; or a combination of diet and illness. Some studies have found an association between maternal thinness and maternal mortality, although there is limited research on this association (Black et al. 2013; Ververs et al. 2013). Children of underweight/thin women are at higher risk of intrauterine growth restriction, low birth weight, and preterm birth. Underweight/thinness is determined by a woman's pre-pregnancy body mass index (BMI) (<18.5), which may not be available in settings where routine medical checkups are not common, and/or by mid-upper arm circumference (MUAC) which may be assessed throughout pregnancy.

TIP

The term "underweight" used for adolescents and adults, which reflects weight in relation to height, is distinct from the term "underweight" used for children under 10, which reflects weight in relation to age.

LINKS TO RELATED CONTENT

- Measurement: **Pre-pregnancy BMI**
- Measurement: **MUAC**
- Interpretation: **Cutoffs for MUAC from a variety of countries**
- Interpretation: **Weight gain during pregnancy**

CONDITION: Underweight/Thinness
↳ CONDITION: **Moderate Malnutrition**

Moderate malnutrition is used to describe moderate thinness identified by BMI as well as low MUAC (under a certain cutoff). Moderate malnutrition results from inadequate intake (quantity or quality) and/or utilization of food; severe, repeated, or chronic infections/illness (e.g., tuberculosis, HIV/AIDS, cancer); or a combination of these.

LINKS TO RELATED CONTENT

- Measurement: Pre-pregnancy BMI
- Interpretation: Weight gain during pregnancy
- Measurement: MUAC
- Interpretation: Cutoffs for MUAC

CONDITION: Underweight/Thinness
↳ CONDITION: **Severe Malnutrition**

Severe malnutrition is used to describe severe thinness identified by BMI, low MUAC (under a certain cutoff), and/or the presence of bilateral pitting edema of nutritional origin. Adults suffering from severe malnutrition are at increased risk of death. Medical treatment and nutrition support are necessary to address their condition. When reporting a person's nutritional status, it is useful to know what measure was used since edema will affect BMI but will not affect MUAC.

LINKS TO RELATED CONTENT

- Measurement: Pre-pregnancy BMI
- Interpretation: Weight gain during pregnancy
- Measurement: MUAC
- Interpretation: Cutoffs for MUAC
- Measurement: Bilateral pitting edema
- Interpretation: Classification of bilateral pitting edema

CONDITION: **Overweight and Obesity**

Overweight and obesity (severe overweight) occur when a woman or girl has too much body fat and weighs more than would be expected for a healthy woman or girl of the same height, putting her health at risk. Overweight and obesity are complex conditions with multiple causes, including an imbalance between calories consumed and calories expended, low levels of physical activity, medical conditions, and genetics, among others. The prevalence of overweight and obesity have been increasing worldwide, and about 35 percent of adult women are overweight or obese (WHO 2011). Overweight and obesity during pregnancy increase women's risk of developing gestational diabetes and pre-eclampsia, and of having complications during delivery; they also are associated with increased risk of death of the mother and newborn child. In addition, maternal overweight and obesity during pregnancy increase the risk that the child will be overweight or obese (Black et al. 2013). It is recommended that women who are overweight or obese gain less weight during pregnancy than women of normal weight (IOM and NRC 2009). Although there have been limited studies exploring the effects of overweight and obesity among pregnant adolescents, evidence suggests that they suffer similar risks, including increased risk of gestational diabetes, pre-eclampsia, and cesarean delivery (Sukalich et al. 2006). In addition, although some women lose weight or return to their pre-pregnancy weight, many women retain weight after pregnancy, with an average weight gain of 0.5 to 3.0 kg above their pre-pregnancy weight. The amount of weight gain (or loss) varies widely, and there is evidence that women who gain excessive weight during pregnancy or were overweight before pregnancy are more likely to retain more weight postpartum (Gore et al. 2003). Overweight and obesity in pregnant women are identified by calculating a woman's pre-pregnancy BMI. Postpartum weight retention is calculated by subtracting a woman's pre-pregnancy weight from her postpartum weight (at least 6 months after delivery).

LINKS TO RELATED CONTENT

Measurement: **Pre-pregnancy BMI**

Measurement: **Gestational weight gain**

Measurement: **Postpartum weight retention**

Interpretation: **Weight gain during pregnancy**

Interpretation: **Postpartum weight-retention guidelines**

What Anthropometric Measurements and Indices Are Used for Pregnant and Postpartum Women and Girls?

This section describes the anthropometric measurements and indices commonly used to identify nutrition-related conditions in pregnant and postpartum women and girls, as well as the challenges with using them. In addition, bilateral pitting edema, a clinical measure of severe malnutrition, is included because it is frequently assessed alongside anthropometry. However, edema is common in pregnancy and usually is not nutrition-related. Anthropometric measurements during pregnancy seek to assess the mother's nutritional status and predict her body's ability to cope with pregnancy, identifying women and girls who may benefit from intervention. Anthropometry can also help to indirectly monitor the growth of the fetus, as good maternal nutritional status and appropriate weight gain during pregnancy contribute to normal/optimal fetal growth. However, using anthropometry to identify malnutrition during pregnancy and the first 6 months postpartum presents challenges. There is no global agreement on the best measures to use, and evidence to establish standard measures or cutoffs for use in developing countries is insufficient. The guidance here reflects the current knowledge of the most commonly used anthropometric measurements and indices. See **Table 4.1** for a summary of measurements and indices included in this module.

Already familiar with measurements and indices? Jump ahead to the Interpretation section.

TABLE 4.1 Anthropometric Measures and Indices in this Module

	Height	**Height-for-age** (girls 19 and under)	**Pre-pregnancy BMI**	**Weight**	**MUAC**	**Bilateral Pitting Edema**
Nutritional condition that the measurement/index identifies	Short stature	Stunting	Thinness and overweight/ obesity	Used to monitor weight gain during pregnancy and postpartum weight loss	Thinness	Severe malnutrition

MEASUREMENT: **Height**

Height. A woman's height reflects her childhood growth, which is determined by a combination of genetic potential and environmental factors, such as nutritional status, disease, and poverty. It can be a proxy indicator for pelvic size, which can predict challenges such as obstructed labor. In pregnant women, height can be used to identify women with short stature who may need specialized medical care for a safe delivery. It can also be used in combination with weight to calculate pre-pregnancy BMI to assess underweight/thinness and overweight and obesity (see pre-pregnancy BMI below) and with age and sex to assess stunting in adolescent girls up to age 19 (see Pre-Pregnancy BMI section on the next page). Height can be measured at any time during pregnancy or postpartum.

LINKS TO RELATED CONTENT

Condition: **Short stature in women** Interpretation: **Cutoffs for short stature**

MEASUREMENT: **Height-for-Age**

Height-for-age is sex-specific and measures a girl's height relative to her age. It identifies stunting (chronic malnutrition). This index can be used among adolescent girls until age 19. To date, stunting has not routinely been measured among school-age children and adolescents. Height-for-age can be applied to adolescent girls at any time during pregnancy or postpartum.

LINKS TO RELATED CONTENT

Condition: **Stunting in adolescent girls** Interpretation: **Cutoffs for stunting**

MEASUREMENT: **Pre-Pregnancy BMI**

Pre-pregnancy BMI, a ratio of weight relative to height using the formula (weight in kilograms)/(height in meters)^2, is used to identify underweight/thinness and overweight and obesity in women and girls, and can help determine recommended weight gain during pregnancy. Women who are planning to become pregnant should try to achieve and maintain a healthy BMI before conceiving because a woman's BMI at the start of pregnancy affects the growth of her fetus, influences her weight gain during pregnancy, and is predictive of adverse pregnancy outcomes (IOM and NRC 2009). Note, BMI is not used during pregnancy since it cannot account for pregnancy-related weight gain (see **Box 4.1**). A low pre-pregnancy BMI indicates increased risk of low birth weight and intrauterine growth restriction. A high pre-pregnancy BMI is associated with complications such as pre-eclampsia, gestational diabetes, and need for cesarean delivery (Black et al. 2013). **To calculate BMI, a woman's weight before conception can be approximated by using a weight measured no more than 2 months before conception or during the first trimester of pregnancy** (IOM and NRC 2009). However, among the at-risk poor populations in developing countries, it is relatively common for a pregnant woman or girl's first contact with the health system to be after the first trimester, when it is no longer possible to measure or approximate pre-pregnancy weight (WHO 1995b; WHO 1995a). Adolescent pre-pregnancy BMI should be categorized using the WHO categories for adults, rather than the BMI-for-age charts (IOM and NRC 2009).

BOX 4.1 BMI AND PREGNANCY

BMI is not used for pregnant and postpartum women because there are no BMI reference standards that account for pregnancy-related weight gain. After delivery, it is hard to pinpoint a precise moment when using BMI with the standard cutoffs becomes meaningful. However, based on average weight loss patterns of postpartum women, **it is probably acceptable to start using BMI to assess nutritional status somewhere between 6 and 12 months postpartum.**

LINKS TO RELATED CONTENT

- Condition: Underweight/thinness
- Condition: Overweight/obesity
- Interpretation: Weight gain during pregnancy

MEASUREMENT: **Gestational Weight Gain**

Gestational weight gain. Gaining a healthy amount of weight during pregnancy contributes to a healthy birth for mother and child. Gestational weight gain, also called pregnancy weight gain, is affected by pre-pregnancy weight as well as genetics, health, dietary choices, socioeconomic status, and culture, among other factors. There is a range of weight gain that is considered healthy, and recommendations vary according to a mother's pre-pregnancy BMI. If a woman gains too little weight, she may have a preterm or low birth weight infant; gaining too much weight in pregnancy is associated with retaining excessive weight postpartum, delivering large-for-gestational-age infants, and cesarean delivery, and it may lead to the child being overweight later in life (Siega-Riz et al. 2009; IOM and NRC 2009). To maintain a healthy pregnancy, it is recommended that underweight women gain more weight than their healthy/normal and overweight/obese counterparts, and that overweight and obese women gain less than women of normal weight. Most weight gain occurs in the second and third trimester, and weight loss during pregnancy is discouraged (including among overweight/obese women) (IOM and NRC 2009; Health Canada 2014). It is recommended that adolescents' pre-pregnancy BMI be classified using WHO adult cutoffs rather than BMI-for-age. Using the adult ranges will probably classify the adolescents as thin more readily and therefore adolescents will be advised to gain more weight. This is appropriate because adolescents often need to gain more weight than their older peers for improved birth outcomes (IOM and NRC 2009).

LINKS TO RELATED CONTENT

Interpretation: **Weight gain during pregnancy**

MEASUREMENT: **Postpartum Weight Retention**

Postpartum weight retention is the difference between what a woman weighs before pregnancy and after delivery. Postpartum women who lose weight return to their pre-pregnancy weight at varying rates because of a number of factors including their pre-pregnancy weight, type of delivery, gestational weight gain, breastfeeding status, and age. Weight loss is generally more rapid in the first 6 months but may continue at a slower rate through 12 months postpartum (Butte and Hopkinson 1998; IOM 1991; Williams et al. 2014). Excessive postpartum weight retention is a concern, and evidence suggests it is associated with longer-term overweight and obesity (Endres et al. 2015; Gore et al. 2003). Clinicians may wish to monitor a woman's postpartum weight loss and weight retention to help her return to a healthy weight at a reasonable pace. There is no specific guideline for how soon after birth to monitor postpartum weight loss and the exact timing of when a woman should return to her pre-pregnancy weight. In 1992, the IOM published guidelines on healthy weight loss 4–6 weeks after delivery.

LINKS TO RELATED CONTENT

Condition: **Overweight/obesity**

Interpretation: **Postpartum weight-retention guidelines**

MEASUREMENT: **MUAC**

MUAC identifies underweight/thinness by measuring the circumference of the mid-upper arm and comparing it to a pre-determined cutoff. In pregnant women, low MUAC has been associated with intrauterine growth restriction, low birth weight, and neonatal morbidity (WHO 1995a). Because MUAC is a relatively simple measurement that requires minimal equipment, is not affected by pregnancy status, and can be measured at any time during pregnancy, it is increasingly being used to assess nutritional status of pregnant and postpartum women and determine eligibility for nutrition support programs, especially in emergency or humanitarian contexts when measuring weight and height may be difficult (Tang et al. 2016; WHO 1995a; Ververs et al. 2013). As discussed below, international evidence-based MUAC cutoffs for pregnant women have not been established. One study looking into MUAC cutoffs to assess malnutrition in pregnant women concluded that it would be difficult to recommend a cutoff that is suitable in all settings. The study recommended that countries and programs conduct a cost-benefit analysis before adopting a specific MUAC cutoff (Tang et al. 2016).

LINKS TO RELATED CONTENT

Condition: Underweight/thinness
Interpretation: MUAC

MEASUREMENT: **Bilateral Pitting Edema**

Bilateral pitting edema is an abnormal accumulation of fluid in body tissues that causes swelling. Bilateral pitting edema can be a clinical sign of a specific form of severe malnutrition known as nutritional edema, edematous malnutrition, severe malnutrition with edema, or kwashiorkor. However, edema is quite common during pregnancy, especially in the third trimester due to the additional blood and body fluid needed to support the fetus, and typically does not indicate malnutrition. Therefore, edema during pregnancy can be normal or it can indicate other medical conditions, such as pre-eclampsia (particularly if the edema is sudden and in the hands and face) (Swamy and Heine n.d.; Navarro-Colorado 2006). It is recommended that pregnant women and girls with edema be assessed further to determine the cause and provided with appropriate treatment as needed.

LINKS TO RELATED CONTENT

Condition: Severe malnutrition

Interpretation: Classification of bilateral pitting edema

How to Interpret Anthropometric Indicators and Classify Nutritional Status

This section provides guidance on how to interpret the various measurements and indices in this module to better understand the nutritional status of pregnant and postpartum women and girls. Aside from pre-pregnancy BMI, there are no universally accepted international cutoffs for most of the anthropometric measurements discussed in this module. Therefore, various countries have created their own guidance. The BMI cutoffs, along with caveats on the application of country-specific guidance on other anthropometric measurements, are discussed here.

Summary Tables: Classifying Nutritional Status of Pregnant and Postpartum Women and Girls

The summary tables in this section indicate cutoffs for various nutrition conditions and are organized according to the measurement or index used.

Short Stature and Height-for-Age

While a universally accepted international cutoff for short stature has not been established, a height of <145 cm is a commonly used cutoff in surveys such as the Demographic and Health Survey (DHS) and was also used in the Lancet's 2013 Maternal and Child Nutrition Series to identify short stature (see **Table 4.2**). However, various risks to mother and child have been associated with cutoffs ranging from approximately 140–156 cm (WHO 1995a; Ververs et al. 2013). For adolescent girls, height-for-age is the appropriate measure to identify stunting (see **Table 4.2**). See **Box 4.2** on the next page for more information on z-scores (used to determine height-for-age cutoffs).

TABLE 4.2 Cutoffs for Short Stature and Stunting

Age Group	Condition	Cutoff
Women	Short stature (adult)	< 145 cm
Adolescent girls up to age 19	Severe stunting (height-for-age)	< - 3 z-score
	Moderate stunting (height-for-age)	≥ - 3 and < - 2 z-score

LINKS TO RELATED CONTENT

Measurement: **Height and height-for-age**

Condition: **Short stature** Condition: **Stunting**

BOX 4.2 MAKING SENSE OF THE DATA: Z-SCORES

What Are Z-Scores and What Do They Tell Us?

Anthropometric z-scores describe how far and in what direction an individual's measurement is from the reference populations' median value. Z-scores that fall outside of the normal range indicate a nutritional issue (undernutrition or overweight). The further away from the normal range, the more severe the nutritional issue. Z-scores provide information on current nutritional status and can also be used to follow an individual's growth over time.

Who Needs to Understand Z-Scores and Why?

Z-score cutoffs are used to define malnutrition according to anthropometric indices (e.g., length/height-for-age). Therefore, health care workers and nutrition program staff need to understand what z-scores are, how to interpret them, and what they mean at individual and population levels to make informed decisions.

How Is a Z-Score Determined?

Z-scores can be estimated using growth charts/tables and/or calculated using computer software. See Annex 2 for more information on z-scores.

Pre-Pregnancy BMI and Recommended Pregnancy Weight Gain

In 2009, the IOM revised its pregnancy weight gain guidelines for women in the United States. These recommendations reflect the wide range of weight gain that can be considered healthy; they should be applied in the context of an individual woman's overall health and in conjunction with counseling on healthy diet and exercise. The guidelines may apply to similar populations outside the United States and have been adopted by some industrialized countries, such as Canada and New Zealand (Health Canada 2014; New Zealand Ministry of Health 2014). Others, such as the United Kingdom, have not adopted them.[7] The guidelines were not intended for use among populations in which women are substantially shorter or thinner than American women or do not have access to adequate obstetric care, which is often the case in developing countries (IOM and NRC 2009). There is limited research on the guidelines' applicability in developing countries, and studies have shown varying results (Ramakrishnan et al. 2014; Li et al. 2015). However, in the absence of country-specific weight gain guidelines, the 2009 IOM recommendations are a helpful reference point (see **Table 4.3**). Based on limited available evidence, the IOM recommends that these weight gain guidelines be applied to pregnant adolescents, although further research may be needed on optimal weight gain for this group (IOM and NRC 2009; Harper et al. 2011). Because gestational age and multiple weight measurements are required, gestational weight gain as a tool to guide nutrition counseling during pregnancy is more suited to non-emergency contexts (Ververs et al. 2013). Please note that while the IOM found that pregnancy weight gain guidelines also applied to women shorter than 157 cm, there was no evidence to determine whether guidelines should be modified for women shorter than 150 cm (IOM and NRC 2009).

[7] The United Kingdom does not currently have recommended pregnancy weight gain guidelines and instead focuses on achieving a healthy pre-pregnancy weight and healthy diet and physical activity during pregnancy (The National Institute for Health and Care Excellence [NICE] 2010).

TABLE 4.3 Recommended Total Weight Gain and Rate of Weight Gain during Pregnancy

Pre-pregnancy BMI[a]	Nutritional Status	Recommended in kilograms				Recommended in pounds			
		Singleton Pregnancies			Twins[b]	Singleton Pregnancies			Twins[b]
		Recommended Total Weight Gain	Rate of Weekly Weight Gain in 2nd and 3rd Trimester		Recommended Total Weight Gain	Recommended Total Weight Gain	Rate of Weekly Weight Gain in 2nd and 3rd Trimester		Recommended Total Weight Gain
			Mean	Range			Mean	Range	
BMI < 18.5	Underweight/ thin	12.5–18 kg	0.51 kg	0.44–0.58 kg	No recommend-ation	28–40 lbs	1 lb	1–1.3 lbs	No recommend-ation
BMI 18.5–24.9	Normal	11.5–16 kg	0.42 kg	0.35–0.5 kg	17–25 kg	25–35 lbs	1 lb	0.8–1 lb	37–54 lbs
BMI 25–29.9	Overweight	7–11.5 kg	0.28 kg	0.23–0.33 kg	14–23 kg	15–25 lbs	0.6 lb	0.5–0.7 lb	31–50 lbs
BMI ≥ 30	Obese	5–9 kg	0.22 kg	0.17–0.27 kg	11–19 kg	11–20 lbs	0.5 lb	0.4–0.6 lb	25–42 lbs

Adapted from IOM and NRC 2009.

a Based on a weight measured up to 2 months before conception or within the first trimester of pregnancy (IOM and NRC 2009).

b The guidelines for twins are provisional and do not refer to other multiples. There were insufficient data to establish guidelines for underweight women carrying twins (IOM and NRC 2009).

LINKS TO RELATED CONTENT

Measurement: Pre-pregnancy BMI

Measurement: Gestational weight gain

Condition: Underweight/thinness

Condition: Overweight/obesity

Postpartum Weight: Signs of Possible Weight-Related Problems during Lactation

Guidance on postpartum weight management was developed by the IOM in 1992 to guide health professionals working with postpartum women who are breastfeeding. They are based on experiences in a U.S. population and are here as a reference. Their applicability to non-U.S. populations has not been determined. **Table 4.4** provides updated guidance, adapted[8] from the 1992 IOM guidance, to include the current BMI cutoffs.

TABLE 4.4 Signs of Potential Postpartum Weight-Related Problems

Pre-pregnancy BMI	Signal of potential problem
BMI < 18.5 (underweight)	• Losing more than 2 kg (4.5 lb)/month after the first month postpartum • Any additional weight loss after BMI returns to the underweight classification or weight returns to pre-pregnancy weight
BMI 18.5–24.9 (normal)	• Losing more than 2 kg (4.5 lb)/month after the first month postpartum • Falling below normal BMI • Weight gain leading to high BMI • Major fluctuations in weight and a preoccupation with weight
BMI 25 or higher (overweight or obese)	• Losing more than 3 kg (6.5 lb)/month after the first month postpartum • Postpartum weight gain

Source: Adapted from IOM 1992

LINKS TO RELATED CONTENT

Measurement: Pre-pregnancy BMI
Measurement: Postpartum weight retention
Condition: Underweight/thinness
Condition: Overweight/obesity

[8] The 1992 IOM classifications are based on pre-pregnancy weight-for-height, which was commonly used in 1992. The FANTA Guide to Anthropometry adapted the guidance to use the current BMI cutoffs, applying the recommendations for each category—"underweight, normal, overweight/obese"—according to the BMI currently associated with that category (e.g., underweight = BMI <18.5).

Mid-Upper Arm Circumference

Several studies have found an association between low MUAC and low birth weight, preterm birth, intrauterine growth restriction, and poor maternal health (Tang et al. 2016; Ververs et al. 2013; WHO 1995a). However, these studies used a variety of cutoffs. There is no clear definition of low MUAC or established universally accepted international MUAC cutoffs for pregnant and postpartum women. However, because MUAC is simpler to measure than other indicators and is not affected by pregnancy status, several countries have established their own cutoffs for classifying malnutrition in women who are pregnant or up to 6 months postpartum. Although there is limited evidence to support these cutoffs, they help determine eligibility for nutrition support programs. **Table 4.5** provides a few examples of cutoffs that select countries were using as of 2016; this is not an exhaustive list of countries that have established their own MUAC cutoffs. The 2011 Sphere Handbook and United Nations High Commissioner for Refugees (UNHCR) guidelines also note that although cutoffs vary by country, 210 mm or 230 mm are commonly used cutoffs for pregnant women's entry into feeding programs and 210 mm has been proposed as a cutoff for women at risk during emergency situations (Sphere Project 2011). In selecting cutoffs associated with enrollment in nutrition support programs, it will also be important to be aware of available resources. For example, a higher cutoff would qualify more people for enrollment, so it is important to ensure that a program has funds and supplies to provide support for all who qualify (UNHCR and World Food Programme [WFP] 2011). Currently, there are no specific recommendations for MUAC cutoffs for pregnant adolescents, and several countries stipulate that their cutoffs for pregnant and postpartum women also apply to pregnant and postpartum adolescents. While not clearly defined in all countries, "postpartum" in the cutoffs on the next page usually refers to women within 6 months of delivery.

TABLE 4.5 Sample Country-Specific MUAC Cutoffs

Country	Severe Malnutrition	Moderate Malnutrition	Normal
Cote d'Ivoire*	< 185 mm	≥ 185 to < 210 mm	≥ 210 mm
Democratic Republic of Congo*	< 210 mm	≥ 210 to < 220 mm	≥ 220 mm
Ethiopia	< 180 mm	≥ 180 to < 210 mm	≥ 210 mm
Malawi	< 190 mm	≥ 190 to < 220 mm	≥ 220 to < 300 mm
Mozambique	< 210 mm	≥ 210 to < 230 mm	≥ 230 mm
Namibia	< 190 mm	≥ 190 to < 230 mm	≥ 230 mm
Tanzania	< 190 mm	≥ 190 to < 230 mm	≥ 230 mm
Uganda	< 190 mm	≥ 190 to < 220 mm	≥ 220 mm
Zambia	< 210 mm	≥ 210 to < 230 mm	≥ 230 mm

* Indicates cutoff also used for pregnant adolescents.

Source: Adapted from: Food and Nutrition Technical Assistance III Project (FANTA). 2016. Nutrition Assessment, Counseling, and Support (NACS): A User's Guide—Module 2: Nutrition Assessment and Classification, Version 2. Washington, DC: FHI 360/FANTA.

LINKS TO RELATED CONTENT

Measurement: **MUAC** Condition: **Underweight/thinness**

Clinical Assessment: Bilateral Pitting Edema

Nutritional edema in pregnant women and girls can be classified as shown in **Table 4.6** below. However, as noted previously, bilateral pitting edema during pregnancy is relatively common and has many potential causes other than malnutrition.

TABLE 4.6 Nutritional Status Classification of Bilateral Pitting Edema

Description	Grade of Edema	Nutritional Status
No bilateral pitting edema	Absent (O)	Does not have edematous malnutrition
Present in both feet/ankles	Mild (+)	SAM/severe malnutrition
Present in both feet/ankles, plus lower legs, hands, or lower arms	Moderate (++)	SAM/severe malnutrition
Generalized, including both feet, legs, hands, arms, and face	Severe (+++)	SAM/severe malnutrition

Sources: WHO 2013; WHO e-Library of Evidence for Nutrition Actions (eLENA) n.d. (a); WHO eLENA n.d. (b).

LINKS TO RELATED CONTENT

Measurement: **Bilateral pitting edema** Condition: **Severe malnutrition**

Tools to Assess, Classify, and/or Monitor Nutritional Status of Pregnant and Postpartum Women and Girls

TOOL: **INTERGROWTH-21st Standards and Tools**

In 2008, INTERGROWTH-21st, a multi-country project to extend the 2006 WHO Child Growth Standards into the fetal and neonatal period was launched. In addition to standards on fetal and newborn growth, INTERGROWTH-21st has developed gestational weight gain standards for pregnant women. As of the publication of this guide, standards for gestational weight gain for women with normal pre-pregnancy BMI are available on the website, with standards for overweight women forthcoming. The standards can be accessed at https://intergrowth21.tghn.org/gestational-weight-gain/#c6.

Because the INTERGROWTH-21st standards have not yet been widely adopted, they are not addressed in detail in this guide.

More information is available on the INTERGROWTH-21st Standards website.

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MODULE 5
Adults (18 Years of Age and Older)

What Does this Module Cover?

Module 5 focuses on anthropometry for non-pregnant, non-postpartum adults (18 years of age and older), including older adults. The module includes sections on:

- the importance of nutrition among adults
- nutrition-related conditions identified by anthropometry
- measurements and indices used to identify nutrition-related conditions
- interpretation of anthropometric indices and classification of nutritional status
- tools to assess adult nutritional status

Users are encouraged to review Module 1 alongside this module because it explains key concepts that are relevant to all modules.

Who Is the Focus of Module 5?

Adults in this module refers to individuals 18 years of age (i.e., have reached their 18th birthday) and older who are not pregnant or less than 6 months postpartum. Older adults refers to individuals 60 years of age (i.e., have reached their 60th birthday) and older.

Nutrition during Adulthood: Why Does It Matter?

Monitoring the nutritional status of adults is critical not only for individual well-being but also for promoting national development and economic growth. The ability of adults to provide for their families—both financially and as caregivers—and contribute to a country's economy is hindered by malnutrition. Malnutrition can reduce an adult's ability to fight off and recover from illness and can compromise physical and mental abilities. Adult malnutrition also reinforces intergenerational malnutrition as women who are underweight are more likely to have low birth weight babies and continue the cycle of malnutrition. In addition, adults who are overweight or obese have increased risks for morbidity and mortality, including risk of cardiovascular disease, type 2 diabetes, high blood pressure, osteoporosis, and some types of cancer, as well as complicated medical treatment for those conditions (World Health Organization [WHO] Expert Consultation 2004). These combined challenges increase health costs for individuals and governments while also reducing people's ability to work, which lowers productivity and economic potential at the individual and societal level.

Nutrition during Adulthood: Why Does It Matter? (continued)

Optimal nutrition is also critical for adults 60 years of age and older. Nutrition can influence how a person ages, while aging influences a person's nutritional status. Good nutrition helps older adults reduce their risk of developing acute and chronic disease, fight off illness, and function independently. Conversely, aging leads to problems such as increases in and redistribution of body fat, loss of muscle, lost height due to vertebral compression, oral health issues that can influence what and how much a person can eat, and reduced absorption and digestion of certain fats and vitamins (WHO 1995; Bernstein and Munoz 2016).

Anthropometric indicators in adult individuals and populations are strong predictors of future ill health, functional impairment, and mortality (WHO 1995). They can help determine individual nutritional status and guide counseling and support. Population-level data can be used to evaluate trends in nutritional status, help determine whether a large-scale intervention is needed, and monitor a nutrition intervention's impact on a population. Ethnicity, genetics, sex, age, and other factors influence the ability of anthropometric measures to determine the nutritional status of adults. Due to the heterogeneity of adult populations, there are few globally accepted international standards for determining adult nutritional status using anthropometry. To obtain a complete picture of an individual's current nutritional status and future risk, a nutritional assessment should involve not only anthropometry but also biochemical tests, clinical assessment (including medical history), and a review of dietary patterns, when possible.

What Nutrition-Related Conditions Are Identified through Anthropometry?

This section provides a description of some common nutrition-related conditions affecting adults that can be identified using anthropometry. The anthropometric measurements, indicators, and indices used to identify these nutrition conditions are described in the **Measurements** section.

CONDITIONS IN THIS SECTION

Already familiar with nutrition-related conditions?
Jump ahead to the **Measurements** section.

CONDITION: **Short Stature**

Short stature refers to an adult whose attained height is much shorter than the height of a typical adult. It is a permanent condition because height does not increase during adulthood. One cause of short stature is childhood undernutrition that prevented the person from growing to her/his full height potential, causing stunting during childhood and short stature in adulthood.

Although there is no treatment for short stature, it is important to identify short stature in women because it increases the risk of a complicated childbirth (e.g., the need for cesarean delivery), potentially requiring referral for specialized care during pregnancy and delivery (Black et al. 2008). Therefore, although both men and women can be of short stature, this guide only covers guidance on assessing the condition in women due to its health implications. Short stature is identified through height measurement.

LINKS TO RELATED CONTENT

Measurement: **Height** Interpretation: **Cutoffs for short stature**

TIP

The terms underweight/thinness and moderate and severe malnutrition are commonly used interchangeably for adults. Underweight/thinness is assessed using body mass index (BMI). Moderate malnutrition and severe malnutrition (discussed further on the next page) are assessed using BMI and/or mid-upper arm circumference (MUAC) and, for severe malnutrition, bilateral pitting edema of nutritional origin.

CONDITION: **Underweight/Thinness**

Underweight/thinness occurs when an adult's weight is too low for his/her height. It can be caused by rapid weight loss over a short period or can reflect chronic (long-term) malnutrition. Underweight/thinness may result from inadequate dietary intake (quantity or quality) and/or utilization of food; severe, repeated, or chronic infections/illness (e.g., tuberculosis, HIV/AIDS, cancer); or a combination of diet and disease. The overall condition in adults is referred to as underweight and is categorized by degree of thinness: mild, moderate, or severe. It is also sometimes referred to as mild, moderate, or severe malnutrition (see next page).

Individuals with severe thinness need medical treatment and require specialized therapeutic foods to recover (WHO 2011a). A high prevalence of underweight/thinness in a country is often an indication of food insecurity and/or high levels of infectious disease (WHO 1995). Individuals who are underweight often have an impaired immune system, which increases their risk of infection, reduces their ability to recover from illness, and therefore may put them at increased risk of mortality (Navarro-Colorado 2006; Flegal et al. 2005). In addition, underweight/thinness reduces work capacity and productivity (WHO 1995). BMI, which uses both height and weight measurements, is used among non-pregnant, non-postpartum adults to determine if an individual is underweight and categorize the severity of thinness. In older adults, calf circumference may also be used to determine underweight/thinness.

LINKS TO RELATED CONTENT

- Measurement: **BMI**
- Interpretation: **Cutoffs for BMI**
- Interpretation: **Unintentional weight loss**
- Measurement: **MUAC**
- Interpretation: **Cutoffs for MUAC**
- Measurement: **Calf circumference**
- Interpretation: **Cutoffs for calf circumference**

CONDITION: Underweight/Thinness
↳ CONDITION: **Moderate Malnutrition**

Moderate malnutrition is used to describe moderate thinness identified by BMI as well as low MUAC (under a certain cutoff). Moderate malnutrition results from inadequate intake (quantity or quality) and/or utilization of food; severe, repeated, or chronic infections/illness (e.g., tuberculosis, HIV/AIDS, cancer); or a combination of these.

LINKS TO RELATED CONTENT

- Measurement: **BMI**
- Measurement: **MUAC**
- Interpretation: **Cutoffs for BMI**
- Interpretation: **Cutoffs for MUAC**

CONDITION: Underweight/Thinness
↳ CONDITION: **Severe Malnutrition**

Severe malnutrition is used to describe severe thinness identified by BMI, low MUAC (under a certain cutoff), and/or the presence of bilateral pitting edema of nutritional origin. Adults suffering from severe malnutrition are at increased risk of death. Medical treatment and nutrition support are necessary to address their condition. When reporting a person's nutritional status, it is useful to know what measure was used since edema will affect BMI but will not affect MUAC.

LINKS TO RELATED CONTENT

- Measurement: **BMI**
- Measurement: **MUAC**
- Measurement: **Bilateral pitting edema**
- Interpretation: **Cutoffs for BMI**
- Interpretation: **Cutoffs for MUAC**
- Interpretation: **Classification of bilateral pitting edema**

CONDITION: **Overweight/Obesity**

Overweight and obesity (severe overweight) occur when an individual has too much body fat and weighs more than would be expected for a healthy person of the same height, putting his/her health at risk. Overweight and obesity are complex conditions with multiple causes, including an imbalance between the quantity and type of calories consumed and calories expended, medical conditions, and genetics, among others.

The prevalence of overweight and obesity has been growing worldwide, in both developing and developed countries, increasing risks of non-communicable diseases, heart disease, stroke, diabetes, some cancers, and other chronic diseases (U.S. Department of Health and Human Services 2013). Overweight and obesity are mainly identified among non-pregnant adults using BMI. In addition, waist circumference, which measures abdominal fat, can be used on its own or in combination with BMI to determine increased risk of morbidity and mortality due to excessive fat around the abdomen (WHO Expert Consultation 2004).

LINKS TO RELATED CONTENT

Measurement: **BMI**
Measurement: **Waist circumference**
Interpretation: **Cutoffs for BMI**
Interpretation: **Waist circumference**
Interpretation: **BMI and waist circumference**

TIP

While waist-to-hip ratio also can be used to measure central obesity, it is not included in this guide. Waist circumference is the preferred measurement because it is easier to use. Additional measures of central obesity such as waist-to-height ratio are also not included due to insufficient data at this time on whether it is a more appropriate index to use (WHO 2011b). However, waist-to-height ratio may be a superior measure to BMI and waist circumference for detecting increased cardiometabolic risk (Ashwell et al. 2012).

What Anthropometric Measurements and Indices Are Used for Adults?

Various anthropometric measurements and indices are used to identify nutrition conditions in adults. This section describes in detail the most common measurements and indices used in development settings to assess adult nutritional status: height, weight, BMI, waist circumference, MUAC, and calf circumference. Bilateral pitting edema, a clinical indicator to assess severe malnutrition, is also included because it is commonly assessed alongside anthropometry. **Table 5.1** summarizes the measurements and indices used in this module to identify nutrition conditions in adults. For information on assessing the nutritional status of pregnant women and women within the first 6 months postpartum, refer to Module 4.

Already familiar with measurements and indices? Jump ahead to the **Interpretation** section.

TABLE 5.1 Anthropometric Measures and Indices in this Module

	Height	Weight	BMI	Waist Circumference	MUAC	Calf Circumference	Bilateral Pitting Edema
Nutritional condition that the measurement/ index identifies	Used on its own to determine short stature or with other measurements to determine other nutrition conditions	Used on its own or with other measurements to determine multiple nutrition conditions	Underweight/ thinness; overweight/ obesity	Overweight/ obesity (central adiposity)	Underweight/ thinness	Low or loss of muscle mass; can be used as a proxy for thinness among older adults (60+ years)	Severe malnutrition

MEASUREMENT: **Height**

Height is used in assessments of both undernutrition and overweight in adults. Height in adulthood reflects both a person's genetic potential for growth and the influence of environmental factors that have affected that growth potential. Many factors can influence a person's height aside from her/his genetic potential, such as poor nutrition in utero and during early childhood, and acute and chronic diseases. Height is a common anthropometric measurement taken in adulthood as it is required to determine BMI. It is also used to determine short stature.

LINKS TO RELATED CONTENT

Condition: **Short stature** Interpretation: **Cutoffs for short stature**

MEASUREMENT: **Knee Height**

Knee height is used to estimate height in people whose height cannot be measured directly, often because they cannot stand or have severely curved spines. It may also be used instead of height to calculate BMI for older adults, who typically lose 1–2 cm in height per decade due to vertebral compression, loss of muscle tone, and changes in posture, which can influence their BMI. This is because knee height is not altered by vertebral compression or posture changes (WHO 1995; Bernstein and Munoz 2016). It can be measured while the person is sitting or lying down.

LINKS TO RELATED CONTENT

Interpretation: **Equations for knee height**

MEASUREMENT: **Weight**

Weight in adults is an important aspect of a person's health and nutritional status. Weight is a common anthropometric measurement taken among adults as it is required to determine BMI (described below). Significant weight loss over a short period, if unintentional, can be a signal that an individual has an underlying health issue that must be addressed (e.g., cancer, infectious disease, depression) (Navarro-Colorado 2006). In particular, weight loss among older adults is a key way to monitor health and nutritional status (Fischer and Johnson 1990). This is because adults typically gain weight until they reach a certain age. Among men, weight gain tends to plateau around age 65 and then decline, while weight gain for women generally continues until around age 75 and then tends to plateau (WHO 1995). However, one limitation of using weight loss in development settings to monitor health and nutritional status is that baseline adult weight is often not available, making it difficult to determine whether the weight loss is significant (Navarro-Colorado 2006).

LINKS TO RELATED CONTENT

Interpretation: **Unintentional weight loss**

MEASUREMENT: **BMI**

BMI is a ratio of weight relative to height that is used to identify underweight/thinness and overweight and obesity in adults. It is calculated using the formula (weight in kilograms)/(height in meters)^2 and its cutoffs are not age- or sex-specific. Although it is not a direct measurement of body fat and does not distinguish between muscle weight and body fat weight, BMI is moderately correlated with more direct measurements of body fat and is strongly correlated with various metabolic and disease outcomes (U.S. Centers for Disease Control and Prevention [CDC] 2016). In addition, several studies have found an increased risk of mortality associated with low BMI and high BMI (Allison et al. 1997; Flegal et al. 2005; Prospective Studies Collaboration 2009; Winter et al. 2014). Because BMI may overestimate the body fat in a person with a muscular build and may underestimate body fat in older adults who have lost muscle, it is best to use BMI in conjunction with other information, such as overall health, age, and activity level to provide better insight into an individual's nutritional status. BMI cannot be used to assess the nutritional status of women who are pregnant or within 6 months postpartum (see **Box 5.1**) and does not account for edema (National Heart, Lung, and Blood Institute Obesity Education Initiative 2000).

BOX 5.1 BMI AND PREGNANT/ POSTPARTUM WOMEN

BMI is not used to assess pregnant/ postpartum women because it doesn't distinguish between muscle weight, body fat weight, and pregnancy-associated weight gain. However, knowing a woman's pre-pregnancy BMI can indicate her nutritional status before conceiving and help guide counseling and nutritional support decisions, which is extremely important as optimal pre-pregnancy weight and weight gain during pregnancy are critical to a healthy pregnancy and birth (see Module 4 for more information).

LINKS TO RELATED CONTENT

Condition: **Underweight/thinness**

Condition: **Overweight/obesity**

Interpretation: **Cutoffs for BMI**

Interpretation: **BMI and waist circumference**

MEASUREMENT: **Waist Circumference**

Waist circumference is a measure of abdominal, or visceral, fat. Increased waist circumference is associated with the risk of diabetes and cardiovascular disease (WHO 2011b). Waist circumference can be used on its own or in combination with BMI to determine increased risk of morbidity and mortality due to excessive abdominal fat. Waist circumference should not be used to assess pregnant/early postpartum women (<6 months) and people who cannot stand (Madden and Smith 2016). Waist circumference is generally viewed as easier to determine than BMI (which requires both height and weight), as it is a single measurement taken using a non-stretch tape.

LINKS TO RELATED CONTENT

Condition: Overweight/obesity

Interpretation: Cutoffs for waist circumference

Interpretation: BMI and waist circumference

MEASUREMENT: **MUAC**

MUAC is used to identify moderate and severe malnutrition in adults by measuring the circumference of the mid-upper arm and comparing it to an established cutoff. MUAC once was used mostly for screening people for entry into feeding and acute malnutrition treatment programs, particularly children under 5. However, as a simple and practical measurement that indicates undernutrition, it is increasingly being used to determine the nutritional status and nutrition program eligibility of adults, especially pregnant women and people living with HIV (Tang et al. 2013). However, international evidence-based MUAC cutoffs for adults have not yet been established. In the absence of international cutoffs, several countries have established their own cutoffs, which vary. In the Interpretation section of this module, we provide a few examples of cutoffs that select countries were using as of 2016; this is not an exhaustive list.

LINKS TO RELATED CONTENT

Condition: Underweight/thinness

Interpretation: MUAC

MEASUREMENT: **Calf Circumference**

Calf circumference is used to estimate muscle mass in elderly populations, indicating the changes in fat-free mass that occur as an individual ages and becomes less active. WHO recommends its use for older adults as it is considered the most sensitive measurement of total body muscle loss, which has significant functional and health consequences for older adults (WHO 1995). When it is not possible to obtain BMI for older adults who are malnourished or at risk of malnutrition, it is recommended that calf circumference be used (Nestle Nutrition Institute n.d.). It can be measured while the person is sitting or standing. One limitation of this measurement is that swelling from edema in the leg/s, which is found in about 25 percent of older adults, can affect the measurement's accuracy (Dunn et al. 2004; Sullivan et al. 2013).

LINKS TO RELATED CONTENT

Condition: **Underweight/thinness**

Interpretation: **Cutoffs for calf circumference**

MEASUREMENT: **Bilateral Pitting Edema**

Bilateral pitting edema is a clinical sign of a specific form of severe malnutrition known as nutritional edema, edematous malnutrition, severe malnutrition with edema, or kwashiorkor. Bilateral pitting edema is an abnormal accumulation of fluid in body tissues that causes swelling beginning in both feet in its mild form and is generalized to both feet, legs, hands, arms, and face in its most severe form. It is characterized by a lasting pitting (indentation) of the skin when pressure is applied to both feet for 3 seconds. Even mild bilateral pitting edema indicates severe malnutrition or another serious medical condition; cases should be referred for further assessment and treatment. Other reasons for edema, especially in adults, that are not related to nutrition include congestive heart failure, lymphatic disorders, kidney disease, pregnancy, and allergic reactions (Navarro-Colorado 2006).

LINKS TO RELATED CONTENT

Condition: **Severe malnutrition**

Interpretation: **Classification of bilateral pitting edema**

How to Interpret Anthropometric Indicators and Classify Nutritional Status

This section provides guidance on how to interpret the anthropometric measurements and indicators used in this module to better understand the nutritional status of adults. The interpretation of anthropometric data for adults is not as straightforward as interpretation of child anthropometry because only BMI and bilateral pitting edema have universally accepted international cutoffs. To compensate for this lack of established global guidance, various countries have created their own cutoffs and guidelines. The BMI cutoffs and edema classification, along with caveats on the application of country-specific guidance for other anthropometric measurements more broadly, are discussed later in this module.

To minimize misclassification of an individual's nutritional status or a population's risk, caution must be used when interpreting adult anthropometric data. In addition to using the cutoffs described later in this module, other nutritional assessment results; clinical criteria; and an individual's weight trends, health status, food security status, behaviors, and care practices should be considered. In surveys, the broader context should be considered, including food security and illness levels in the community and trends in the overall population's nutritional status. Although there are challenges, anthropometry remains a key method of determining eligibility for certain care and support programs and is critical in determining whether additional counseling or services are needed to address a nutritional condition that may influence an individual's health. At the population level, anthropometric data can help determine whether additional policies, strategies, or investments are needed to support a population's health.

Summary Tables: Classifying Nutritional Status of Adults

The summary tables in this section provide cutoffs for nutritional conditions and are organized according to the measurement or index used.

Short Stature (for Women Only)

There are no internationally accepted cutoffs for short stature for men. For women, while a universally accepted international cutoff for short stature has not been established, a height of less than 145 cm is a commonly used cutoff in surveys, such as the Demographic and Health Surveys (DHS), and was also used in the Lancet's 2008 and 2013 Maternal and Child Nutrition Series to identify short stature in developing countries. However, various health risks during pregnancy to mother and child have been associated with cutoffs ranging from approximately 140–156 cm (WHO 1995; Ververs et al. 2013; WHO 2011c).

TABLE 5.2 Cutoffs for Short Stature

Condition	Cutoff
Short stature (adult women)	< 145 cm

Source: ICF 2012

LINKS TO RELATED CONTENT

Measurement: **Height** Condition: **Short stature**

Knee Height

Knee height is the WHO-recommended measurement to use as a proxy for standing height if the person being measured cannot stand or has significant curvature of the spine (often found in older adults) (WHO 1995). Although universally applicable international standards do not exist, there are equations that estimate height based on knee height. The equations created to estimate height from knee height for African American and Caucasian American men and women 60–80 years of age are shown below.

TABLE 5.3 Equations to Estimate Height from Knee Height

Americans 60–80 years	Equation
African American men	Height = (1.37 x knee height) + 95.79
Caucasian men	Height = (2.08 x knee height) + 59.01
African American women	Height = (1.96 x knee height) + 58.72
Caucasian women	Height = (1.91 x knee height) – (0.17 x age) + 75.00

Source: WHO 1995.

Additional equations for different populations and age groups are available in the guide to completing the Mini Nutritional Assessment.

LINKS TO RELATED CONTENT

Measurement: **Knee height**

Unintentional Weight Loss

Unintentional weight loss indicates potential health problems in an adult and is a good predictor of an individual's risk of mortality, even before he/she becomes malnourished. It may be caused by chronic diseases such as cancer and uncontrolled diabetes, infectious diseases such as tuberculosis and HIV and their accompanying complications, mental health issues such as depression, or lack of food/starvation (WHO 1995; WHO 2011a). Unintentional weight loss of 10 percent or more of an individual's body weight within 6 months is considered clinically significant (WHO 1995). Calculating the percentage of unintentional weight loss requires two weight measurements, the baseline body weight and the current body weight. Although not an actual measure of malnutrition, the percentage of weight lost is useful in clinical assessments of an individual's overall health.

$$\frac{[(\text{baseline body weight} - \text{current body weight})}{\text{baseline body weight}] \times 100}$$

Source: WHO 2011a.

LINKS TO RELATED CONTENT

Measurement: **Weight** Condition: **Underweight/thinness**

Body Mass Index

There are internationally accepted BMI cutoffs to determine underweight/thinness and overweight/obesity in adults (**Table 5.4**), which were proposed originally by WHO in 1993. In 2004 WHO convened discussions on the possibility of establishing population-specific cutoffs for BMI, because research has shown that certain populations (particularly Asian populations), due to higher percentages of body fat and central obesity, may have higher risks for poor health at lower overweight and obesity BMI cutoff points than other populations. However, WHO determined that although there did appear to be substantially higher risk for type 2 diabetes and cardiovascular disease at lower overweight and obesity BMI cutoff points for certain Asian populations, the available data did not provide clear cutoff points for all Asians. As a result, WHO did not create population-specific cutoffs but instead identified additional public health action points (levels) along the BMI continuum and proposed methods countries could use to make their own decisions. Therefore, some Asian countries such as China and Japan have lowered their cutoffs to indicate overweight and obesity (**Table 5.5**). In addition, WHO recommends that for populations with a predisposition for central obesity and a related increased risk of developing metabolic syndrome,[9] waist circumference should also be used to help establish country-specific cutoffs that consider, for example, that if a person with high BMI also has high waist circumference, his/her risk might be further increased (see **Table 5.6** for further discussion) (WHO 2011b).

LINKS TO RELATED CONTENT

Measurement: BMI

Condition: Underweight/thinness

Condition: Overweight/obesity

[9] Metabolic syndrome is an insulin resistance-related set of clinical characteristics known to increase the risk of cardiovascular disease, type 2 diabetes, and mortality in adults (Kelsey et al. 2014).

TABLE 5.4
BMI Cutoffs for Adults

Classification	BMI (kg /m²) Cutoff Points
Underweight	<18.50
Severe thinness	<16.00
Moderate thinness	16.00–16.99
Mild thinness	17.00–18.49
Normal range	18.50–24.99
Overweight	≥25.00
Obese	≥30.00
Obese class I	30.00–34.99
Obese class II	35.00–39.99
Obese class III	≥40.00

Source: WHO Expert Consultation 2004.

TABLE 5.5
BMI Cutoffs for China and Japan

Country	BMI Cutoff	
	Overweight	Obesity
China	≥ 24	≥ 28
Japan	≥ 23	≥ 27

Source: Harvard School of Public Health 2016.

BOX 5.2 BMI IN OLDER ADULTS

There is debate over whether BMI should be used to determine nutritional status in adults over 65 and, if used, whether different cutoffs should be established. This debate centers around the changes in body composition that come with age, including reduced muscle mass, increased body fat, and loss of height (WHO 1995; Bernstein and Munoz 2016). Some evidence indicates that a higher BMI may protect older adults' health and reduce mortality. Other research has found higher risk of mortality as BMI increases and raised concerns that overweight can exacerbate physical decline (Bernstein and Munoz 2016; Kiesswetter et al. 2013; Prospective Studies Collaboration 2009; Flegal et al. 2013; Villareal et al. 2005). A clear determination has not been made. However, it is suggested that if an older adult does have a higher BMI (or waist circumference) than currently recommended, he/she should maintain body weight and improve physical fitness to prevent loss of bone and muscle mass that may accompany attempts to lose weight (DeCaria et al. 2012).

Waist Circumference

There are currently no standard international cutoffs for waist circumference. The health risks associated with particular waist circumference cutoffs vary by sex, age, and across races and ethnic groups; more work must be done to determine the best approach to defining cutoffs (WHO 2011b). Similar to the issues with BMI cutoffs, Asian populations may have increased health risks at lower waist circumference cutoffs than individuals of European heritage due to greater central adipose tissue and higher percentage of body fat (WHO 2011b). However, several countries and health organizations have established their own sex-specific cutoffs, often in relation to risks to specific diseases. Common cutoffs for increased risk of metabolic complications range from 80–88 cm in women and 90–102 cm in men (WHO 2011b). See **Table 5.6** on the next page for a range of cutoffs used by various agencies.

BOX 5.3 WAIST CIRCUMFERENCE IN OLDER ADULTS

In older adults, waist circumference may be influenced by height loss as individuals age, which shortens a person's trunk and increases the diameter of the abdomen. Still, waist circumference may better predict metabolic risk in older adults than BMI. **Therefore, it is recommended that both waist circumference and BMI be used to assess disease risk in older adults.** Note, however, there is no clear global guidance on how to use them in combination (Castillo-Martinez et al. 2012).

In addition, because of the changes in older adults' body composition, waist circumference and BMI cutoffs for younger adults may not be appropriate for older adults. More research is needed to establish cutoffs for BMI and waist circumference in older adults (DeCaria et al. 2012).

LINKS TO RELATED CONTENT

Measurement: Waist circumference Condition: Overweight/obesity

TABLE 5.6 Sample Waist Circumference Cutoffs

Agency	Increased Risk of Disease
WHO*	Men: >94 cm Women: >80 cm **Substantially Increased Risk of Disease:** Men: > 102 cm Women: > 88 cm
International Diabetes Federation**	Men (Asian—refers to South Asian, Chinese, and Japanese): > 90 cm Men (European): >94 cm Women (European and Asian): > 80 cm
U.S. National Cholesterol Education Program	Men: > 102 cm Women: > 88 cm
Range of cutoffs established by countries***	Men: >80 cm to >96 cm Women: > 75 cm to > 99 cm

Source: WHO 2011b.

* These are examples cited during expert consultation meetings, based on an increase in the relative risk of metabolic complications observed in Caucasian populations in the Netherlands (20–59 years of age) (Han et al. 1995). These are not specific recommendations from WHO.

** The International Diabetes Federation (IDF) provides sex- and geography-specific cutoff recommendations (IDF 2006; Zimmet and Alberti 2006).

*** Countries include Barbados, China, Iran, and Mexico. See WHO 2011b for more information.

Using BMI and Waist Circumference Together

Using both BMI and waist circumference can provide additional information about an individual's risk for diabetes, hypertension, and cardiovascular disease, particularly in patients classified as overweight or obese using BMI. However, the National Heart, Lung, and Blood Institute (NHLBI) suggests that among individuals with a BMI ≥ 35, waist circumference adds minimal additional predictive power of disease risk as most individuals will exceed the waist circumference cutoff (NHLBI Obesity Education Initiative 2000).

TABLE 5.7 BMI and Waist Circumference: Associations with Disease Risk

This table describes the interaction between BMI and waist circumference relative to disease risk. For example, a person classified as overweight using BMI is already at increased disease risk, but that risk increases further if they have a high waist circumference.

	Body Mass Index	Disease Risk (Relative to normal weight and waist circumference)	
		Men < 102 cm Women < 88 cm	Men > 102 cm Women > 88 cm
Overweight	25.0-29.9	Increased	High
Obesity	30.0-34.9 (Obesity class I) 35.0-39.9 (Obesity class II)	High Very high	Very high Very high
Extreme obesity	> 40.0 (Obesity class III)	Extremely high	Extremely high

Source: NHLBI Obesity Education Initiative 2000.

LINKS TO RELATED CONTENT

Measurement: **BMI** Measurement: **Waist circumference** Condition: **Overweight/obesity**

Mid-Upper Arm Circumference

To date, international evidence-based MUAC cutoffs have not been established for adults. However, MUAC is simpler to measure than other indicators, and several countries use MUAC to assess adult nutritional status in clinical settings and have established their own cutoffs, which vary (Tang et al. 2013). This guide shares the cutoffs adopted by several countries because they are relevant to development programs seeking to operate in those locations (**Table 5.8** on the next page). However, implementers must be aware of the limitations of these cutoffs, which are not validated, and keep in mind that additional anthropometric, dietary, and clinical assessments as well as biochemical testing for micronutrient deficiencies will help provide a clearer understanding of adult nutritional status. In selecting cutoffs associated with enrollment in nutrition support programs, it will also be important to be aware of available resources. For example, a higher cutoff would qualify more people for enrollment, so it is important to ensure that a program has funds and supplies to provide support for all who qualify (UNHCR and World Food Programme [WFP] 2011).

In addition, a 2017 meta-analysis found that MUAC cutoffs in the range of ≤23.0 to ≤25.5 cm could potentially serve as appropriate indicators for low BMI (<18.5) among adults screened at the community level. The analysis suggests that ≤24.0 cm may be an appropriate cutoff to trigger referral to a health facility for further assessment. This research is preliminary and validation studies are needed to ensure that the proposed cutoff, which would trigger referral for further assessment, can efficiently and effectively screen for adult undernutrition (Tang et al. 2017).

LINKS TO RELATED CONTENT

Measurement: MUAC Condition: Moderate malnutrition Condition: Severe malnutrition

TABLE 5.8 Examples of Country-Specific MUAC Cutoffs

Country	Age	Severe Malnutrition	Moderate Malnutrition	Normal
Adults (non-pregnant/non-postpartum)				
Cote d'Ivoire	≥ 19 years	< 160	≥ 160 to < 180	≥ 180
Democratic Republic of Congo	≥ 18 years	< 180	≥ 180 to < 220	≥ 220
Ethiopia	≥ 18 years	< 180	≥ 180 to < 210	≥ 210
Malawi	≥ 19 years	< 190	≥ 190 to < 220	≥ 220
Namibia	≥ 18 years	< 190	≥ 190 to < 220	≥ 220
Zambia	≥ 18 years	< 185	≥ 185 to < 210	≥ 210
Elderly Adults				
Mozambique	> 55 years	< 185	≥ 185 to < 210	≥ 210
Uganda	≥ 60 years	< 160	≥ 160 to < 185	≥ 18.5
Adults (including pregnant/postpartum)				
Mozambique	19–55 years	< 210	≥ 210 to < 230	≥ 230
Uganda	18–59 years	< 190	≥ 190 to < 220	≥ 220

Source: Food and Nutrition Technical Assistance III Project (FANTA). 2016. Compilation of Anthropometric Cutoffs for Select Countries. Washington, DC: FHI 360/FANTA. Available at: http://www.fantaproject.org/sites/default/files/download/FANTA-anthropometric-cutoffs-Feb2016.xlsx.

Calf Circumference

To date, international evidence-based calf circumference cutoffs have not been established. Various published studies have used different cutoffs to identify an increased risk of malnutrition. As a result, clinicians have used cutoffs based on individual research studies. For example, the Mini Nutritional Assessment tool uses a cutoff of <31 cm to indicate malnutrition among older men and women, which is based on a study among French adults age 65 or older (Nestle Nutrition Institute n.d.). **Table 5.9** lists cutoffs that have been used in published reports but is not an exhaustive list of all cutoffs in use. Similar to other measurements discussed in this guide, cutoffs may need to be adapted to the population (e.g., Asian populations). Age may also play a role in the usefulness of calf circumference to determine malnutrition, as one study found that low calf circumference was more likely to predict malnutrition (as well as increased mortality risk) among adults over age 65 (Sakinah et al. 2016).

TABLE 5.9 Examples of Country-Specific Calf Circumference Cutoffs

Country	Calf Circumference Cutoff (cm)		Source
	Male	Female	
France	<31	<31	Guigoz et al. 1997
Brazil	<32.2	<32.2	Aparecida et al. 2012
Finland	<35.2	<35.2	Soini et al. 2004
Taiwan	<30	<27	Tsai and Chang 2011
Taiwan	<28	<25	Tsai et al. 2007
Malaysia	<30.1	<27.3	Sakinah et al. 2016
India	<31	<31	Jose and Kumar 2014
Indonesia	<34.8	<32.5	Setiati et al. 2010

Source: Adapted from Sakinah et al. 2016.

LINKS TO RELATED CONTENT

Measurement: Calf circumference Condition: Underweight/thinness

Clinical Assessment: Bilateral Pitting Edema

The bilateral pitting edema classification system in **Table 5.10** is the same one used for all populations in this guide. Even mild bilateral pitting edema in adults can be a clinical sign of severe malnutrition or other serious medical conditions and requires referral for testing and treatment. However, determining the grade and severity of edema and distinguishing between nutritional and non-nutritional causes may be more complicated in adults. Note that adults who have had a diet low in protein, salts, and calories may experience short-term edema after treatment for malnutrition and receiving a better diet (Navarro-Colorado 2006).

TABLE 5.10 Nutritional Status Classification of Bilateral Pitting Edema

Description	Grade of Edema	Nutritional Status
No bilateral pitting edema	Absent (O)	Does not have edematous malnutrition
Present in both feet/ankles	Mild (+)	severe malnutrition
Present in both feet/ankles, plus lower legs, hands, or lower arms	Moderate (++)	severe malnutrition
Generalized, including both feet, legs, hands, arms, and face	Severe (+++)	severe malnutrition

Sources: WHO 2013; WHO e-Library of Evidence for Nutrition Actions (eLENA) n.d. (a); WHO eLENA n.d. (b).

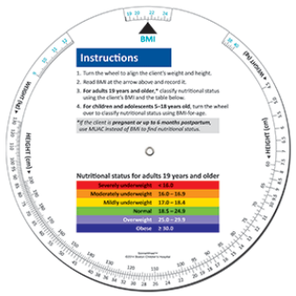
LINKS TO RELATED CONTENT

Measurement: **Bilateral pitting edema** Condition: **Severe malnutrition**

Tools to Assess, Classify, and/or Monitor Nutritional Status of Adults

This section provides information on two tools that can be used to assess, classify, and/or monitor nutritional status of adults.

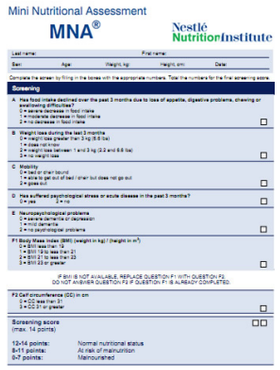
TOOL: **BMI Wheel**



A tool that can be used to calculate and interpret BMI for an adult 19 years of age and older is the BMI wheel. This small, hand-held tool is made of sturdy card stock and is easily carried, so it can be used on site, in a clinic, or other location. Note that the BMI wheel should not be used to determine the nutritional status of a pregnant or postpartum woman (up to 6 months after pregnancy); MUAC should be used instead. More information on the BMI wheel, including a video on how to use it and how to have it printed is available.

Visit the FANTA website for more information.

TOOL: **Mini Nutritional Assessment**



The Mini Nutritional Assessment is a nutrition screening and assessment tool that is commonly used in the United States to identify adults 65 years of age and older who are malnourished or at risk of malnutrition. The tool has been used in many countries and has proven to be applicable to populations around the world; however, some adaptation to cutoffs and assessment approaches may be necessary. The tool includes six questions that can be completed in about 5 minutes.

Visit the MNA website for more information.

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MODULE 6
Protocols and Equipment

What Does this Module Cover?

Module 6 provides instructions on how to take anthropometric measurements. This module covers:

- How to plan and prepare to take anthropometric measurements
- Measurement protocols that explain how to weigh an individual and how to measure an individual's length/height (or knee height), mid-upper arm circumference (MUAC), head circumference, waist circumference, and calf circumference and assess for bilateral pitting edema. The protocols are accompanied by drawings.
- Information on anthropometric equipment, including basic information on the common types of equipment needed to conduct anthropometry, suggested basic standards to help users select appropriate equipment, and information on where to purchase equipment

This module can be used as a resource to inform the development of training materials. Users are encouraged to review Module 1 alongside this module because it explains key concepts that are relevant to all modules.

How to Plan and Prepare to Take Anthropometric Measurements

The information and tips in this section are adapted from several sources (United Nations Department of Technical Co-Operation for Development [UNDTCD] and United Nations Statistical Office [UNSO] 1986; Cogill 2003; and ICF International 2012).

This section explains key aspects of planning and preparing to take anthropometric measurements. Guidance includes personnel needed, how to set up equipment and obtain consent from the individual or parent/caregiver, and other tips to ensure measurements are taken correctly. Following these preparations helps to protect the safety of individuals being measured and ensure that the measurements are accurate. Additional tips are provided specifically for weighing and measuring children and adolescents, who can be harder to work with and may need additional support.

Recommended Personnel

The number of personnel needed varies according to the age of the person being measured and the measurement being taken. In all circumstances, measurements must be taken by trained personnel who have demonstrated the necessary skills. Cultural norms should be considered when selecting measurers. For example, a woman may be uncomfortable with having her waist circumference measured by a man; having female measurers available would be recommended in that situation.

Children from birth to 5 years of age: Ideally, two trained persons should work together to take and record all measurements. One person conducts and calls out the measurements, while the other helps to position the child being measured and records the measurements. Having two people is particularly useful for measuring length and weight of the youngest children, who cannot follow directions and may be frightened or not understand what is happening.

Most program and clinical settings do not have the resources for two staff people to take measurements. In this situation, an untrained assistant such as a parent/caregiver can help position the child—following instructions from the trained person—and keep the child calm while the trained person weighs or measures the child and records all measurements.

This guide focuses on the use of two trained measurers and provides guidance on what to do if there is only one trained measurer and untrained parents/caregivers are available to assist.

People 5 years of age and older: One trained person is often enough when weighing and measuring older children (although an untrained parent/caregiver may help ensure their cooperation) and is all that is required to measure an adult.

SURVEY TIP

When conducting a survey, two trained people are usually expected to take the height and weight of children from birth to 5 years of age.

Setting up the Equipment

Ensure that all equipment is clean, working, and correctly calibrated (adjusted so that it measures accurately). Standing scales and measuring boards should be placed on a hard, flat, and level surface during measurement. Hanging scales should be securely hung with adequate room for taking measurements. Measuring tapes used for MUAC, waist, calf, and head circumferences should be in good condition (e.g., not stretched out and with clearly legible numbers). Different MUAC tapes are used for specific age groups, so the correct tapes should be available for the age group(s) being measured. Measurements may be taken outdoors, weather permitting. If measuring outdoors is uncomfortable due to heat, rain, or interference from other people, move indoors or to a secluded place to conduct measurements.

Greeting

Always greet and introduce yourself to the person you are going to measure as well as the parent/caregiver if a child or adolescent is being measured. Using a respectful, kind, and gentle tone, explain the reason for taking the measurement and the procedures involved and ask if the individual or parent/caregiver has any questions.

TIP

Checking the **calibration** of equipment can be done in the field by any trained person. To test whether a scale is accurately calibrated, weigh a standardized set of weights (e.g., 10 kg, 20 kg, 30 kg weights) and see whether the scale accurately measures them. If the test shows that the scale is not calibrated correctly, the scale must be sent to a technician who is trained to fix the equipment. It is helpful to have extra equipment in the field in case a scale needs to be sent off-site for calibration.

Consent

Before beginning any measurement, consent must be obtained from the individual to be weighed and measured. For children and adolescents, parental or caregiver consent as well as the child/adolescent's assent (as appropriate and required by local law) are necessary before taking any measurements. If the person refuses to participate, respect this decision and do not take any measurement. Always thank the person and parent/caregiver (if a child or adolescent is being measured).

Stop/do not measure if:

- The person being measured refuses.
- The parent/caregiver refuses.
- The person being measured is distressed or too sick.

SURVEY TIP

Ethical Approvals for Surveys

If the anthropometric data collected from individuals are part of a larger data collection effort designed to make a generalized statement about the anthropometric status of the population (e.g., as part of a population-based survey), ethical approval(s) must be obtained from an institutional review board (IRB). If the organization conducting the survey is based outside the country (e.g., an academic institution based abroad or an international nongovernmental organization), IRB approval both within and outside the country in which the data collection is planned is likely to be required.

In addition, as part of the data collection process, informed consent must be obtained from the person being measured. If the individual being measured is not old enough to give informed consent according to local law, then consent must be obtained from the individual's parent or guardian. Moreover, if a minor is of a certain age, in many cases, she/he must also provide assent for the measurement. Different countries will have different guidance on the age at which a person can legally give informed consent and on the protocol for obtaining assent from a minor who is legally unable to provide informed consent.

Measurer Preparation

The measurer should have clean hands before holding or positioning the person being measured. The measurer should remove any objects from her/his hands and wrists, such as big watches or bracelets, so as not to interfere with the measurement.

Individuals with Special Needs

It can be challenging to accurately and safely measure individuals with conditions that affect their ability to stand; straighten their arms, legs or back; or hold themselves steady. In these circumstances, it may be necessary to adapt measurement protocols or provide additional assistance to the individual being measured. Interpretation of measurements may also be more challenging in this population (see Module 2, **Box 2.6**). When conducting anthropometry for a survey, measurers should measure the individual and note his/her impairment or condition on the survey form. The survey management team will decide whether it is appropriate to include that data in the analysis.

Things to Keep in Mind while Measuring

Follow the protocols: Following each step of every procedure every time measurements are taken improves quality. Though some procedures may seem simple and repetitive, never take them for granted or omit any step.

Keep hands free of sharp objects: For safety, hold pencils or pens only while recording measurements, not while positioning or holding the person being measured.

Measure one person at a time: If you are measuring more than one person, it is important to complete and record all measurements for one person before beginning to measure another person. This will help prevent errors in recording measurements and respects the time of the person being measured.

Always supervise the person being measured; do not leave him/her unattended on or near anthropometric equipment: This prevents the person from being injured (e.g., tripping on, falling off, or cutting him/herself with equipment).

Carefully record measurements: Recording measurements in pencil allows mistakes to be easily corrected. Measurements should be recorded in the appropriate spaces as marked on the health card, questionnaire, or other relevant document. **Figure 1** shows how to correctly record measurements.

When recording an individual's age, it is best to record the exact age, if possible (see the section on estimating age for more information). However, while it is important to know and record the date of birth, the date of measurement, and the exact age of an individual (especially for children and adolescents), most growth charts use months to track growth and therefore a child's age in completed months is typically necessary when plotting his/her growth.

Measurements should be recorded clearly and accurately to the precision required for each measure. Weight should be recorded to the nearest 0.01 kg for infants and 0.1 kg for all other age groups. All other measurements should be recorded to the nearest 0.1 cm (1 mm), depending on local practice. If a mistake is made using a pencil, erase the error completely and write the correct measurement. If using a pen, cross out the error completely and write the correct measurement. When plotting growth, points should be clearly marked on the appropriate growth record (chart) for a person's sex and age, and the measurements being taken (e.g., weight-for-age) at the intersection of the two measures being taken. See **Annex 1** for more information on plotting measurements and interpreting growth patterns.

Measurements should be repeated if needed. The repeated measurement should be taken by a trained assistant (see **Box 6.1** for more information).

BOX 6.1 REPEATED MEASUREMENTS

Some research studies (e.g., the World Health Organization's Multicentre Growth Reference Study) measure each person twice, using two different measurers (e.g., the measurer and assistant switch roles for the second measurement). This can help identify any measurement problems and reduce error.

However, this is not usually done in clinics, program settings, or smaller-scale surveys because it increases the cost and time needed to measure each person. The protocols in this module do not include repeated measurements. Information on conducting repeated measurements can be found in the references near the end of this module (Cogill 2003; Global Nutrition Cluster [GNC] 2011; and World Vision 2011a). Information on using repeated measurements for standardization may be found in SMART 2006.

Tips for Successfully Measuring Children and Adolescents

(Adapted from UNDTCD and UNSO 1986; Cogill 2003; and ICF International 2012)

Children and adolescents may need additional support while being measured. These tips will help measurers to obtain accurate weights and/or measurements while minimizing stress on the child or adolescent and the parent/caregiver. These tips are especially applicable to younger children as older children are more likely to cooperate without needing a caregiver's reassurances.

Provide gentle and clear directions to the parent/caregiver and the person being measured: To ensure accurate measurements, the person being measured must be placed (or clearly instructed to place themselves) on the equipment according to the protocols in this guide (specific instructions for each measurement are in the Measurement Protocols section). A child may resist being measured if s/he is afraid or stressed. This can include kicking, crying, hitting, or biting; do not underestimate children's mobility or strength when upset. Clearly explaining the measurement process and projecting calm self-confidence may help the person being measured to be calm as well.

Involve the parent/caregiver: Being weighed and/or measured can be an uncomfortable or frightening experience for a child. The parent/caregiver can assist in positioning, carrying, and/or calming the child being measured, helping the child to feel secure and remain still. This will help achieve an accurate measurement and reduce the child's stress.

Getting Started: Determining Sex and Age

Many anthropometric measurements are interpreted based on an individual's age and/or sex because young children are smaller than older children, boys and girls grow at different rates, and men tend to be larger than women. For this reason, the 2006 WHO Growth Standards and 2007 WHO Growth Reference have sex-specific and age-specific standards and growth charts, and some anthropometric cutoffs (e.g., waist circumference) are different for men and women. It is necessary to know an individual's sex and age to compare his/her measurements with the correct growth standards, growth references, or cutoffs; determine eligibility for inclusion in surveys; and calculate the z-scores that classify nutritional status.

How to Determine the Sex of the Person Being Measured

A birth card can be reviewed to determine the sex of an infant or child. However, if no birth card is available, it is always best to ask the parent/caregiver the infant/child's sex. Do not assume the child's sex based on appearance, clothing, or name. It can be difficult to distinguish between males and females based on appearance, and some names may be used for both sexes (for example, in Ghana the name Nana is used for both males and females).

Be sure to record the individual's sex in the growth record, survey questionnaire, or other appropriate document and to select the appropriate growth chart according to the person's sex.

TIP

In a clinic setting, older children or adolescents might not be accompanied by an adult. Any questions normally asked of the parent/caregiver may be directed to the older child or adolescent.

How to Determine the Date of Birth (Age) of the Person Being Measured

An individual's date of birth is used to calculate his/her exact age (see **Box 6.2**). It is preferable to have this information for all individuals being measured. For children, age in days is recommended when computer software is used for assigning z-scores.

Formal record. A written birth record, health/immunization card, or baptismal card or other religious record can be used to determine date of birth. The measurer should confirm the date with the individual (or the child's parent/caregiver) before recording it. This is the preferred method of determining date of birth.

Self-report. If there is no formal record of the date of birth, ask the individual (or in the case of a child, the parent/caregiver) for his/her date of birth. Specifically ask for the person's date of birth, and not age, because self-reported age is often rounded and the date of birth will determine the exact age.

Estimate. Without a written birth record or health/immunization card or self-reported date of birth, it is necessary to estimate the date of birth to calculate an estimated age. This can be challenging, especially for older adolescents and adults, who were born many years ago, and for infants and children whose parent(s) is not present or no longer alive. In an anthropometric survey, this can be one of the most difficult aspects of data collection. Ideally, estimates should be to the day, but if that isn't possible, they should at least include the month and year of birth.

It can be very difficult to determine an adult's exact age if the person does not know his/her birth date. This is because tools and approaches (explained later in this module) that can help estimate an individual's age rely on knowledge of specific events surrounding a person's birth, which may be unclear 30–40 years later. However, while knowing an adult's exact age is often necessary when conducting a survey, an estimated age is often adequate in a clinical setting since most anthropometric indices and classifications use large age ranges (e.g., anyone over 18 years of age is considered an adult) and an adult's exact age is not necessary to determine his/her nutritional status.

BOX 6.2 AGE CALCULATIONS: DO THEY NEED TO BE EXACT?

Clinical or Program Settings

During clinical or programmatic assessment, a child's or adolescent's measurement is written down and plotted on a growth curve according to the nearest completed month. It is important to know a child's or adolescent's precise age to correctly assess growth as measured against standards or references to inform an appropriate plan of care. If this is not possible, an estimated birth month may be used.

Surveys

For surveys, an exact date of birth is needed to calculate a z-score for a child or adolescent. If the birth date must be estimated, it should be as precise as possible, at least to the month (surveys such as Multiple Indicator Cluster Surveys and the Demographic and Health Surveys use the 15th of the month as the birth date in these circumstances). While software such as WHO Anthro and WHO AnthroPlus can accommodate estimates to the month, keep in mind that systematic inaccuracies in age can bias survey results and lead to over- or under-estimation of malnutrition prevalence.

How to Estimate Date of Birth

Local Events Calendar

(Adapted from FAO 2008)

There are several tools that can be used to help estimate an individual's date of birth. One such tool is a local events calendar that can be developed and used to estimate a person's birth date, based on the proximity of his/her birth to a major local event. While this tool can be used to determine any individual's age, it is recommended for use with children.

How to Develop a Local Events Calendar

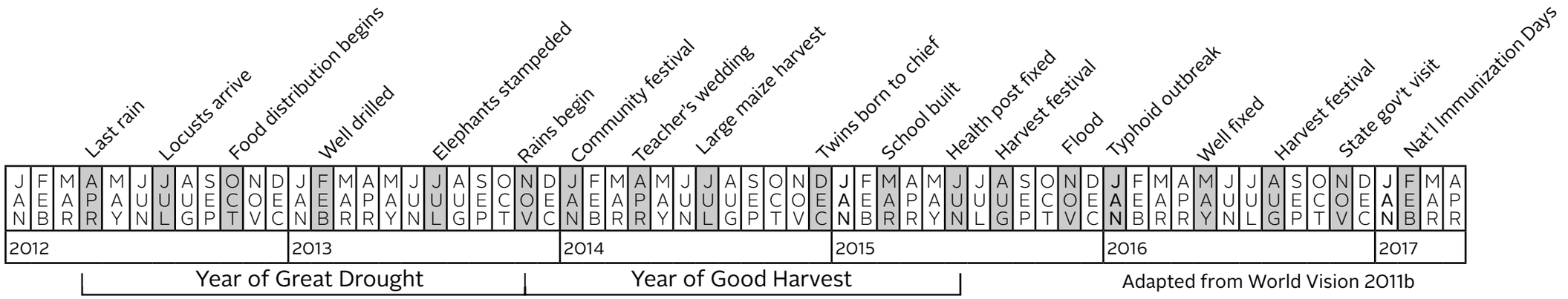
- Determine the timeframe needed based on the age of your demographic group (e.g., children from birth to 5 years of age).
- Work with key informants in the community to identify important events that happened in the community in that period and when they happened. There should be at least one event per month, preferably two, and they should be meaningful to the parents/caregivers of young children (see **Box 6.3**). In addition, there should be one major event per year that can be used to verify the year of birth.
- Develop the calendar using a format appropriate to the users. This might include a horizontal timeline with graphics or a table of key events. Both pictures and words can be used to show each event. The calendar should be tested before use. An example of a local events calendar is shown on the next page.

BOX 6.3 WHAT TO INCLUDE IN A LOCAL EVENTS CALENDAR

The following types of events should be included in a local events calendar:

- Harvests
- Festivals
- National and religious holidays
- Floods, droughts, other natural disasters
- Elections and major political events
- Vaccination or health campaign days
- Disease outbreaks
- Municipal events like opening of new schools, clinics, roads
- Birth or death of major figures

Community Events Timeline



Adapted from World Vision 2011b

How to Use the Local Events Calendar to Estimate Date of Birth

For children and adolescents: Begin by asking the parent/caregiver if she/he remembers when the person to be measured was born. If she/he does, ask her/him about that person's birth in relation to events around that time, according to the local calendar (e.g., if she/he thinks it was about 3 years ago, begin asking about events from 3 years ago).

For everyone: Ask the individual (or if the person is a child, the parent/caregiver) to be measured about what happened before and after his/her birth. For example, you can ask: "Were you born after the elections that year?" or "Was she born before the harvest festival?" Eventually it should become clear that the person was born between two specific events, and the month of birth can be estimated. In some circumstances, it may be possible to estimate an exact date, based on the type of calendar being used.

Note: It may be particularly challenging to use a local events calendar to estimate the date of birth of an older child, adolescent, or adult, as the calendar will need to be very long. This could lead to recording and interpretation difficulties, and the parents/caregivers or individuals themselves may not be able to recall events associated with a birth that occurred many years ago.

For more detailed guidance on local calendars, please see FAO's guide.

How to Use Probing Questions to Estimate Date of Birth

Asking probing questions is a technique used in the DHS to determine an adult's age. In this approach, an individual is asked several questions about both non-personal events (e.g., natural disasters, similar to the events calendar) and significant personal events during his/her life (e.g., birth of a child) to determine his/her age.

Sample questions and examples from the 2017 DHS Interviewer's Manual (ICF 2017) include:

1) Ask the respondent how old she was when she got married or had her first child, and then try to estimate how long ago she got married or had her first child.

   EXAMPLE *If she says she was 19 years old when she had her first child and that the child is now 12 years old, she is probably 31 years old.*

2) Relate her age to that of someone else in the household whose age is more reliably known.

3) Try to determine how old she was at the time of an important event such as war, flood, earthquake, change in political regime, etc., and add her age at that time to the number of years that have passed since the event.

If, after asking the questions, the respondent's age is still unclear and date of birth is unknown, then as a last resort estimate the individual's age.

How to Calculate Age Using Date of Birth

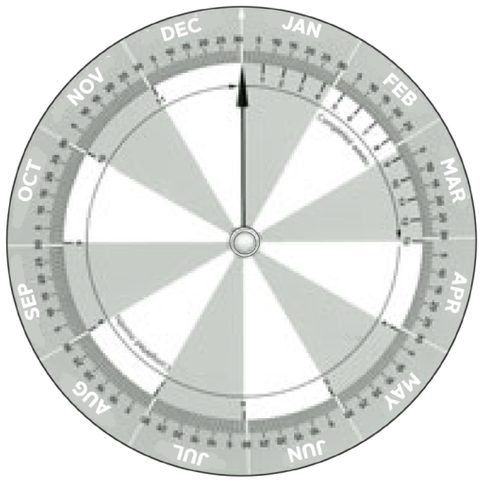
Once the date of birth is determined or estimated, the age of the person to be measured can be calculated using one of the tools discussed below: the World Health Organization (WHO) Child Age Calculator, a child age calculation chart, and computer software programs (e.g., Epi-Info.)

WHO Child Age Calculator

The WHO Child Age Calculator is a disk that calculates the age of a child or adolescent in completed weeks or months, using his/her date of birth. For infants under 1 year of age, the disk can be used alone to count the number of weeks (for children under 3 months) or months (children 3–11 months) of age. For children over 1 year of age, the number of years they have completed must be calculated before using the disk to calculate additional months. The calculator is part of the WHO Child Growth Standards training package, designed for children under 5 years of age. However, it could be adapted for older children and adolescents.

To Use the Child Age Calculator:

- Turn the disk until the bold arrow points to the person's birthday (month and day) on the stationary circular calendar.
- Locate today's date on the stationary calendar and count on the rotating disk how many months (or weeks for a child less than 3 months of age) the person has completed since birth or the last birthday.
- Record the person's age today. Make sure the abbreviations being used for year, month, and week have been agreed upon.



Source: WHO 2008a.

Child Age Calculation Chart

A simple way to determine age in months is to create an age calculation chart (see example in Figure 6.2).

To develop a chart:

1. Create a table with as many cells as there are months lived by the oldest person in your target age group. For example, if your target age group is children under 5 years of age, the table should have 60 cells, since 5 years equals 60 months. (Note: If the calendar is being used regularly, it will need a longer duration of months or to be updated monthly.)
2. In the last cell (bottom right), write the month and year when the weighing and measuring are being done.
3. In the first cell (top left), write the month and year of birth of a person exactly 5 years of age (i.e., whose fifth birthday would fall on the day of weighing and measuring).
4. Fill in the remaining cells with the appropriate month and year. For example, if the top left cell was labeled Jan 12, the cell immediately to the right of the top left cell (i.e., the second cell in the first row) would be Feb 12 and the cell immediately to the right of that cell would be Mar 12, and so on.

To use the chart:

1. Locate the month when the child was born.
2. Starting with the month after the child was born, count the cells/months from left to right in each row until (and including) the current month.
3. The number of cells you counted is the child's age in months.

Figure 6.2 Child Age Calculation Chart

To Use: Circle the birth month and circle the current month. Count the months starting with the birth month through to the current month.											
Jan 2012	Feb 12	Mar 12	Apr 12	May 12	Jun 12	Jul 12	Aug 12	Sep 12	Oct 12	Nov 12	Dec 12
Jan 2013	Feb 13	Mar 13	Apr 13	May 13	Jun 13	Jul 13	Aug 13	Sep 13	Oct 13	Nov 13	Dec 13
Jan 2014	Feb 14	Mar 14	Apr 14	May 14	Jun 14	Jul 14	Aug 14	Sep 14	Oct 14	Nov 14	Dec 14
Jan 2015	Feb 15	Mar 15	Apr 15	May 15	Jun 15	Jul 15	Aug 15	Sep 15	Oct 15	Nov 15	Dec 15
Jan 2016	Feb 16	Mar 16	Apr 16	May 16	Jun 16	Jul 16	Aug 16	Sep 16	Oct 16	Nov 16	Dec 16
Jan 2017	Feb 17	Mar 17	Apr 17	May 17	Jun 17	Jul 17	Aug 17	Sep 17	Oct 17	Nov 17	Dec 17

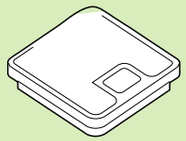
Source: Adapted from World Vision International 2011a; World Vision International 2011b.

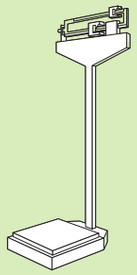
Calculating Age with Electronic Applications and Computer Software

It is increasingly common to calculate a person's age electronically, such as on a computer or a mobile device like a tablet or smartphone. Software such as Epi-Info, WHO Anthro (children under 5 years of age), and WHO AnthroPlus (children 5–19 years of age) can be installed on an electronic device to calculate a person's age (in completed months) instantly when the date of birth and date of measurement are entered.

Protocols

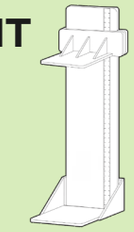
WEIGHT





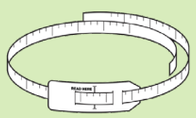
Preparing to Measure
Weighing Infants Using an Electronic Scale
Weighing Infants Using a Beam Scale
Weighing Children under 5 Years of Age with a Hanging Scale
Weighing Children Who Cannot Stand Alone on a Standing Scale
Weighing Children Who Can Stand, Adolescents, and Adults on an Electronic Scale
Weighing Children Who Can Stand, Adolescents, and Adults on an Beam Scale

LENGTH & HEIGHT



Preparing to Measure
Measuring Length in Children 0–2 Years of Age
Measuring Height in Children 2 Years of Age and Older, Adolescents, and Adults
Measuring Knee Height

CIRCUMFERENCE



Measuring Mid-Upper Arm Circumference
Measuring Head Circumference
Measuring Waist Circumference
Measuring Calf Circumference

BILATERAL PITTING EDEMA

Assessing Bilateral Pitting Edema

Measurement Protocols: Weight

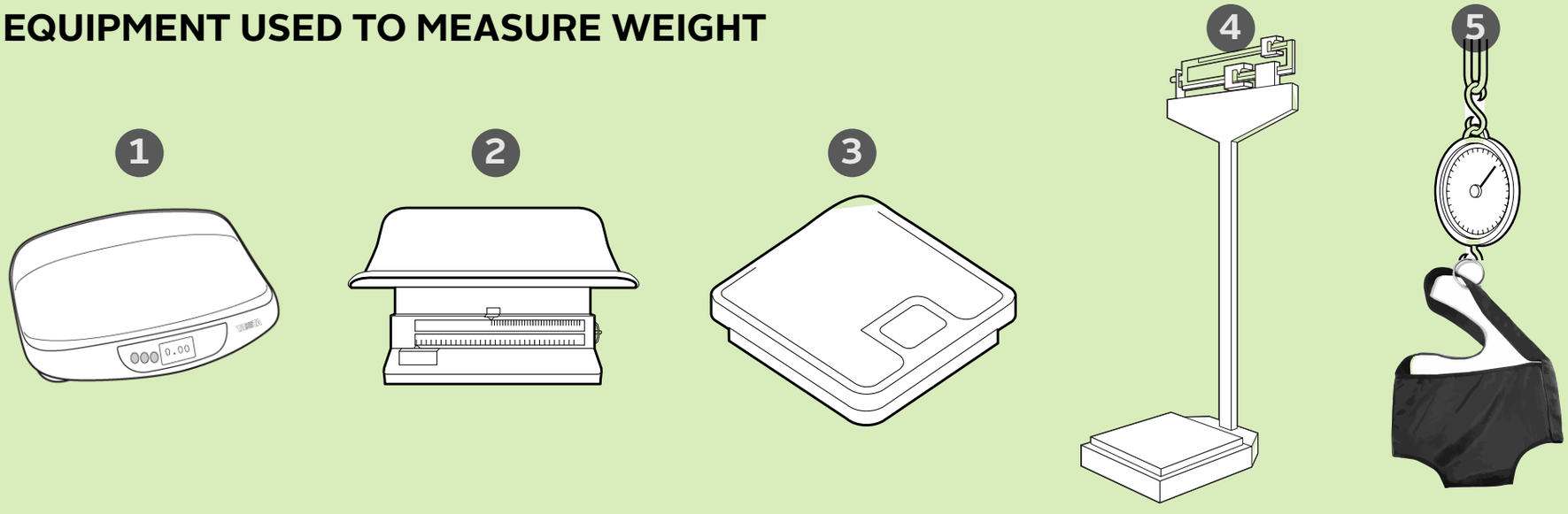
(Adapted from UNDTCD and UNSO 1986; Cogill 2003; U.S. Centers for Disease Control and Prevention [CDC] 2016; Division of Women, Infants, and Children [WIC] 2010; WHO 2008a; World Vision International 2011; ICF 2012)

This section provides basic instructions for weighing:

- Infants with an infant scale
- Children under 5 years of age with a hanging scale
- Infants, children, adolescents, and adults with a standing scale:
  - Children under 2 years of age or who cannot stand, using a scale with a taring feature
  - Children who can stand, adolescents, and adults

Already familiar with measurement protocols? Jump ahead to the Equipment section.

EQUIPMENT USED TO MEASURE WEIGHT



1. Infant electronic scale 2. Infant beam scale 3. Electronic scale 4. Beam scale 5. Hanging scale with pants

Preparing to Measure Weight

1. Show the scale to the person being weighed and/or the person's parent/caregiver and explain that it will be used to weigh him/her. For young children, inform the parent/caregiver that her/his help may be needed.
2. Place the scale on a hard, flat (level) surface. Make sure there is enough light to read the display on the scale, but do not place it under direct heat, which may damage the scale. If a hanging scale is used, make sure the scale is securely attached to a stable object and hung at eye level. In addition, make sure that the scale surfaces, slings, or pants are clean before weighing each person. When not in use, make sure the scale is covered and protected from dust and damage.
3. Ask the person being weighed to remove his/her socks, shoes, and any heavy clothing. Adults being weighed should be wearing only light clothing when the measurement is taken.
4. For children under 5 years of age, ask the parent/caregiver to undress the child (or help him/her undress) just before weighing, leaving on only the child's underpants, to ensure that clothing does not add weight.

Because of cultural preferences or climate, some parents/caregivers may not allow the child to be measured without clothing. To accommodate this preference and maintain accuracy, the undressed child may be weighed while wrapped in a blanket using a taring scale (discussed below) or weighed clothed, but only wearing light clothing.

To use blankets and a taring scale: First ask the adult to stand on a scale with the blanket and tare the scale, so that the weight of the blanket used to cover the child while weighing will not be included when measuring the child's weight. Next, have the adult hold the child, wrapped in the blanket, while standing on the scale for measurement.

To adjust for light clothing: Compile a list of the weights of common local clothes and based on that list, estimate how much weight to subtract from the child's measured weight.

Weighing Infants with Specialized Infant Scales

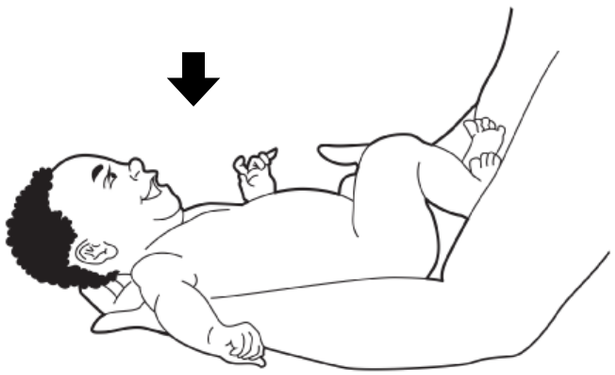
Using an Electronic Infant Scale

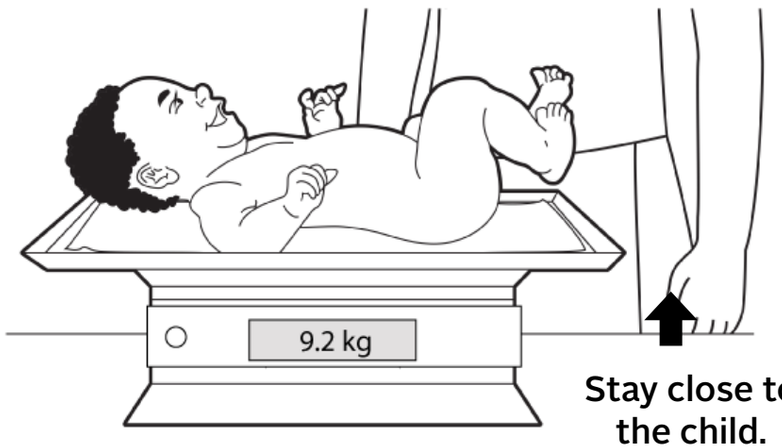
(Adapted from: Lee 1996; Gibson 2005; WHO 1995)

There are a variety of electronic scales that can be used to weigh infants. Because infants are so small, the electronic scales used to weigh them must be more precise than scales used to measure older children or adults (the scales must be able to detect changes as small as 10 g). Below are the general steps for operating common electronic infant scales; there may be slight variations.

Procedure

1. Turn on the scale by pressing the START button (or follow instructions for that scale). Wait until 0.000 appears.
2. Gently place the infant on his/her back on the center of the scale pan with the help of the trained assistant or parent/caregiver, who should help calm and secure the infant if he/she starts crying or moving. Stay close to and observe the infant to ensure he/she does not roll or fall off the scale.
3. Read the weight aloud when the infant is still and the digital display is no longer changing.
4. The trained assistant should record and/or plot the infant's weight to the nearest 0.01 kg (10 g) clearly and accurately on the health card, questionnaire, or other relevant document. If no trained assistant is available, record and/or plot the weight yourself.
5. Check the recorded or plotted weight for accuracy and legibility.





Stay close to the child.

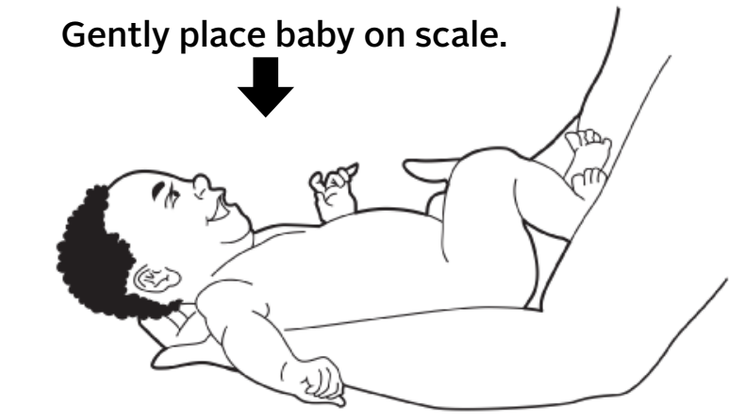
FOR ACCURATE MEASUREMENT, REMEMBER:

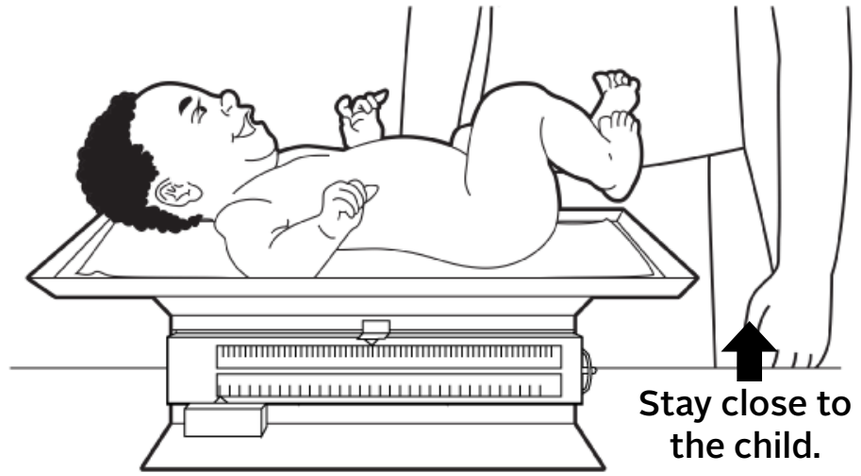
- Place the scale on a hard, flat (level) surface.
- Remove footwear and all clothing except clean/dry diapers or underpants.
- Wait until the child is still before reading and recording the child's weight. Stay close to the child.
- Read, record, and plot measurements carefully.

Using a Beam Scale for Infants

Procedure

1. Balance the scale at zero before each use. To do this, move both weights left to zero. If the scale does not balance at the midpoint, the counterweight must be adjusted.
2. Gently place the infant on his/her back on the center of the scale pan with the help of the trained assistant or parent/caregiver, who should help calm and secure the infant (without touching the child or the scale) if he/she starts crying or moving. Stay close to and observe the infant to ensure he/she does not roll or fall off the scale.
3. With the small weight at zero, move the large weight to the right until the indicator arrow drops below the midpoint.
4. Move the large weight back to the left one segment to raise the arrow just above the midpoint.
5. Move the small weight slowly to the right until the indicator arrow points directly at the midpoint.
6. Read the weight aloud when the infant is still and the indicator arrow steadily points at the midpoint.
7. The trained assistant should record and/or plot the infant's weight to the nearest 0.01 kg (10 g) clearly and accurately on the health card, questionnaire, or other relevant document. If no trained assistant is available, record and/or plot the weight yourself.
8. Check the recorded or plotted weight for accuracy and legibility.





FOR ACCURATE MEASUREMENT, REMEMBER:

- Place the scale on a hard, flat (level) surface.
- Remove footwear and all clothing except clean/dry diapers or underpants.
- Wait until the child is still before reading and recording the child's weight. Stay close to the child.
- Read, record, and plot measurements carefully.

Weighing Children under 5 Years of Age with a Hanging Scale

(Adapted from: UNDTCD and UNSO 1986; Cogill 2003; World Vision 2011a; World Vision 2011b; CDC 2016)

Using a Hanging Scale

Hanging scales can be used to weigh children under 5 years of age (see the **Equipment** section for more information). Young infants (less than 3 months of age) are usually weighed in a sling (which provides more head support) while older infants (3 months of age and older) are weighed in weighing pants. Hanging scales are less reliable than other infant scales, especially when weighing an agitated child (WHO 2008a). Below are the general steps for operating common hanging scales. However, there may be slight variations.

Procedure

1. Hang the scale by putting a rope through the upper hook of the scale; looping the rope around a post, beam, or branch of a tree; and tying it securely. Make sure the scale is at eye level so that the weight can be read correctly and that the scale is not too high from the ground, to avoid injury to the child in case of a fall.
2. Adjust the scale to zero with the weighing pants/sling attached.

(continued on next page)

FOR ACCURATE MEASUREMENT, REMEMBER:

- Hang the scale securely.
- Do not let the child hold onto anyone else.
- Remove footwear and all clothing except clean/dry diapers or underpants.
- Wait until the child is still and the needle is steady before reading the weight.
- Read, record, and plot measurements carefully.

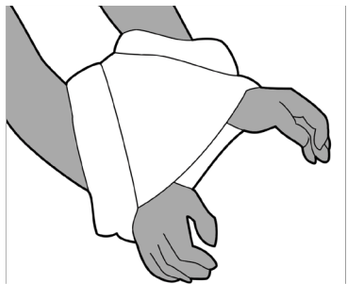
EQUIPMENT

TIP

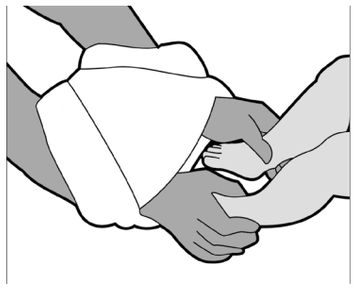
Hanging scales can be used for children weighing up to 25 kg; over 97 percent of children age 5 years weigh less than 25 kg. However, as children grow with age, it may become increasingly difficult to use hanging scales. A standing scale may be preferred for older preschool children.

Procedure for Using a Hanging Scale (continued)

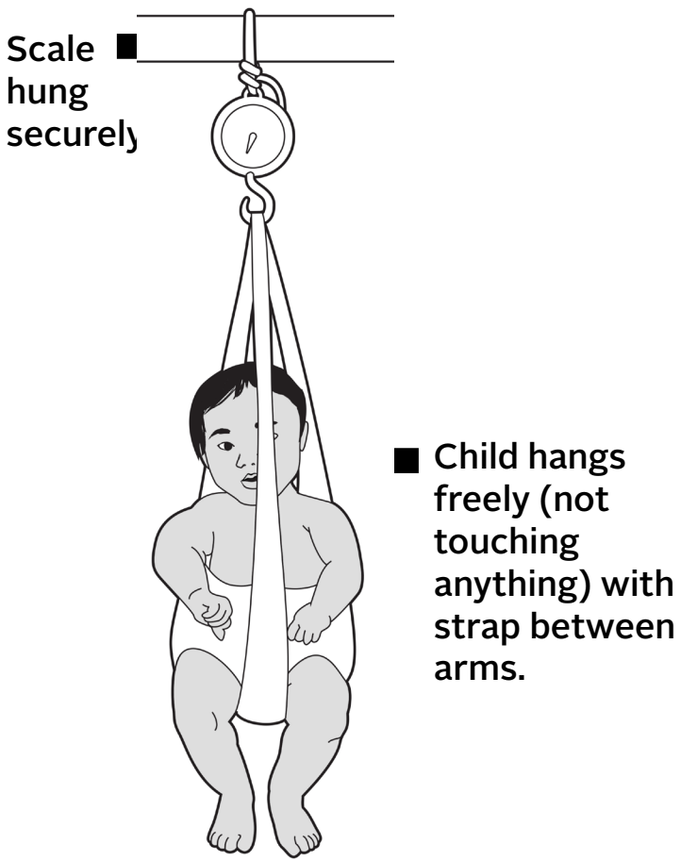
3. Remove the weighing pants/sling from the scale.
4. Place the child in the weighing pants/sling with the help of the trained assistant or parent/caregiver and make sure the child is secure. If using the weighing pants, ensure that the strap of the pants is in front of the child, with his/her arms on either side. For the sling, ensure the child is sitting or lying in the center with both arms in the sling.
5. Lift the child up in the pants/sling carefully with the help of the trained assistant or parent/caregiver—do not carry the child by the straps only—and hold him/her securely.
6. Place the strap onto the scale's hook and carefully let go of the child. Allow the child to hang freely on the scale.
7. Check the child's position and ensure that he/she is not touching or holding anything. Have the trained assistant or parent/caregiver ensure the child is secure and still (without touching the child or scale).
8. Stand facing the front of the scale to read the measurement when the child is still and the needle is steady (not fluctuating).
9. Read the weight aloud to the trained assistant, who should record and/or plot the child's weight to the nearest 0.1 kg (100 g) clearly and accurately on the health card, questionnaire, or other relevant document. If no trained assistant is available, record and/or plot the weight yourself.
10. With both hands on the child's body, lift the child and pants/sling off the hook with the help of the trained assistant or parent/caregiver, and then remove child from the pants/sling. If an assistant is not available when using the pants, use one arm to lift the child by the body and the free hand to release the strap of the pants from the hook. Hold him/her securely; never carry the child by the straps only.
11. Check the recorded or plotted weight for accuracy and legibility.



Hands through leg holes of weighing pants.



Grasp child's feet and pull through pants.



■ **Child hangs freely (not touching anything) with strap between arms.**

Weighing Infants, Children, Adolescents, and Adults with Standing Scales

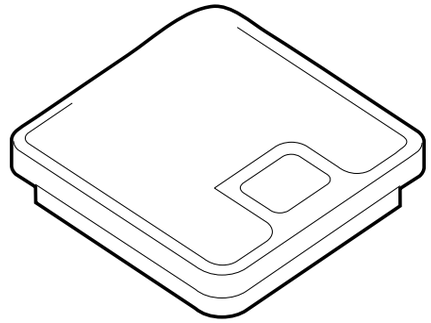
(Adapted from WHO 2008a; Cogill 2003; World Vision 2011a; World Vision 2011b; ICF 2012)

Children Who Cannot Stand Alone

Standing Scale with Taring Feature

Various types of electronic standing scales have a taring feature that can be reset to zero (zeroed or tared) while a person is standing on it. With the taring feature, when a child is placed in a parent/caregiver's arms, the weight of the child registers, rather than the combined weight. These scales are commonly used in clinical/programmatic settings and surveys to weigh children who cannot stand without assistance. Each type of scale has a specific procedure for weighing. The procedure discussed here is the general method for using a typical electronic standing scale with the taring feature.

EQUIPMENT



TIP

If there is no taring scale, a standing scale can be used:

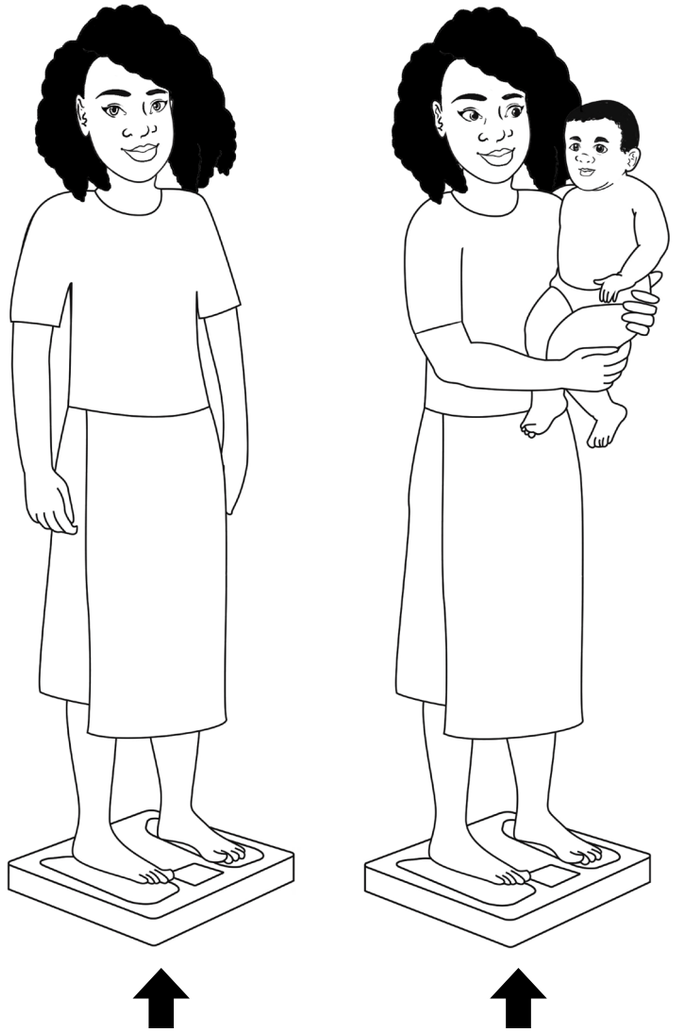
- Weigh the parent/caregiver alone and record the weight.
- Have the parent/caregiver hold the child while standing on the scale. Write down their combined weight.
- Subtract the parent/caregiver's weight from the combined weight of the child and the parent/caregiver. This is the child's weight.
- Record the calculated weight of just the child on the health record, questionnaire, or other relevant document.

Procedure for Using a Taring Scale

1. Zero the scale. The method used to zero the scale depends on the type of scale being used. Some scales can be zeroed by covering the solar panel for 1 second. When the readout says O.O and an image of a mother and baby is displayed, the scale is ready to be used. Other scales require that someone step on the scale.
2. Ask the parent/caregiver to step onto the center of the scale and stand still. Wait until the weight of the parent/caregiver displays and remains fixed in the display panel. If no parent/caregiver is available, a trained assistant or another adult may play this role.
3. Tare the scale while the parent/caregiver is on it, following the appropriate method for that scale.
4. Place the child in the parent/caregiver's arms and ask the parent/caregiver to remain still. The parent/caregiver should try to calm the child and prevent him/her from moving.
5. The child's weight will appear in the display.
6. Read the child's weight aloud. The trained assistant should record and/or plot the child's weight to the nearest 0.1 kg clearly and accurately on the health card, questionnaire, or other relevant document. If no trained assistant is available, record and/or plot the measurement yourself.
7. Check the recorded or plotted weight for accuracy and legibility.

TIP

When using a taring scale, if the parent/caregiver is relatively heavy (over 100 kg) and the child is small, the child's weight may not register on the display panel. In this circumstance, ask a smaller person to be weighed with the child.



First, weigh adult. Feet centered on scale.

Second, adult holds child securely.

Weighing Children Who Can Stand, Adolescents, and Adults on a Standing Scale

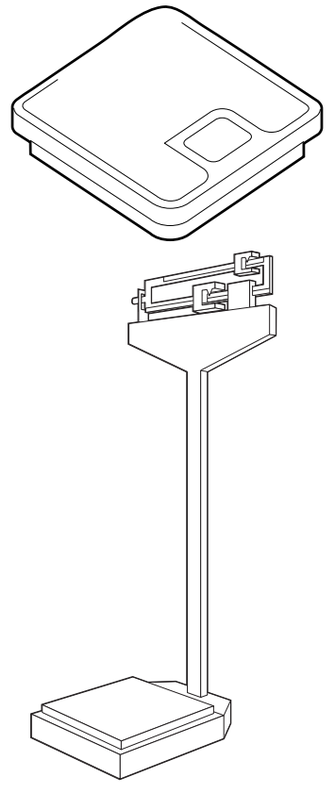
(Sources: ICF International 2012; CDC 2016; WIC 2010)

Several types of standing scales can be used to weigh those who can stand, although it is important to note that a common household/bathroom scale is not recommended (see the **Equipment** section for more information on specific scales). Each type of standing scale has a specific procedure for weighing. Below are the general steps for weighing a person on a typical electronic standing scale and a beam scale.

FOR ACCURATE MEASUREMENT, REMEMBER:

- Place the scale on a hard, flat (level) surface.
- Remove the child's footwear and all clothing, except clean/dry diapers or underpants.
- Properly tare the scale.
- Wait until the child is still and the weight is not fluctuating before reading the weight.
- Read, record, and plot measurements carefully.

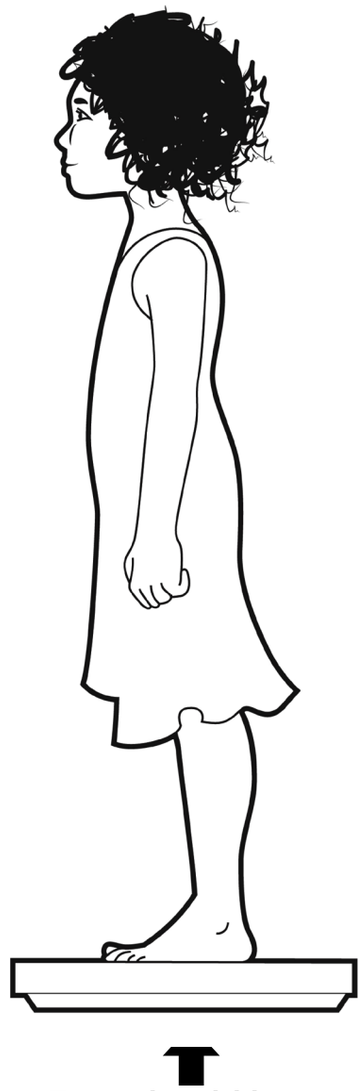
EQUIPMENT



Using an Electronic Standing Scale

Procedure

1. Zero the scale, following the appropriate method for the scale being used. For example, to zero commonly used solar-powered scales, cover the solar panel for 1 second. When the readout says 0.0, the scale is zeroed and ready to be used. Other scales can be zeroed by standing/stepping on them.
2. Ask the person to step onto the center of the scale and to stand still. For children, the trained assistant or parent/caregiver should help position the child on the center of the scale and assist in keeping the child calm and still without touching the child.
3. Wait until the weight displays and remains fixed in the display panel.
4. Read aloud the weight to the nearest 0.1 kg. The trained assistant should record and/or plot the person's weight clearly and accurately on the health card, survey form, or other relevant document. If no trained assistant is available, record and/or plot the weight yourself.
5. Gently help the person to get off the scale. Return a child to his or her parent/caregiver.
6. Check the recorded or plotted weight for accuracy and legibility.



Feet should be centered on scale.

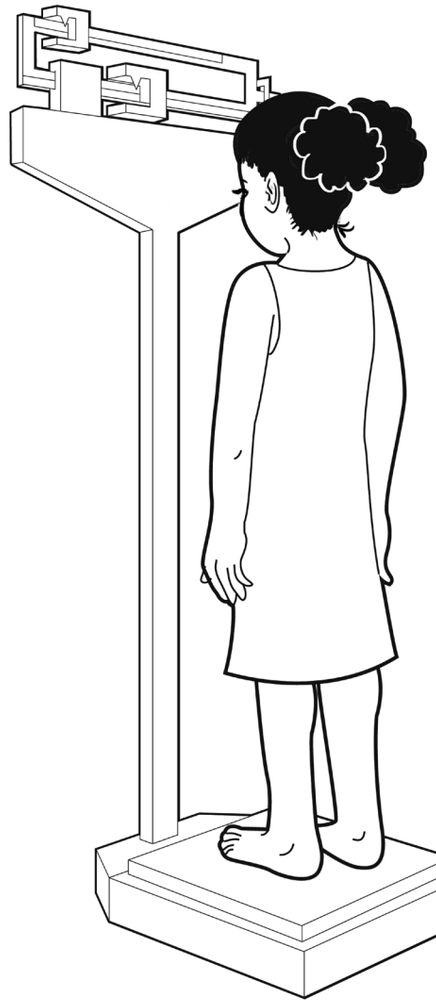
Using a Beam Scale

Procedure

1. Balance the scale at zero before each use. To do this, move both weights left to zero. If the scale does not balance at the midpoint, the counterweight must be adjusted.
2. Ask the person to step onto the center of the scale and to stand still. For children, the trained assistant or parent/caregiver should help position the child on the center of the scale and assist in keeping the child calm and still without touching the child.
3. Move the larger weight to the right until the indicator arrow drops below the center.
4. Move the larger weight back to the left one segment to move the indicator arrow slightly above the midpoint.
5. Move the smaller weight to the right until the indicator arrow points directly at the midpoint.
6. Read aloud the weight to the nearest 0.1 kg. The trained assistant should record and/or plot the person's weight clearly and accurately on the health card, survey form, or other relevant document. If no trained assistant is available, record and/or plot the weight yourself.
7. Gently help the person to get off the scale. Return a child to his or her parent/caregiver.
8. Check the recorded or plotted weight for accuracy and legibility.

FOR ACCURATE MEASUREMENT, REMEMBER:

- Ensure scale is placed on a hard, flat, surface
- Remove footwear and all heavy outer clothing.
- Ensure that the person stands in the center of the scale's platform, is stable, and is not holding onto anyone else.
- Wait until the weight is no longer fluctuating before reading.
- Read, record, and plot measurements carefully.



Feet should be centered on scale.

Measurement Protocols: Length and Height

(Adapted from UNDTCD and UNSO 1986; Cogill 2003; Westat 1988; CDC 2016; ICF International 2012; Nestle 2009; WHO 2008a; WHO and UNICEF 2009; World Vision International 2011)

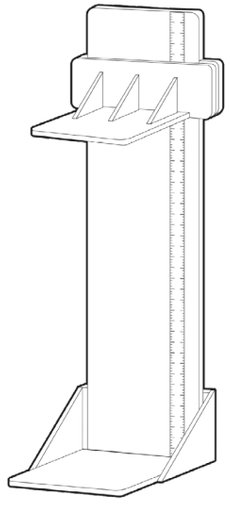
This section provides basic instructions for measuring:

- Length in children under 2 years of age
- Height in children 2 years of age and older, adolescents, and adults
- Knee height (a proxy for height)

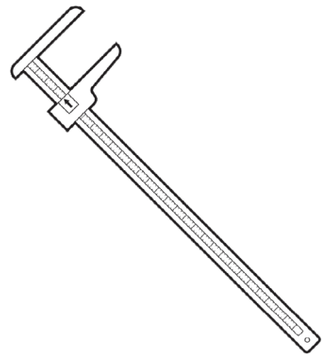
A length/height board is used to measure the length/height of an individual and a caliper is used to measure knee height.

Already familiar with measurement protocols? Jump ahead to the Equipment section.

EQUIPMENT TO MEASURE LENGTH/HEIGHT AND KNEE HEIGHT



Length/height board



Knee calipers

Preparing to Measure Length/Height

1. Show the measuring board to the person being measured and/or his or her parent/caregiver and explain that the board will be used to measure the person's length/height. If measuring a child, inform the parent/caregiver that her/his help may be needed.
2. Ask the person being measured or the parent/caregiver to remove the person's shoes and anything on her/his head or hair, such as a hat or hair ornament, that may interfere with the length/height measurement.
3. Make sure the surface of the measuring board is clean before placing the person on it.
4. Measure children under age 2 (under 24 months) while they are lying down. This measurement is known as "length" or "recumbent length." Children 2 years (24 months) of age or older, adolescents, and adults who can stand on their own without assistance should be measured while standing. This measurement is known as "height" or "standing height."

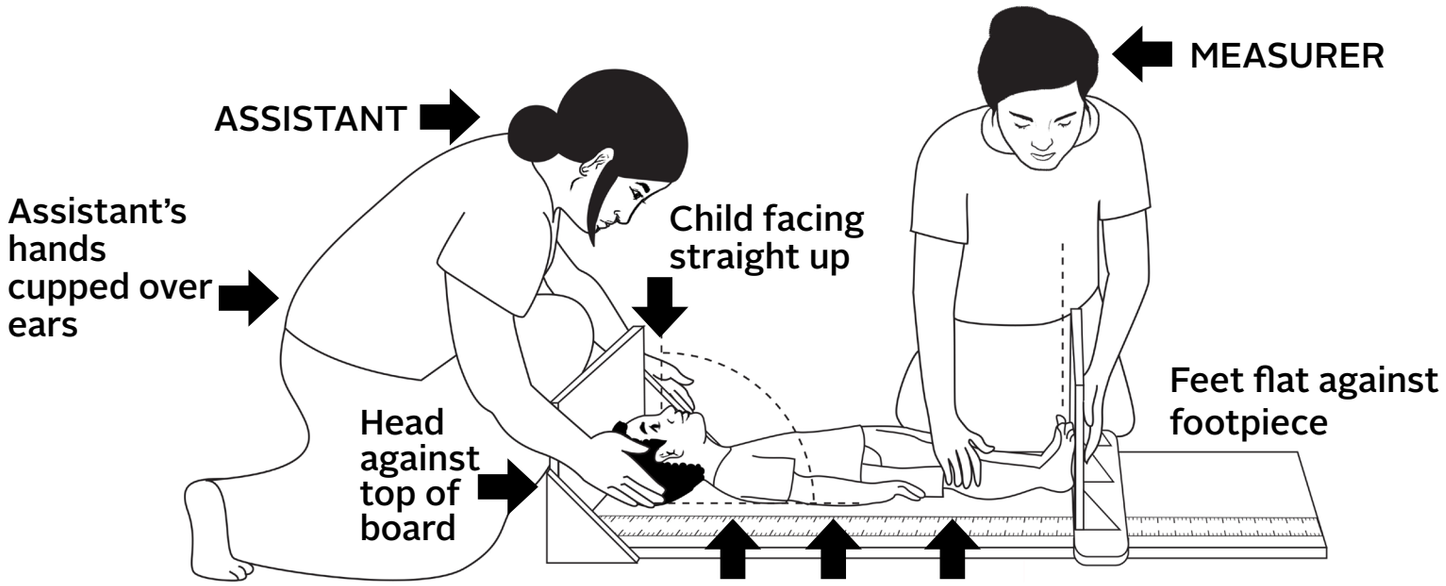
TIPS

- If the child's exact age cannot be determined, measure length in children less than 87 cm and height in children 87 cm or taller (WHO and UNICEF 2009). (Some surveys, such as DHS and MICS use 85 cm as the cutoff.)
- Measure length in children 2 years (24 months) of age and older who cannot stand and height in children under 2 years (24 months) of age who refuse to lie down and note it in your reporting.

  Standing height is about 0.7 cm less than recumbent length. This difference was taken into account in developing the WHO Growth Standards. Therefore, it is important to adjust the measurements if length is taken instead of height, and vice versa. If a child under 2 years of age will not lie down, measure standing height and add 0.7 cm to convert it to length. If a child 2 years of age or older cannot stand, measure recumbent length and subtract 0.7 cm to convert it to height. If the measurement is part of a survey, record the measurement according to instructions, including method of measurement, which will be reviewed and corrected as needed during data analysis. In a programmatic setting, note both the measured length and the adjusted length.

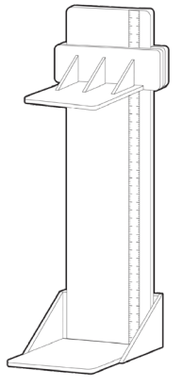
Measuring Length in Children 0–2 Years of Age

(Adapted from: UNDTCD and UNSO 1986; Cogill 2003; WHO 2008a; ICF International 2012; CDC 2016)



Child flat against board

EQUIPMENT

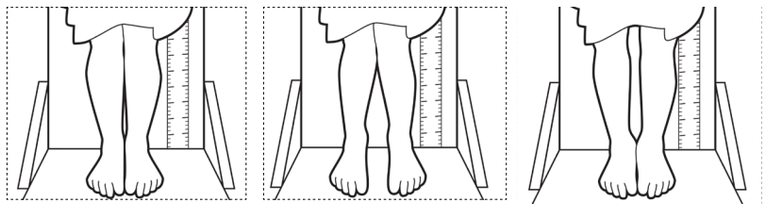


FOR ACCURATE MEASUREMENT, REMEMBER:

- Place the measuring board on a hard, flat, surface.
- Place the footboard firmly against the heels of both of the child's feet.
- Ensure that the child's legs are straight at the knees and that the knees are positioned correctly.
- Check the child's position to ensure that she/he is lying straight just before taking length measurement.
- Read, record, and plot measurements carefully.

Procedure

1. Before beginning measurement, place the measuring board horizontally on a hard, flat (level) surface such as the ground, floor, or a sturdy table. Make sure the measuring board is stable.
2. If the measuring board is on the ground or floor, kneel on the right side of the bottom of the board (where the child's feet will be) so that you can hold the footboard with your right hand. Ask the trained assistant or parent/caregiver to kneel with both knees behind the base of the board (where the child's head will be).
3. Ask the trained assistant or parent/caregiver to lower the child gently onto the board and to support the back of the child's head with his/her hands. The measurer should support the trunk of the child's body.
4. Place the child's head against the base of the board so that the child is looking straight up. Ask the trained assistant or parent/caregiver to gently cup his/her hands over the child's ears and, with arms straight, to then place the child's head in the correct position, with the top of the child's head touching the base of the board. The head of the trained assistant or parent/caregiver should be directly over the child's head.
5. The child's shoulders should touch the board and the spine should not arch. The child's line of sight (i.e., the Frankfort plane) should be perpendicular (i.e., 90°) to the ground so that the child is looking straight up.
6. Watch the child's head to make sure it is in the correct position against the base of the measuring board. If the child moves, the trained assistant or parent/caregiver should inform the measurer and readjust the child.
7. Make sure the child is lying flat in the center of the board and then place the child's knees and feet in the correct position. There are three possible correct positions for the knees and feet:



Knees and feet together | **Knees together, feet apart** | **Feet together, knees apart**

Generally, when a child lies down, his/her knees and feet will be in one of those correct positions, with at least the knees or the feet touching each other. The first position the child assumes is generally the correct position for measuring the child's length, as long as either the knees or the feet are touching.

(continued on next page)

Measuring Length (continued)

8. Place your left hand on the child's knees and press down gently but firmly against the measuring board to straighten the legs as much as possible without injuring the child. Your hand should be flat; do not wrap your hand around the knees or squeeze them together. Be very careful not to press too hard, as it may not be possible to straighten the knees of some newborns or very frail children.
9. Check the child's position and make any necessary readjustments. When the child's position is correct, move the footboard firmly against the child's heels. Make sure the soles of the feet are flat against the footboard with toes pointing upward. If the child bends his/her foot or toes either forward or backward and prevents the footboard from touching the soles, stroke the soles slightly and slide the footboard in quickly to touch the heels when the child straightens his/her toes.
10. Read aloud the length to the nearest 0.1 cm.
11. The trained assistant should record and/or plot the child's length clearly and accurately on the health card, questionnaire, or other relevant document. If no trained assistant is available, record and/or plot the length yourself.
12. Lift or help the child to get off the board and return the child to his or her parent/caregiver.
13. Check the recorded or plotted length for accuracy and legibility.

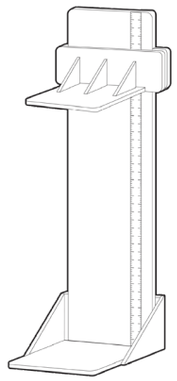
TIP

Gently tickling the bottom of a child's feet can help to straighten them before pressing the footboard against the heels.

Measuring Height in Children 2 Years of Age and Older, Adolescents, and Adults

(Adapted from UNDTCD and UNSO 1986; Cogill 2003; WHO 2008a; ICF International 2012; CDC 2016.)

EQUIPMENT



Procedure

1. Place the measuring board on a hard, flat (level) surface vertically against a wall, table, tree, etc. Make sure the board is stable.

2. Ask the person being measured to stand in the center of the measuring board, with his/her feet flat on the ground and his/her back against the board.

   When measuring a child, ask the parent/caregiver to place the child on the board and kneel in front of the child. The measurer should kneel on the left side of the child, with the trained assistant kneeling on the child's right (or the parent/caregiver moving to that position).

(continued on next page)

FOR ACCURATE MEASUREMENT, REMEMBER:

- Place the measuring board on a hard, flat (level) surface.
- Ensure that the person's feet and knees are in the correct position.
- Ensure that the person is standing straight by assessing the mid-axillary line.
- Ensure that the person is lifting his/her chin properly and looking straight ahead.
- Read, record, and plot measurements carefully.

Measuring Height (continued)

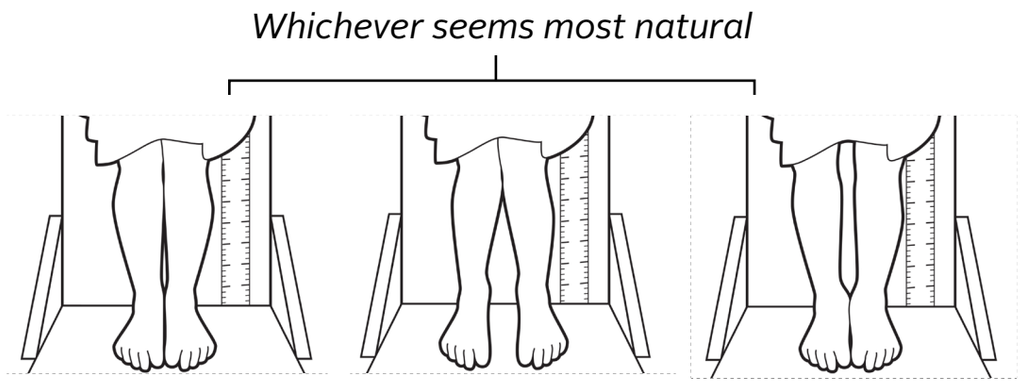
3. Determine whether the person's heel should be against or away from the back of the measuring board by drawing an imaginary line from the tip of the shoulder to the heel (called the "mid-axillary line"). This line should be perpendicular (90°) to the base of the measuring board where the person is standing.

   For almost all adults, you will have to move the person's feet away from the back of the measuring board to put them in the proper position.

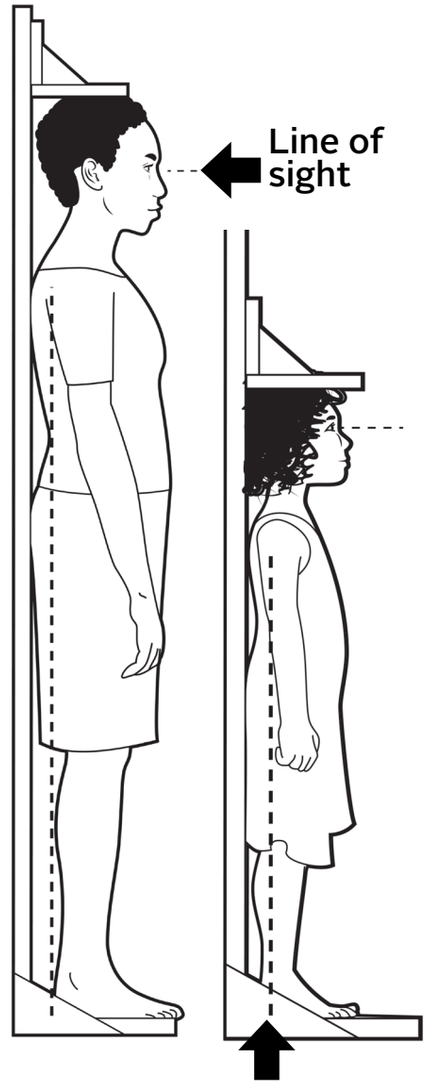
4. Lift the person's chin so his/her eyes look straight ahead. Make sure the person's line of sight (i.e., the Frankfort plane) is parallel to the ground and perpendicular (i.e., 90°) to the back of the measuring board.

   For a child, squat in front of him/her at eye level and gently hold the child's head in position.

5. There are three possible correct positions for the knees and feet:



The first position the person assumes is generally the correct position for measuring that person's height, as long as either the knees or the feet are touching each other.



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Measuring Height (continued)

6. With the help of the trained assistant or parent/caregiver, ensure that:
   - The person's arms hang down at his/her sides and the shoulders are level.
   - The person's weight is distributed evenly on both feet.
   - The person's buttocks touch the back of the board. In addition:

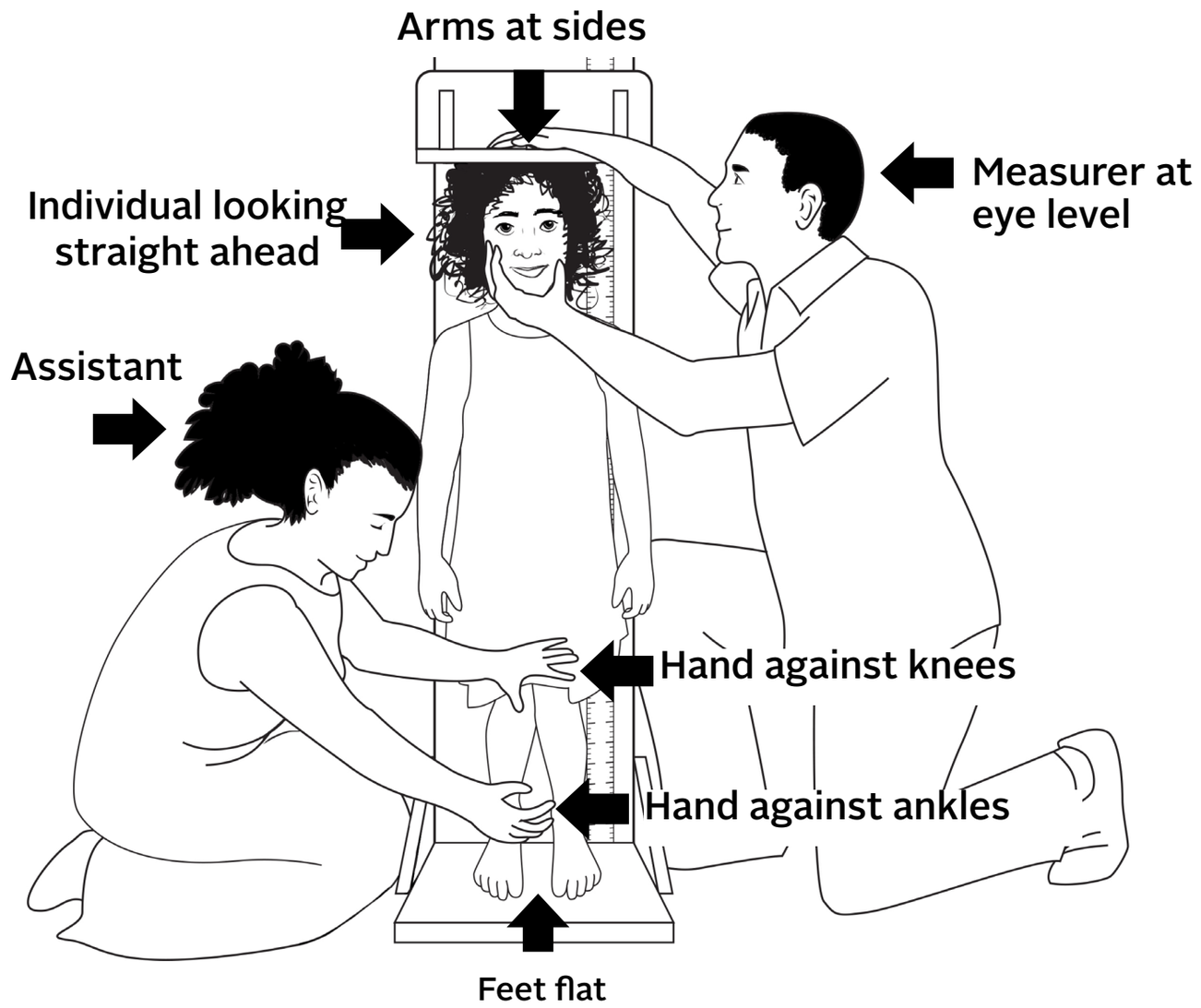
     For most preschool-age children who are underweight or normal weight, the back of the head, shoulder blades, calves, and heels will touch the back of the measuring board.

     For heavy or obese children, the shoulder blades and back of the calves will probably not touch the back of the measuring board, and the back of the head and heels also might not touch it.

     For most adults, the back of the head will probably not touch the measuring board and the shoulder blades may touch the measuring board.
7. Check the person's position and readjust as necessary.

   For children who have difficulty standing fully straight, gently pushing the stomach can help them stand straight.
8. Ask the trained assistant to gently and firmly slide the measuring board's moveable headpiece down until it touches the crown of the person's head (compresses the hair). If no trained assistant is available, slide the headpiece down yourself.
9. Read aloud the height indicated by the headpiece to the nearest 0.1 cm.
10. The trained assistant should record and/or plot the height clearly and accurately on the health card, questionnaire, or other relevant document. If no trained assistant is available, record and/or plot the height yourself.
11. Remove the headpiece from the person's head, and gently help him/her to get off the board. Return a child to the parent/caregiver.
12. Check the recorded or plotted height for accuracy and legibility.

Measuring Height (continued)



Measuring Knee Height

(Adapted from Westat 1988 and Nestle 2009)

Knee height is used to estimate height in people whose height cannot be measured directly, often because they cannot stand or have severely curved spines.

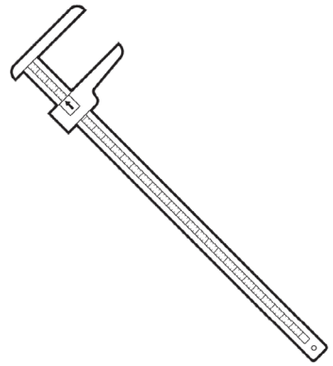
Procedure

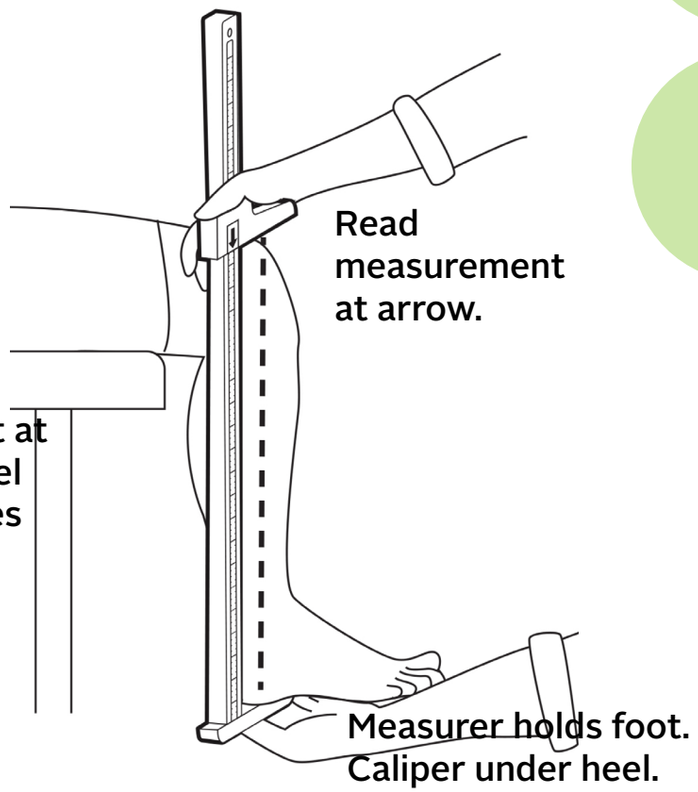
1. Ask the person being measured to sit upright on the measuring table with both legs dangling (i.e., hanging over the edge of the table). Any table strong enough to hold an adult and tall enough for an adult to sit on it with legs dangling freely can be used.
2. Kneel at the side of the leg to be measured. The individual's knee should be bent 90° and the ankle bent so the foot is parallel to the floor. Resting the person's foot in the palm of the measurer's hand can help position the individual being measured.
3. Place the fixed blade of the large sliding caliper under the heel. Position the other blade on the thigh, about 4.0 cm from the kneecap.
4. Hold the shaft of the caliper parallel to the lower leg and gently apply pressure to compress the tissues.
5. The trained assistant should record the knee height clearly and accurately on the health card, questionnaire, or other relevant document. If a trained assistant is not available, record the knee height yourself.
6. Check the recorded knee height for accuracy and legibility.

FOR ACCURATE MEASUREMENT, REMEMBER:

- Ensure that the knee and ankle are bent 90°.
- Carefully position the caliper.
- Read and record measurements carefully.

EQUIPMENT



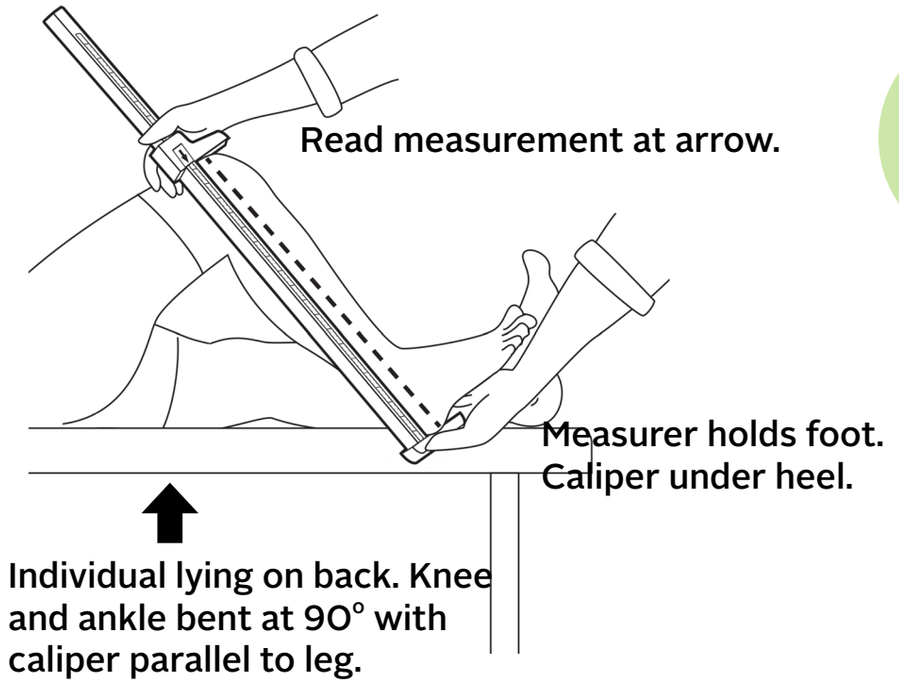


For adults in a wheelchair:

1. Support the person's leg so that the knee is bent 90° and the ankle is bent so the foot is parallel to the floor. An assistant should help support the leg.
2. Kneel at the outside of the leg to be measured and place the fixed blade of the caliper under the person's heel.
3. Position the other blade on the thigh, about 4.0 cm from the kneecap.
4. Hold the shaft of the caliper parallel to the lower leg and gently apply pressure to compress the tissues.
5. The trained assistant should record the knee height clearly and accurately on the health card, questionnaire, or other relevant document. If a trained assistant is not available, record the knee height yourself.
6. Check the recorded knee height for accuracy and legibility.

For bedridden adults:

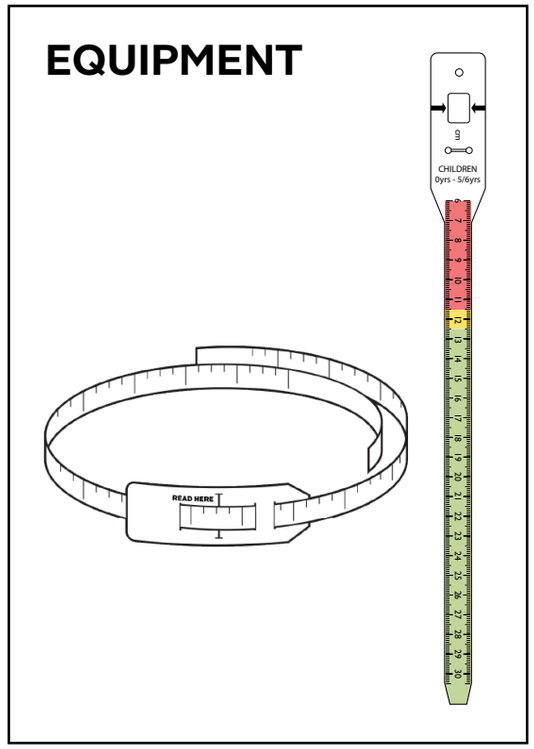
1. Have the person lie on his/her back with the knee and ankle of one leg bent 90°. The assistant should help the person keep the knee and ankle at a 90° angle.
2. Stand to the outside of the leg to be measured and place the fixed blade of the caliper under the person's heel.
3. Position the other blade on the thigh, about 4.0 cm from the kneecap.
4. Hold the shaft of the caliper parallel to the lower leg and gently apply pressure to compress the tissues.
5. The trained assistant should record the knee height clearly and accurately on the health card, questionnaire, or other relevant document. If a trained assistant is not available, record the knee height yourself.
6. Check the recorded knee height for accuracy and legibility.



Measuring Mid-Upper Arm Circumference

(Adapted from: Cogill 2003; FANTA 2008; World Vision International 2011; de Onis 2004)

This section provides guidance on measuring MUAC in all demographic groups. MUAC is measured using a MUAC tape. There are specific tapes for various demographic groups (e.g., children 6–59 months of age). Many of these tapes are color-coded according to the cutoffs used for that group. More information on types of MUAC tapes can be found in the **Equipment** section.



Preparing to Measure MUAC

1. Make sure the appropriate MUAC tape is being used (colored and numbered or numbered alone) for the specific age or target groups (e.g., children 6–59 months of age, pregnant and postpartum women).
2. Show the MUAC tape to the person being measured or to his or her parent/caregiver and explain the MUAC measurement. If measuring a child, inform the parent/caregiver that her/his help may be needed.
3. Ask the person being measured or the parent/caregiver to remove any clothing covering the left arm.
4. For a person who can stand upright, take the MUAC measurement standing.
5. If measuring a child who cannot stand but can sit quietly on a chair or stool, ask the parent/caregiver to kneel by the child so the child will be calm, still, and secure. Otherwise, ask the parent/caregiver to sit on a chair or stool and place the child on her/his lap.

Procedure for Measuring MUAC

1. Work at eye level. Stand, sit, or kneel, if necessary.
2. Locate the midpoint of the person's upper left arm, which is between the shoulder tip and the tip of the elbow:
   - Locate the tip of the person's shoulder with your fingertips.
   - Find the tip of the elbow by bending the person's elbow so the arm makes a right angle.
   - Use a MUAC tape to measure the full length between the shoulder tip and the elbow tip.
   - The trained assistant marks the midpoint (half of the measured full length) on the person's arm with a pen. If a trained assistant is not available, mark the midpoint yourself.
3. Straighten the arm after marking the midpoint. The trained assistant or parent/caregiver can help straighten the arm of the person being measured.
4. Wrap the MUAC tape around the person's arm at the midpoint mark and slide the end of the tape through the window and into the slit on the other side.

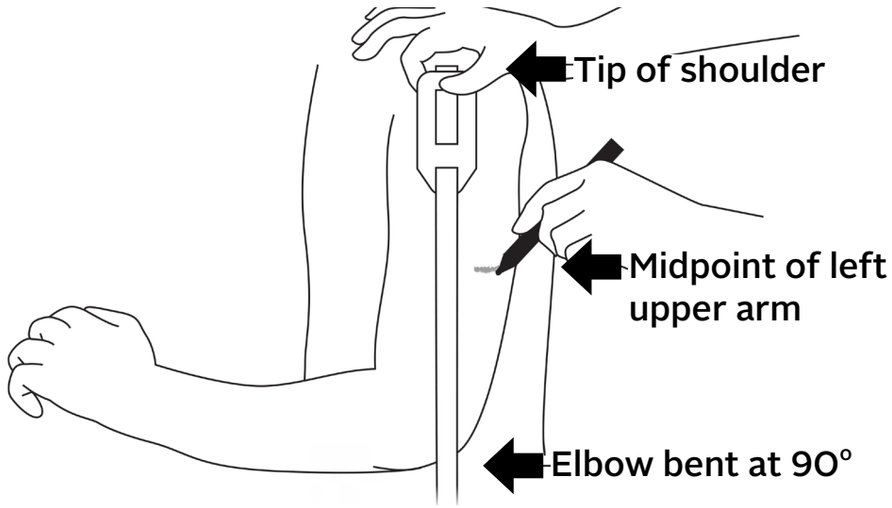
(continued on next page)

TIP

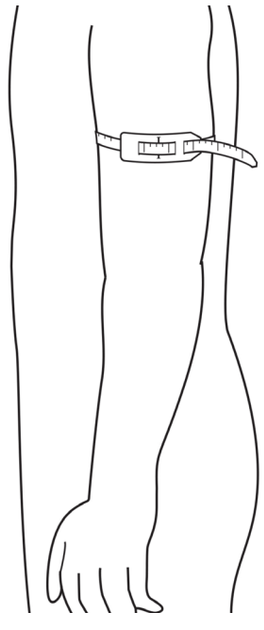
Either arm can be used to take the measurement (accuracy and precision are not highly influenced); however, the left arm is most often used (de Onis et al. 2004).

* Some developing countries have a slightly different procedure to identify the midpoint of the upper arm. For example, in Malawi, the full length from the shoulder tip to the tip of the elbow is measured using the MUAC tape. Then, the MUAC tape is folded into half while still on the upper arm to determine its midpoint.

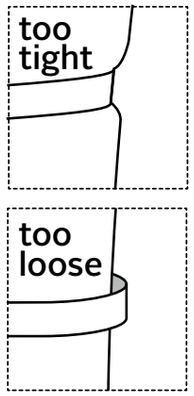
FINDING MIDPOINT



MEASUREMENT



5. Adjust the tape's tension so that the tape is flat against the skin. The measurement will be inaccurate if the skin is pinched (tape is too tight) or if the tape isn't touching the skin (tape is too loose).
6. The arrow on the tape points at the measurement. Read aloud the number to the nearest 0.1 cm (1 mm) (for number-only tape) where the arrow points and the associated color (for numbered and colored tape). For tapes that use only color, note the color indicated by the arrow.
7. The trained assistant should record the person's MUAC to the nearest 0.1 cm (1 mm) clearly and accurately on the health card, questionnaire, or other relevant document. If no trained assistant is available, record the MUAC yourself.
8. Check the recorded MUAC for accuracy and legibility.



FOR ACCURATE MEASUREMENT, REMEMBER:

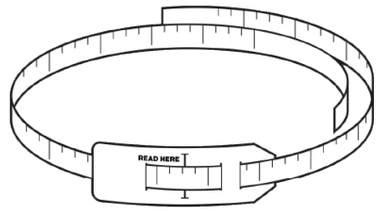
- Use the correct MUAC tape for the age group of the person being measured.
- Carefully identify the midpoint of the upper arm.
- Pull the tape flat against the skin, not too tight or loose.
- Read and record measurements carefully.

Measuring Head Circumference

(Adapted from CDC 2016; University of Oxford 2012; de Onis et al. 2004.)

This section provides guidance on measuring head circumference in children under 5 years of age. Head circumference is measured using a head circumference tape. More information on head circumference tapes can be found in the **Equipment** section.

EQUIPMENT

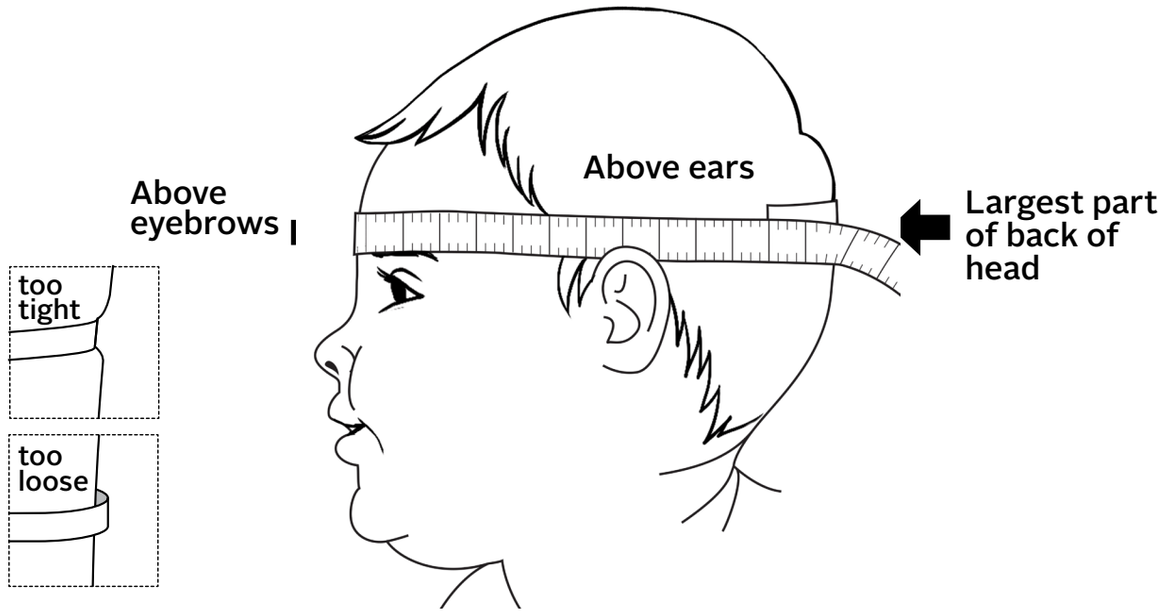


Preparing to Measure Head Circumference

1. Show the head circumference tape to the parent/caregiver and the child. Explain that the child will be measured using the tape. Inform the parent/caregiver that her/his help may be needed.
2. Ask the parent/caregiver to remove any hats, hairpins, bands, or other ornamental head coverings on the child.
3. If the child can sit quietly on a chair or stool, ask the parent/caregiver to kneel by the child so the child will be still and secure. Otherwise, ask the parent/caregiver to sit on a chair or stool and place the child on her/his lap.

FOR ACCURATE MEASUREMENT, REMEMBER:

- Position the tape around the largest part of the head.
- Pull the tape flat against the head, not too tight or loose.
- Read, record, and plot measurements carefully.



PROCEDURE FOR MEASURING HEAD CIRCUMFERENCE

1. Sit next to the child (or his/her parent/caregiver, if the child is being held). Since some children (especially older children) find this measurement uncomfortable, the parent/caregiver should hold the child or kneel next to him/her to help keep the child still and secure.
2. Adjust the head circumference tape so it is easy to place around the child's head and to read correctly when taking the measurement.
3. Place the tape around the child's head so that the tape lies across the frontal bones of the skull, slightly above the eyebrows and over the fullest protuberance of the skull at the back of the head.
4. Move the tape up and down over the back of the head to locate the maximum circumference, then tighten the tape to gently compress the hair and underlying skin, making sure that the measuring tape is snug but not tight enough to compress the skin.
5. Read aloud the head circumference measurement to the nearest 0.1 cm (1 mm).
6. The trained assistant should record the child's head circumference to the nearest 0.1 cm (1 mm) clearly and accurately on the health card, questionnaire, or other relevant document. If no trained assistant is available, record the head circumference yourself.
7. Check the recorded head circumference for accuracy and legibility.

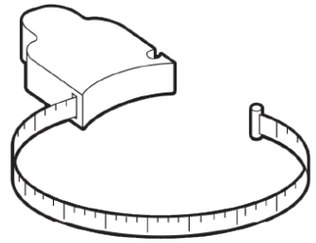
Measuring Waist Circumference

This section provides guidance on measuring waist circumference in adults. Waist circumference is measured using a measuring tape. More information on waist circumference tape can be found in the **Equipment** section.

Several methods may be used to measure waist, or abdominal, circumference. The procedure described in this section is the method agreed upon in a 2008 WHO expert consultation (WHO 2008b; WHO 2008c).

Note: This measurement is not used for pregnant and postpartum women and girls.

EQUIPMENT



Preparing to Measure Waist Circumference

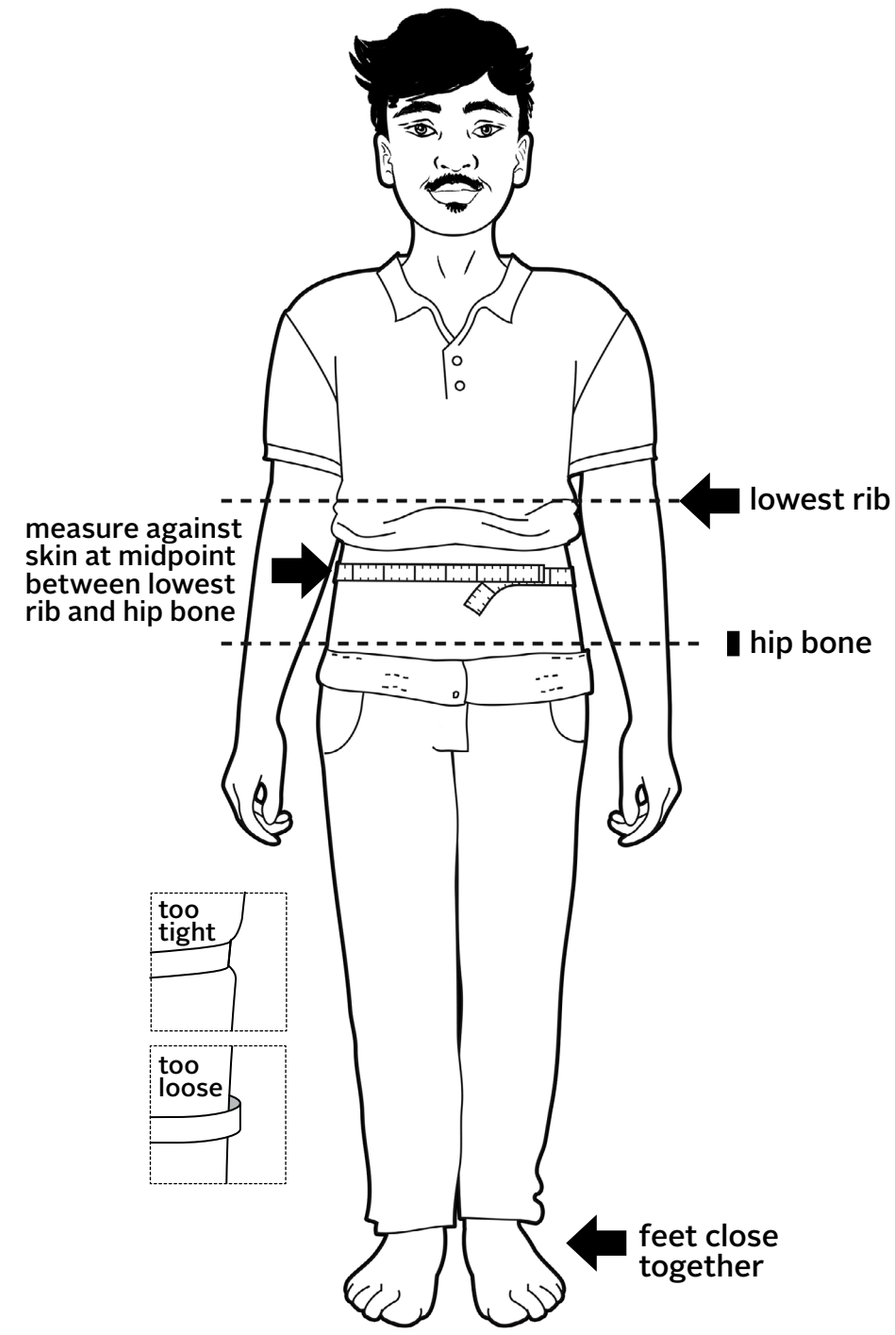
1. Waist circumference tapes come in different sizes; make sure the tape you are using is long enough for the target group you are about to measure.
2. Show the waist circumference tape to the person being measured. Explain that you will use it to measure his/her waist and that you will make some markings on her/his body to ensure that the tape is in the correct position to get an accurate measurement.
3. Explain that you must place the tape directly against the skin and ask the person to adjust her/his clothing (e.g., slightly lower her/his pants and underclothing and slightly lift up his/her shirt) so that the waist is showing.

FOR ACCURATE MEASUREMENT, REMEMBER:

- Measure the midpoint between lowest rib and the top of the hip bone.
- Ensure the tape lies flat and is not too loose or tight.
- Measure against the skin, not over clothing.
- Read and record measurements carefully.

Procedure for Measuring Waist Circumference in Adults

1. Stand to the side of the person being measured and locate his/her lowest rib and the top of her/his hip bone. You may ask the person to help you find these points on her/his body.
2. Ask the person to wrap the waist circumference tape around him/herself and to position the tape at the midpoint between her/his lowest rib and the top of her/his hip bone (i.e., the waist), making sure that the tape is in the same spot on the opposite side. Note: Check that the tape is horizontal across the back and front of the person and as parallel as possible to the floor.
3. Ask the person to:
   - Stand erect, with her/his feet positioned close together and his/her weight evenly distributed on both feet.
   - Relax her/his arms at the sides.
   - Breathe out gently and relax while being measured.
4. Make sure the measuring tape is snug but not tight enough to compress the skin. Measure the person's waist circumference and bend down to the level of the tape so that you can read aloud the measurement to the nearest 0.1 cm (1 mm).
5. The trained assistant should record the person's waist circumference to the nearest 0.1 cm (1 mm) clearly and accurately on the health card, questionnaire, or other relevant document. If a trained assistant is not available, record the measurement yourself.
6. Check the recorded waist circumference for accuracy and legibility.



Measuring Calf Circumference

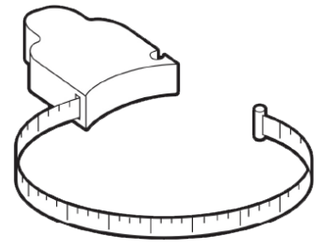
(Adapted from WHO 1995.)

This section provides guidance on measuring calf circumference. Calf circumference is measured around the widest part of the calf using a measuring tape. More information on calf circumference tape can be found in the **Equipment** section.

Preparing to Measure Calf Circumference

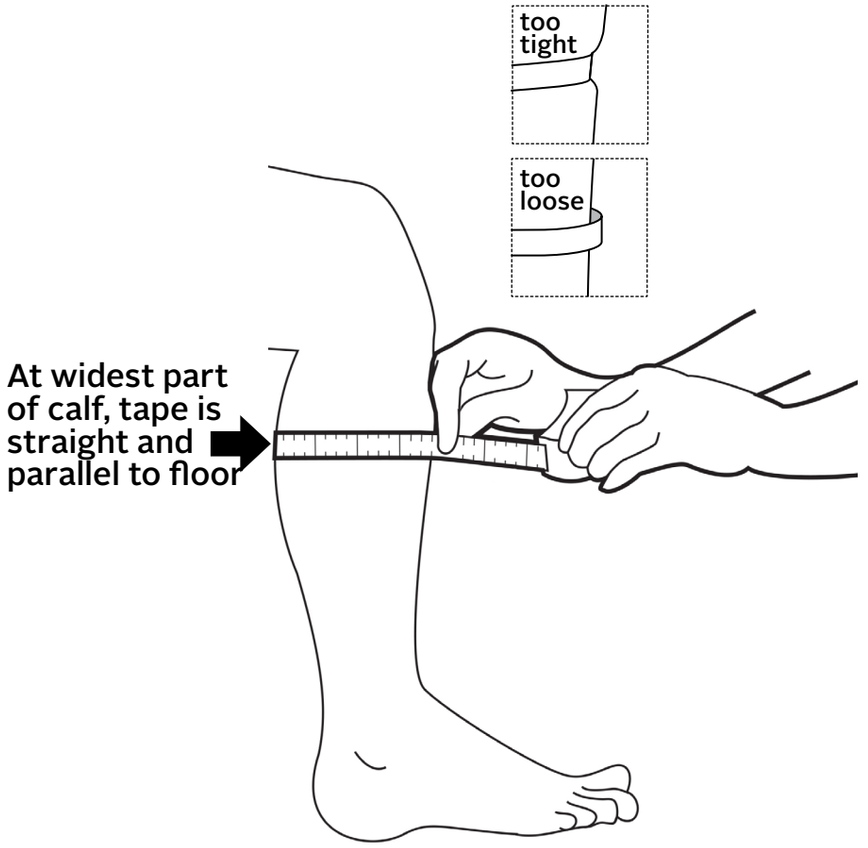
1. Make sure the calf circumference tape is long enough for the person you are about to measure.
2. Show the calf circumference tape to the person being measured and explain that you will use it to measure his/her calf.
3. If the person is wearing pants, ask him/her to roll up the pants leg to uncover the calf.

EQUIPMENT



Procedure for Measuring Calf Circumference

1. Ask the person to either sit with the left leg hanging loosely or stand with his/her weight evenly distributed on both feet.
2. Wrap the tape around the calf at the widest part, making sure the tape is straight. Make sure the measuring tape is snug but not tight enough to compress the skin.
3. Take additional measurements above and below the point measured to ensure that the first measurement was the largest. Read aloud the largest measurement to the nearest 0.1 cm (1 mm).
4. The trained assistant should record the person's calf circumference to the nearest 0.1 cm (1 mm) clearly and accurately on the health card, questionnaire, or other relevant document. If a trained assistant is not available, record the calf circumference yourself.
5. Check the recorded calf circumference for accuracy and legibility.



FOR ACCURATE MEASUREMENT, REMEMBER:

- The leg should dangle loosely and not be flexed.
- Measure the widest part of the calf, directly against the skin.
- Ensure the tape lies flat and is not too loose or tight.
- Read and record measurements carefully.

Procedure for Measuring Calf Circumference for Adults who are Bedridden

1. Ask the person being measured to lie on his/her back with the left knee bent at a 90° angle. An assistant can help, if needed.
2. Wrap the calf circumference tape around the widest part of the calf; slide the tape up and down to be sure you have the largest part of the calf.
3. Pull the tape so it is snug but not so tight that the skin is compressed. Make sure the tape is at a right angle to the length of the calf.
4. The trained assistant should record the person's calf circumference to the nearest 0.1 cm (1 mm) clearly and accurately on the health card, questionnaire, or other relevant document. If a trained assistant is not available, record the calf circumference yourself.
5. Check the recorded calf circumference for accuracy and legibility.

Assessing Bilateral Pitting Edema

(Adapted from GNC 2011 [Module 6: Measuring Malnutrition: Individual Assessment]; WHO 2008a; World Vision International 2011.)

This section provides guidance on assessing for bilateral pitting edema for all demographic groups included in this guide.

Preparing to Assess for Bilateral Pitting Edema

1. Explain to the person or parent/caregiver that you are about to check for bilateral pitting edema. If checking a child, inform the parent/caregiver that her/his help may be needed.

2. Ask the person being measured or the parent/caregiver (if a child is to be measured) to remove any footwear or socks and have the person being measured sit on a chair or stool (or in the case of a small child in the arms of the parent/caregiver). Sitting down will ensure that the person maintains balance when her/his feet are being held.

TIP

If assessing a child who can sit alone, ask the parent/caregiver to kneel by the child to help keep the child still and secure.

Procedure for Assessing for Bilateral Pitting Edema

1. Grasp the person's feet so that they rest in your hands, with one thumb on top of each foot.
2. Press your thumbs gently on both feet at the same time for at least 3 seconds. Count slowly, "one thousand one, one thousand two, and one thousand three" to reach 3 seconds. The person has bilateral pitting edema if pits (dents) remain in both feet when you lift your thumbs.
3. Record the results: absent, edema + (feet/ankles), edema ++ (feet/ankles, lower legs, lower arms, hands), edema +++ (generalized: feet/ankles, legs, arms, face).

Note: If a person has bilateral pitting edema, refer him/her to the health center for diagnosis and treatment, as this is a sign of severe acute malnutrition and may also indicate other medical problems. Pregnant and lactating women and girls may also have edema that is not related to nutrition.

Hold thumbs for three seconds

Pitting in both feet remains

FOR ACCURATE MEASUREMENT, REMEMBER:

- Use thumbs to assess for bilateral pitting edema.
- Press thumbs into feet for at least 3 seconds.
- Record results carefully.

Anthropometric Equipment

What Does this Section Cover?

This section provides information on the equipment needed to conduct the anthropometric measurements in this guide, standards to help users select appropriate equipment for each measurement, and information on where equipment can be purchased. This section does not provide instructions on how to use specific equipment models; users should review the equipment's instruction manual and be trained in the proper use and care of the equipment to ensure accurate measurement. **Table 6.2** summarizes the common types of anthropometric equipment included in this guide. It is organized according to age group and measurement.

PURCHASING ANTHROPOMETRIC EQUIPMENT

Several vendors sell anthropometric equipment. This guide does not endorse any one vendor. For convenience, two websites that sell a wide range of equipment are listed below.

UNICEF Supply Catalogue

Weigh and Measure, LLC

Table 6.2 Anthropometric Equipment Covered in this Guide

	Weighing Scales					Tools to Measure Length or Height		Circumference Tapes for Additional Measurements		
	Electronic		Mechanical							
	Infant electronic scale	Standing electronic scale	Hanging scale	Infant beam scale	Standing beam scale	Length/ height board	Knee caliper	MUAC tape	Head circumference tape	Waist/calf circumference tape
Children under 5 years of age	X*	X**	X	X*	X**	X		X (6–59 months of age)	X	
Children and adolescents 5+ years of age		X			X	X		X		
Pregnant/postpartum women and girls		X			X	X		X		
Adults (18+ years of age)		X			X	X	X	X		X

* The term "infant" usually refers to children under 1 year of age. However, infant scales can be used for any child who weighs less than its maximum capacity, regardless of age.

** Infants and children who cannot stand must be held by an adult.

Equipment for Measuring Weight

Selecting an appropriate scale is an important part of collecting accurate measurements. Both electronic scales, which require electrical power (including batteries) or solar power, and mechanical scales can be used.

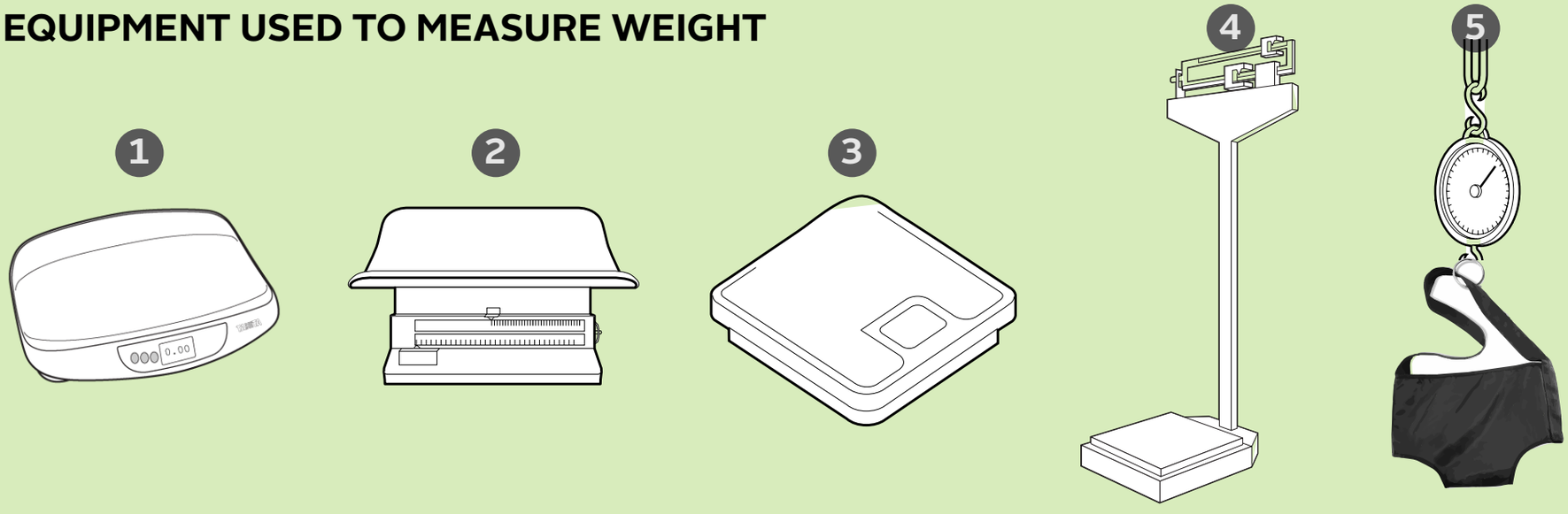
Considerations for choosing a scale:

- What age group do you need to weigh? Adults? Children? Both?
- Does the scale need to be portable?
- How durable is the scale? Can it withstand multiple daily uses and/or traveling to multiple sites?
- Is electricity available at the weighing site?

TIP

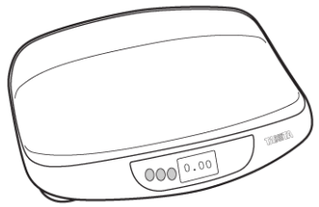
Some scales are intended for infants or young children only while others can weigh people of all ages.

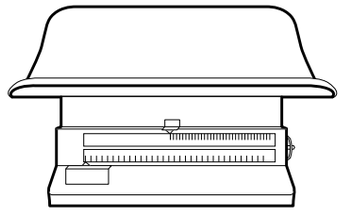
EQUIPMENT USED TO MEASURE WEIGHT



1. Infant electronic scale 2. Infant beam scale 3. Electronic scale 4. Beam scale 5. Hanging scale with pants

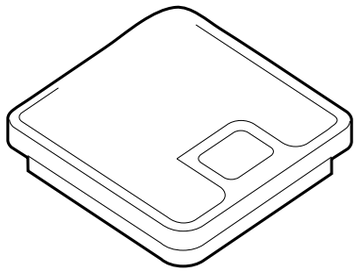
Comparison of Scales for Infants and Children

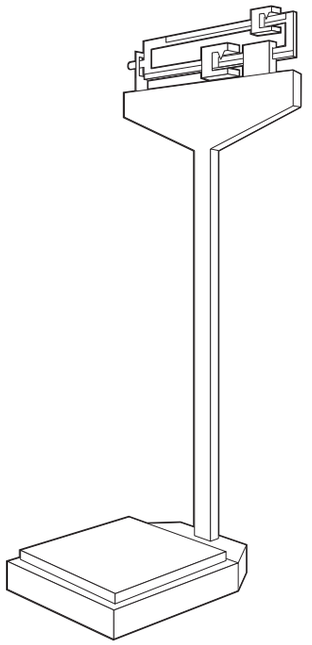




	INFANT ELECTRONIC SCALE	INFANT BEAM SCALE	HANGING SCALE
Age group(s)	Infants only	Infants only	Infants/children under age 5 years
Portable	Yes, depends on model	No	Yes
Features	• Durable, easy to read, and easy to maintain and clean • Some models can also measure an infant's length	• Durable, easy to read, and easy to maintain and clean • Some models can also measure an infant's length	• Can be hung from a post, beam, or tree; a sling or weighing pants are used to weigh the child • Lightweight (often less than 1 kg), easy to carry • Requires little maintenance • Available in developing countries
Other considerations		Heavy and hard to carry	• Harder to clean/keep hygienic than other scales • Less reliable than other infant scales, especially when weighing an agitated child • May be harder to use for heavier/older children • Requires a sling for infants under 3 months of age to support their necks/heads
Range	Typically can weigh children up to 10 kg, but some models can weigh infants up to 20 kg or more	Typically can weigh children up to 10 kg, but some models can weigh infants up to 16 kg or more	Can weigh children up to 25 kg
Precision	Precise to at least 10 g (some infant scales offer precision up to 5 g for infants weighing less than 7.5 kg)	Precise to 10 g (.01 kg)	Precise to 100 g (0.1 kg)
Power	Solar or electrical power (including batteries) depending on model	No power needed	No power needed
Cost	Approximately US$75–300	Approximately US$86–350	• US$6–15 for scale • Sling and/or pants sold separately: Pants are approximately US$12 per set of five; sling is approximately US$2.50

Comparison of Scales for All Age Groups



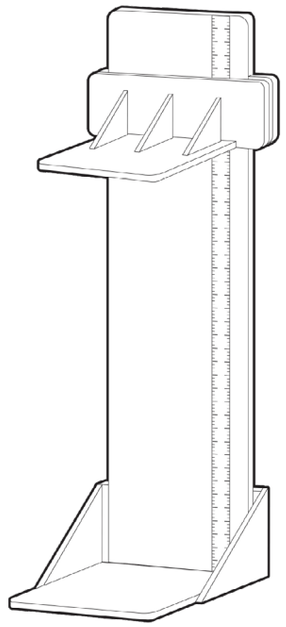


	STANDING ELECTRONIC SCALE	STANDING BEAM SCALE
Age group(s)	All age groups (infants/children who cannot stand must be held by an adult)	All age groups (infants/children who cannot stand must be held by an adult)
Portable	Yes	No
Features	• Durable, easy to read, and easy to maintain and clean • Some models include a taring option, which calculates the weight of a child being held in an adult's arms; this reduces risk of human error in calculating a child's weight by hand	• Durable, easy to read, and easy to maintain and clean • Some models can also measure height
Other considerations	These are professional scales; household or "bathroom" scales are not recommended because they do not have the precision required for high quality anthropometric measurement	• Heavy and hard to move • Weighing an infant in an adult's arms using a beam scale will require calculating the child's weight by hand
Range	Varies; typically can weigh individuals 0–150 kg	Varies; typically can weigh individuals 5–180 kg
Precision	Precise to 100 g (0.1 kg)	Precise to 100 g (0.1 kg)
Power	Solar or electrical power (including batteries), depending on model	No power needed
Cost	Approximately US$45–130	Approximately US$145–165

Equipment for Measuring Height

Length/Height Boards

Length/height boards are used to measure the length/height of individuals. Smaller boards are used only for infants and children; however, most children can also be measured using an adult height board. Some models can be used for length and height, measuring children lying down or standing.

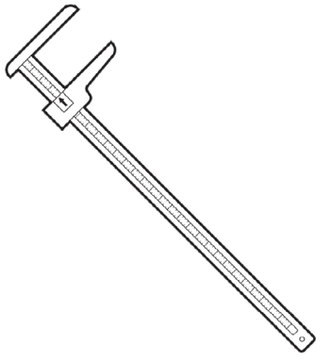


Considerations for choosing a length/height board:

- What age group are you measuring? Children under 2 years of age? Children 2 years of age and over? Adults?
- Does the board need to be portable?
- How frequently will it be used? Does it need to withstand multiple daily uses?

Calipers for Knee Height

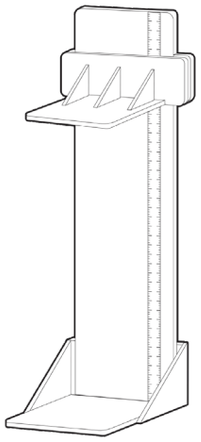
Calipers are used for measuring knee height, a proxy for height, for adults whose height cannot be measured directly.

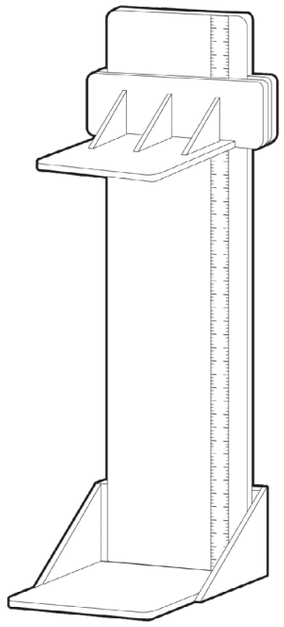


Considerations for choosing knee height calipers:

- Calipers should be able to measure up to at least 80 cm with a precision of 0.1 cm (1 mm)
- Cost: Approximately US$350.

Comparison of Length/Height Boards





	INFANT/CHILD LENGTH/HEIGHT BOARD	INFANT/CHILD/ADULT LENGTH/HEIGHT BOARD
Age group(s)	Infants and children	Infants, children, adults
Portable	• Yes (is disassembled for portability) • Carrying case optional	• Yes (is disassembled for portability) • Carrying case optional
Features	Converts from recumbent length (children under 2 years of age) to standing height (children 2 years of age and over)	Converts from recumbent length (children under 2 years of age) to standing height (children 2 years of age and over and adults)
Materials	Made of wood or plastic (metal can get hot and burn a person's skin)	Made of wood or plastic (metal can get hot and burn a person's skin)
Other considerations	• Easy to set up • Resistant to effects of excessive humidity and high temperature • Waterproof and shock-resistant • Make sure material has a smooth finish for safe use and easy cleaning	• Bigger and heavier than the infant/child board • Easy to set up • Resistant to effects of excessive humidity and high temperature • Waterproof and shock-resistant • Make sure material has a smooth finish for safe use and easy cleaning
Range	Up to 130 cm	Up to 210 cm
Precision	Precise to 0.1 cm	Precise to 0.1 cm
Cost	Approximately US$115–350	Approximately US$129–450; can be made locally for as little as US$20

Circumference Tapes

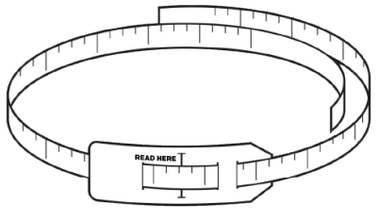
Circumference tapes are used to measure MUAC, head circumference, and waist circumference.

Considerations for choosing circumference tapes:

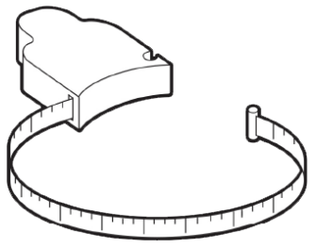
- What measurement do you need to take? Do you need a tape that can be used for different measurements (e.g., both calf and head circumference)?
- What age group are you measuring? Children under 5 years of age? Adults?
- How frequently will the tape be used? Does it need to withstand multiple daily uses?

CIRCUMFERENCE TAPES

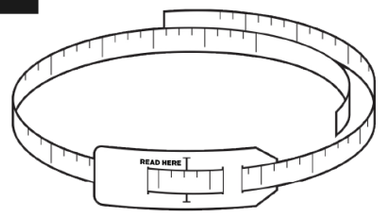
1. MUAC tape (colored)

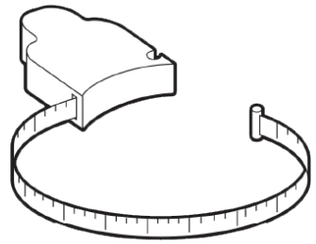


2. Head circumference tape



3. Waist/calf circumference tape





	MUAC TAPE	HEAD CIRCUMFERENCE TAPE	WAIST/CALF CIRCUMFERENCE TAPE
Age group(s)	Individuals 6 months of age and older (there are tapes for specific age and demographic groups)	Children under 5 years of age	Typically only used for adults 18+ years of age
Portable	Yes	Yes	Yes
Features	• Should be made from stretch-resistant plastic, plasticized paper, or synthetic paper that is at least 0.3 mm thick • Should be flexible, unstretchable, untearable, weather-resistant, and easy to read in low light • Should be both colored (red, yellow, and green) and numbered for ease of use • Some tapes can also be used to measure head and calf circumference if it is clearly stated on the tape that it is intended for multiple purposes	• Should be made from stretch-resistant plastic, plasticized paper, or synthetic paper that is at least 0.3 mm thick • Should be flexible, unstretchable, untearable, weather-resistant, and easy to read in low light • Some tapes can be used to measure child and adult head circumference and limb circumference, and adult MUAC	• Should be made from stretch-resistant plastic, plasticized paper, or synthetic paper that is at least 0.3 mm thick • Should be flexible, unstretchable, untearable, weather-resistant, and easy to read in low light • Some tapes can be used to measure MUAC as well
Other considerations	Does not need any special maintenance (replace tapes when the numbers become hard to read)	Does not need any special maintenance (replace tapes when the numbers become hard to read)	Does not need any special maintenance (replace tapes when the numbers become hard to read)
Range	• Should be able to measure up to at least 26 cm (260 mm) for children and 50 cm (500 mm) for adults • Tapes marked with cutoffs for specific target audiences—including children under 5 years of age, adolescents, pregnant women, and non-pregnant adults—are available; some tapes are only for children under 5 years of age	Should be able to measure up to at least 60 cm	Should be able to measure up to at least 150 cm for waist circumference and 65 cm for calf circumference
Precision	Precise to 0.1 cm (1 mm)	Precise to 0.1 cm (1 mm)	Precise to 0.1 cm (1 mm)
Power	No power needed	No power needed	No power needed
Cost	Approximately US$3–10 for a pack of 50	Approximately US$40 for a pack of 25 (prices may vary according to volume purchased)	Approximately US$50

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ANNEXES

Annex 1. Growth Charts: Plotting Measurements and Interpreting Growth Patterns

Annex 2. How Is a Z-Score Calculated?

Annex 1. Growth Charts: Plotting Measurements and Interpreting Growth Patterns

(Adapted from WHO 2008 and Cogill 2003)

To fully understand whether a child is growing at a healthy pace, his/her growth must be examined over time. To do this, health workers will typically plot a child's measurements (length/height-for-age, weight-for-age, weight-for-length/height, and BMI-for-age) across multiple visits, using growth charts to track the child's growth. The growth chart has z-score lines that serve as a reference of where the child's individual measurements fall (e.g., above or below -2 z-score), presenting a clear visual display of nutritional status in that moment and how a child is growing over time in comparison to expectations. This can help identify problems such as poor growth, undernutrition, risk of undernutrition, or overweight/risk of overweight.

Plotting growth is a key part of growth monitoring and promotion programs that typically target children under 5 years of age, using growth charts that are usually based on the WHO Child Growth Standards. It is also possible—and useful—to plot the growth of children and adolescents 5–19 years of age; charts based on the WHO Growth Reference are available for that age group. This annex provides guidance on how to accurately plot children's measurements on a growth chart and interpret growth patterns.

How to Plot and Interpret Measurements

When interpreting plotted growth, remember that children's growth should track with the median and normal z-score lines on the growth charts. Whenever a child's growth line crosses a z-score line (i.e., if the child's curve increases or decreases at a more rapid pace or a much slower pace than the median), the health worker should look at the trends of the child's other growth indices, interpret the trends as a whole, and ask about recent or chronic illnesses, food shortages, or other possible causes that may impact a child's growth. Growth patterns that may cause concern include:

Sharp Declines in Growth Pattern

A sharp decline in weight is always of concern, even among overweight children. Normal and undernourished children who are gaining height should consistently gain weight; those who lose weight are at risk of becoming moderately or severely malnourished. Overweight children should not lose weight rapidly. Rather, they should maintain a steady weight while continuing to grow taller, "growing into their weight." A sharp decline in height indicates a measurement error as children are unlikely to lose height.

Sharp Inclines in Growth Pattern

Sharp inclines in weight must be carefully investigated. If a child has gained weight rapidly, the health care provider should look also at changes in height. If the child grew in weight and height proportionately, this is probably catch-up growth from previous illness or undernutrition or a growth spurt. In such a situation, the weight-for-age and height-for-age charts will show steeper-than-expected inclines, while the weight-for-height growth line tracks steadily along the z-score curves. However, if the child gained weight without gaining height, this may be a cause for concern.

Flat Growth Pattern

A flat (stagnant) growth line indicates that a child is not gaining height or weight (depending on the measurement being charted). This may indicate undernutrition and should be explored. Flat growth is of less concern when an overweight or obese child maintains the same weight over time while growing in height, which would bring the child closer to a healthy weight-for-height. This can be verified by consulting both the weight-for-height and height-for-age growth curves.

When weight and height are both stagnant, the child's overall growth and development may have been compromised by undernutrition and/or illness. For children in age groups that grow rapidly (i.e., with steep growth curves), such as during the first 6 months of life, even one month of flat growth is cause for concern because it is hard to recover that lost growth.

The following examples show how to plot and interpret measurements on growth charts for length/height-for-age, weight-for-age, weight-for-length/height, and body mass index (BMI)-for-age. For plotting growth, be sure to select the appropriate growth chart(s) based on the child's sex, age, and the measurements to be taken.

Each chart has a line showing the median value, which is equal to a z-score of 0 (green), and +2 and -2 (red), and +3 and -3 (black). The weight-for-length/height, BMI-for-age, and head circumference-for-age charts also include orange lines for z-scores of +1 and -1.

Length/Height-for-Age

In the charts for length/height-for-age, the x-axis shows age and the y-axis shows length or height in centimeters. Age is plotted in completed weeks from birth until age 3 months, in completed months from age 3 to 12 months, and then in completed years and months.

To plot length/height-for-age:

- Find the child's age in *completed* weeks, months, or years and months on the x-axis (e.g., a child 5.5 months of age would be 5 completed months). A vertical line will extend from the child's completed age.
- Find the child's length/height on the y-axis. The length/height will fall on a horizontal line or between horizontal lines.
- Find the point on the graph where the vertical line extending from the child's age would meet a horizontal line extended from the child's length/height. Make a small dot on the graph at that point. This is the plotted point showing the child's length/height-for-age.
- When points are plotted for two or more visits, connect the points with a straight line to better observe the trend.

BOX 1. USEFUL DEFINITIONS

Plotting refers to drawing a dot (point) on the chart indicating the value of the measurements taken. Plotting points requires understanding the following terms:

X-axis is the horizontal reference line at the bottom of the graph. In a growth chart, an x-axis may show age or length/height. Points are plotted on the vertical lines that extend from the x-axis, corresponding to completed age (in weeks, months, or years and months) or to length or height rounded to the nearest whole centimeter.

Y-axis is the vertical reference line at the far left of the graph. In a growth chart, the y-axis may show length/height, weight, or body mass index. Points are plotted as precisely as possible on or between horizontal lines that extend from the y-axis, corresponding to length/height, weight, or BMI.

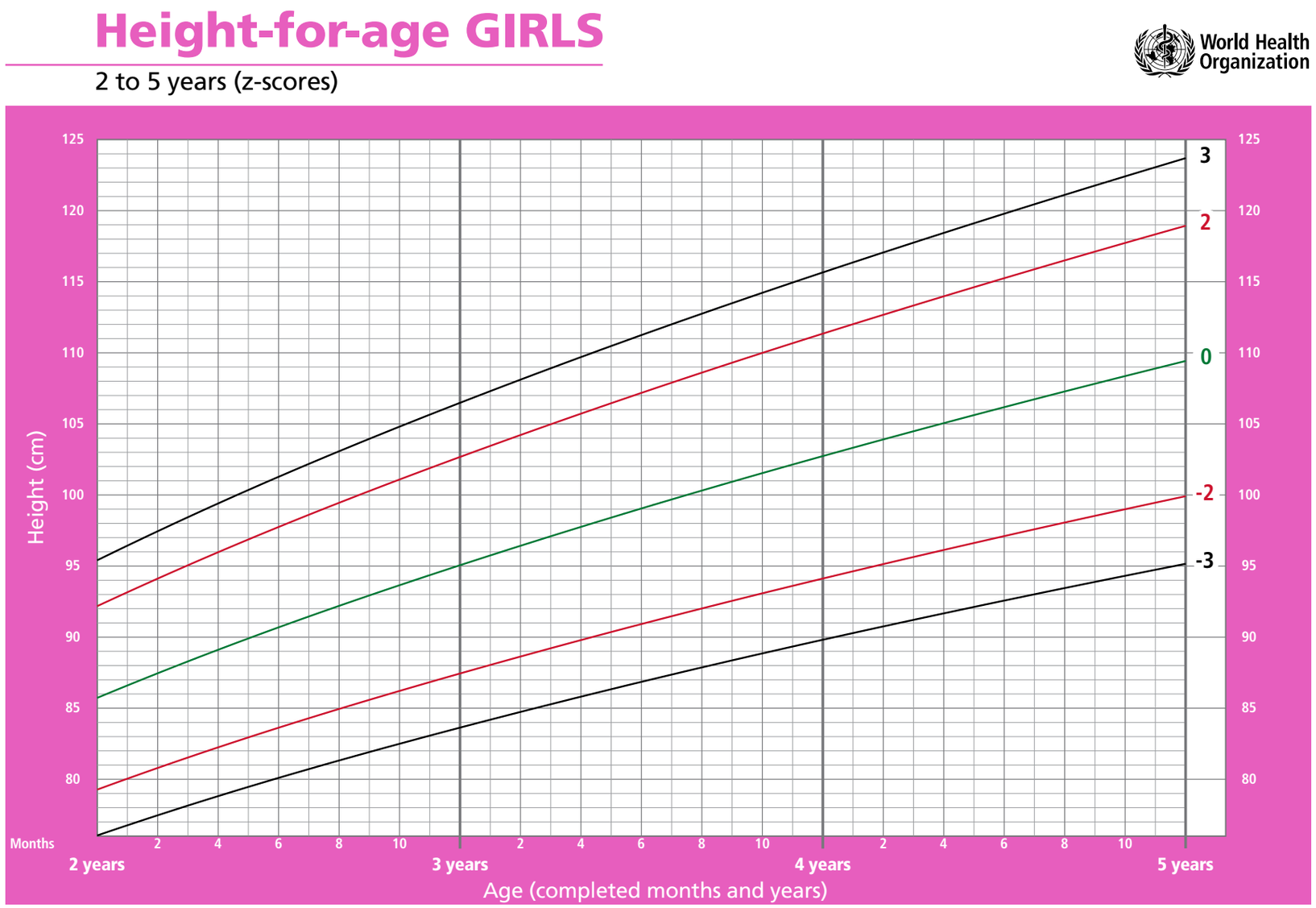
Plotted point is the point on a graph where a line extended from a measurement on the x-axis (e.g., age) intersects with a line extended from a measurement on the y-axis (e.g., weight).

Figure 1, on the next page, shows the correctly plotted points for a girl's height-for-age measurements over time. The horizontal lines extending from the y-axis represent 1 cm increments. At the first visit, the child was 2 years and 4 months of age and was 92 cm tall. This first point falls between 0 and +2 z-scores, a normal height for her age. At the second visit, the girl was 3 years and 3 months of age and 98 cm tall. At the third visit, she was 103 cm tall at 4 years and 2 months of age. Although her height-for-age falls within the normal range at the additional plotted points, her pace of growth has slowed and is no longer tracking with a normal z-score line. By her third measurement, she has crossed the median, moving from a positive to a negative z-score. This indicates a risk of undernutrition if her growth continues to falter.

Table 1. Length/Height-for-Age Z-Score Cutoffs (Birth to 19 Years)

Nutritional status	**Z-score range**
Normal	≥ -2 to ≤ +3
Moderately stunted	≥ -3 to < -2
Severely stunted	< -3

Figure 1. Example of Plotting Height-for-Age



Source: WHO. 2008. *Training Course on Child Growth Assessment. Interpreting Growth Indicators.* Geneva: WHO.

Weight-for-Age

In the charts for weight-for-age, the x-axis shows age and the y-axis shows weight in kilograms. Age is plotted in completed weeks from birth until age 3 months, in completed months from age 3 to 12 months, and then in completed years and months.

To plot weight-for-age:

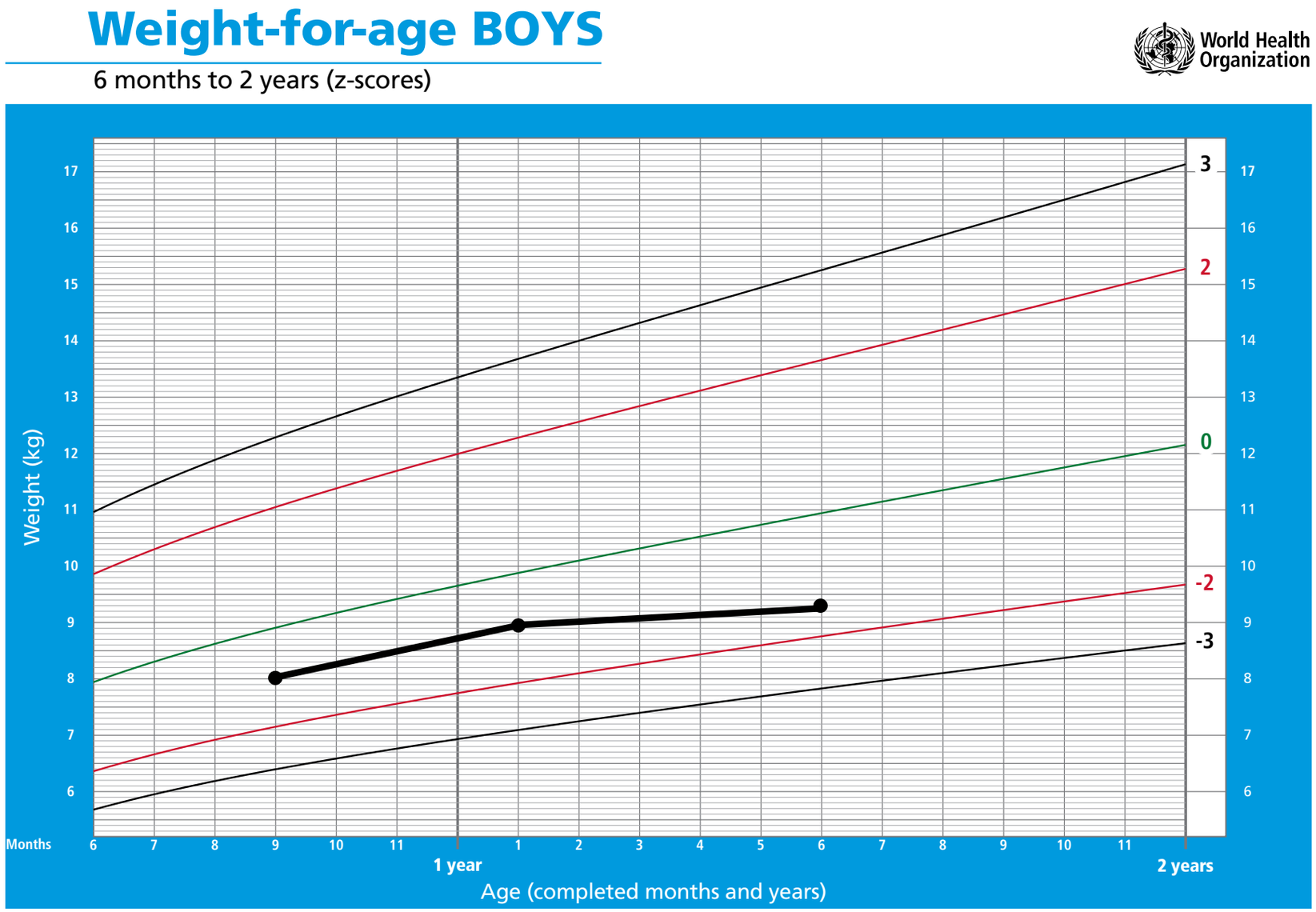
- Find the child's age in *completed* weeks, months, or years and months on the x-axis (e.g., a child 5.5 months of age would be 5 completed months). A vertical line will extend from the child's completed age.
- Find the child's weight on the y-axis. The exact weight may fall on a horizontal line or between horizontal lines. Find the point on the graph where the vertical line extended from the child's age on the x-axis would meet a straight line extended from the child's weight on the y-axis. Make a dot on the graph where the two lines meet. That dot is a plotted point.
- When points are plotted for two or more visits, connect the points with a straight line to better observe the trend.

Figure 2, on the next page, shows correctly plotted points for a boy's weight-for-age at three visits. The horizontal lines extending from the y-axis represent 0.1 kg increments. At the first visit, he was 9 months of age and weighed 8 kg. His z-score is in the normal range. At the second visit, the child was 1 year and 1 month of age and weighed 8.8 kg and his measurement tracks on the same z-score line, indicating normal growth. At the third visit, the child was 1 year and 6 months of age and weighed just over 9.2 kg. His growth has slowed. Although his z-score is not yet below -2, this trend is of concern. It will be helpful to investigate potential causes of this slowed growth during counseling sessions with the mother/caregiver and provide support and guidance as needed.

Table 2. Weight-for-Age Z-Score Cutoffs (Birth to 10 Years)

Nutritional status	Z-score range
Normal	≥ -2 to ≤ +1
Moderately underweight	≥ -3 to < -2
Severely underweight	< -3

Figure 2. Example of Plotting Weight-for-Age



Source: WHO. 2008. *Training Course on Child Growth Assessment. Interpreting Growth Indicators.* Geneva: WHO.

Weight-for-Length/Height

In the charts for weight-for-length/height, the x-axis shows length/height in centimeters and the y-axis shows weight in kilograms in 0.5 kg increments.

To plot weight-for-length/height:

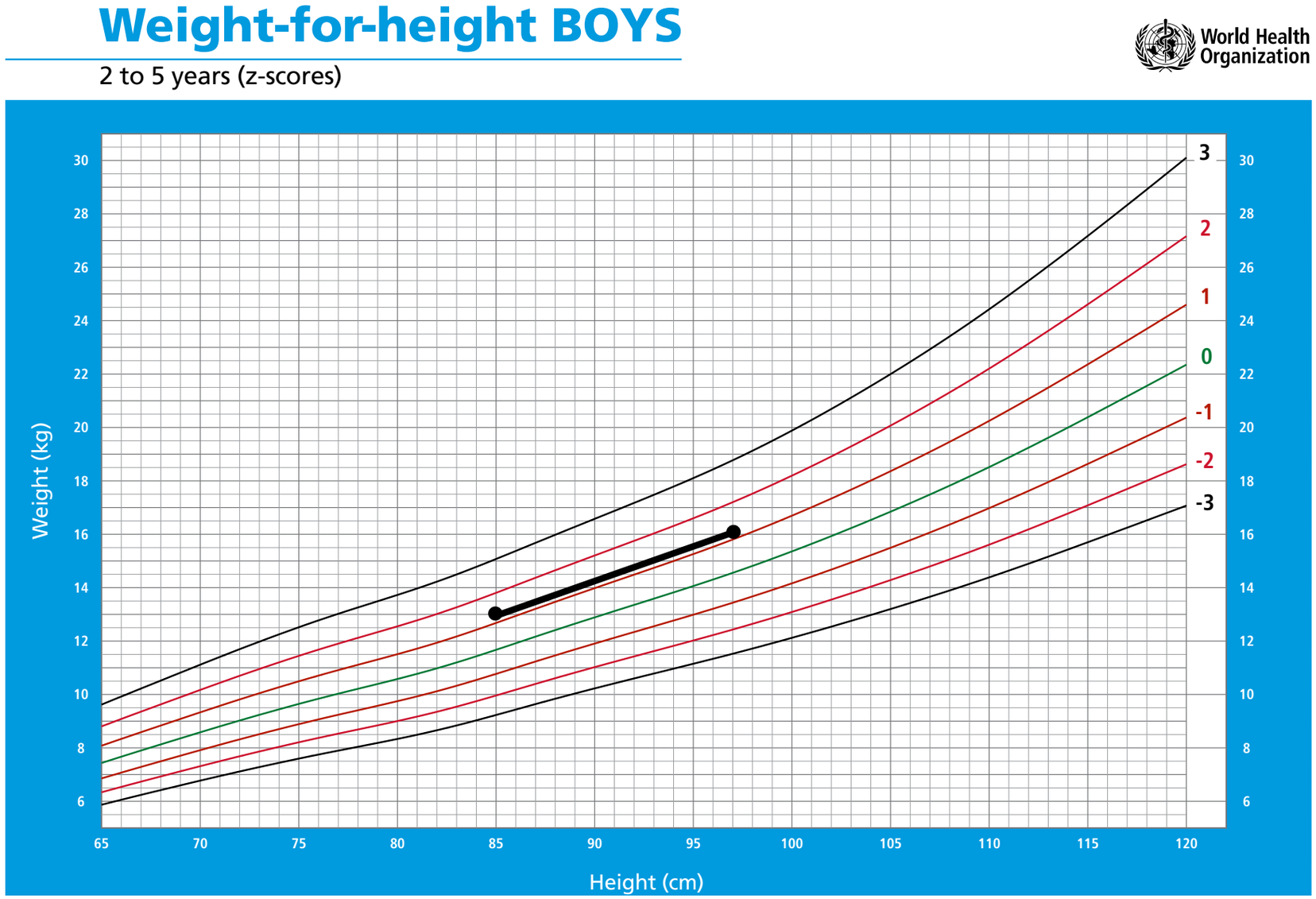
- Round the child's length/height to the nearest whole centimeter. Round down 0.1–0.4 and round up 0.5–0.9 (e.g., 78.7 cm would round to 79 cm).
- Find that length/height on the x-axis. A vertical line will extend from this point on the x-axis.
- Find the child's weight on the y-axis. This may fall on a horizontal line or between horizontal lines (e.g., 10.5 kg would be midway between 10 kg and 11 kg).
- Find the point on the graph where the vertical line extended from the child's height on the x-axis would meet a horizontal line extended from the child's weight on the y-axis. Make a dot on the graph where the two lines meet. That dot is a plotted point.
- When points are plotted for two or more visits, connect the points with a straight line to better observe the trend.

Figure 3, on the next page, shows correctly plotted points for a child's weight-for-height at two visits. At the first visit, the child was 85 cm tall and weighed 13 kg. His weight-for-height is just above +1 z-score line, which is classified as normal. At the second visit, the child was 97 cm tall and weighed 16 kg. He maintains healthy growth, which still tracks along the +1 z-score line.

Table 3. Weight-for-Length/Height Z-Score Cutoffs (Birth to 5 Years)

Nutritional status	Z-score range
Obese	> +3
Overweight	> +2 to ≤+3
Risk of overweight	> +1 to ≤ +2
Normal	≥ -2 to ≤ +1
Moderately wasted	≥ -3 to < -2
Severely wasted	< -3

Figure 3. Example of Plotting Weight-for-Height



Source: WHO. 2008. *Training Course on Child Growth Assessment. Interpreting Growth Indicators.* Geneva: WHO.

BMI-for-Age

In the charts for BMI-for-age, the x-axis shows age in completed months or years and months, and the y-axis shows BMI. Age is plotted in completed months from birth to 12 months and then in completed years and months.

To plot BMI-for-age:

- Find the child's age in *completed* months or years and months on the x-axis (e.g., a child 3.5 months of age would be 3 completed months). A vertical line will extend from the child's completed age.
- Find the child's BMI on the y-axis (e.g., 14, 14.2). This may fall on a horizontal line or between horizontal lines. If a calculator was used to determine BMI, it may be recorded and plotted to one decimal place.
- Find the point on the graph where the vertical line extended from the child's age on the x-axis would meet a horizontal line extended from the child's BMI on the y-axis. Make a dot on the graph where the two lines meet. The dot is a plotted point.
- When points are plotted for two or more visits, connect the points with a straight line to better observe the trend.

Figure 4, on the next page, shows correctly plotted points for a girl's BMI-for-age at two visits. The horizontal lines extending from the y-axis represent 0.2 BMI units. At the first visit, she was 7 months of age and had a BMI of 17. This BMI falls on the median and within the normal BMI-for-age range. At the second visit, the child was 1 year and 2 months of age and had a BMI of 18. She is not tracking along the median z-score line and now falls between +1 and +2 z-scores. She is at risk of overweight.

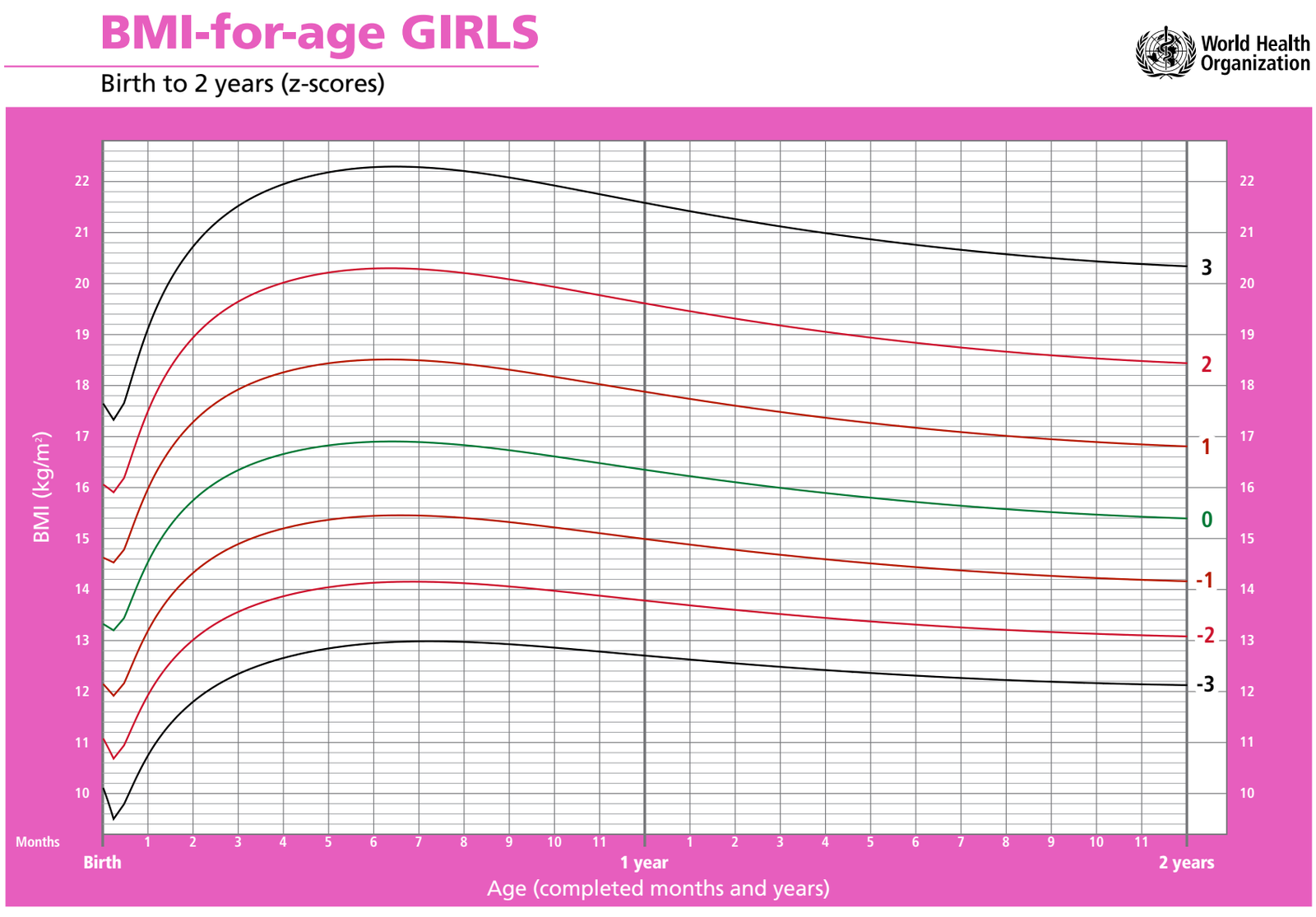
Table 4. BMI-for-Age Z-Score Cutoffs (Birth to 5 Years)

Nutritional status	**Z-score range**
Obese	> +3
Overweight	> +2 to ≤+3
Risk of overweight	> +1 to ≤ +2
Normal	≥ -2 to ≤ +1
Moderately wasted	≥ -3 to < -2
Severely wasted	< -3

Table 5. BMI-for-Age Z-Score Cutoffs (5 to 19 Years)

Nutritional status	**Z-score range**
Obese	> +2
Overweight	> +1 to ≤ +2
Normal	≥ -2 to ≤ +1
Moderately wasted	≥ -3 to < -2
Severely wasted	< -3

Figure 4. Example of Plotting BMI-for-Age



Source: WHO. 2008. *Training Course on Child Growth Assessment. Interpreting Growth Indicators.* Geneva: WHO.

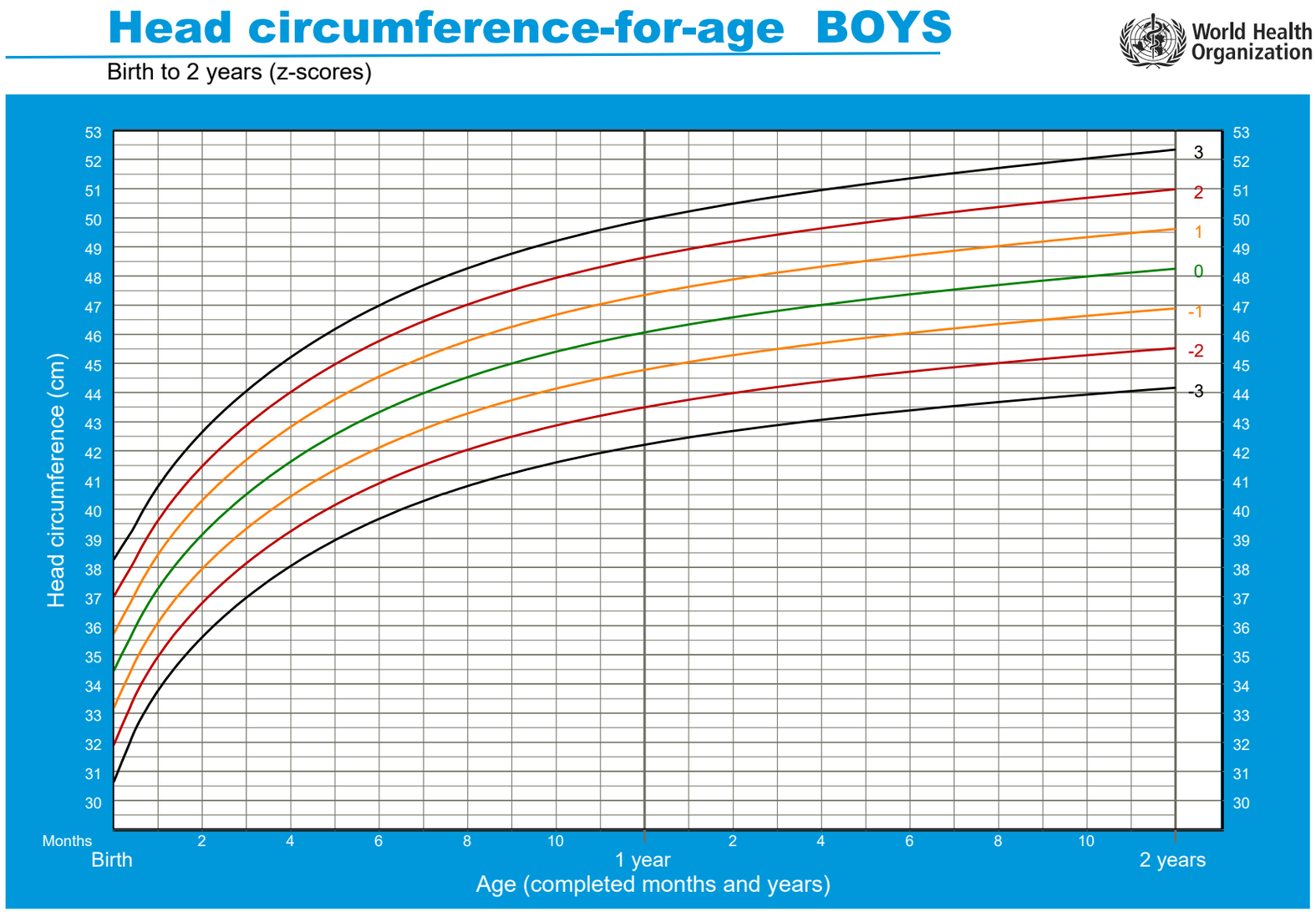
Head Circumference-for-Age

The chart on the next page tracks a boy's head circumference-for-age from 1 month to 1 year of age. Age is on the horizontal (x) axis and head circumference (cm) on the vertical (y) axis. At 1 month of age, this boy had a head circumference of 36.5 cm, within the normal range between -1 z-score and the median. At 6 months of age, his head circumference was 43 cm, still within the normal range and following a healthy trajectory. His healthy pace of growth continued to age 1 year, when his head circumference was 45.5 cm, and there are no concerns about his head circumference.

Table 6. Head Circumference-for-Age Z-Score Cutoffs (Birth to 5 Years)

Nutritional status	**Z-score range**
Large head circumference	> +2
Normal	≥ -2 to ≤ +2
Small head circumference	≥ -3 to < -2
Very small head circumference	< -3

Figure 5. Example of Plotting Head Circumference-for-Age



Source: WHO. 2008. *Training Course on Child Growth Assessment. Interpreting Growth Indicators.* Geneva: WHO.

Annex 2. How Is a Z-Score Calculated?

(Adapted from WHO 2008.)

Z-scores are calculated differently for measurements that are distributed normally and non-normally in the reference population. Z-scores can be easily calculated by software available on the WHO website. Hand calculation, which is described below, is possible but not recommended.

Measurements that Are Normally Distributed in the Reference Population

In a normally distributed population, such as the height measurement reference population in the WHO Child Growth Standards and the WHO Child Growth Reference, about 68 percent of the values fall within 1 standard deviation (z-score) of the median, about 95 percent within 2 z-scores, and more than 99 percent within 3 z-scores. As shown in the Figure 1, in this normal distribution, there is equal distance between the standard deviations.

The z-score for an individual measurement based on a normal distribution is calculated using this formula:

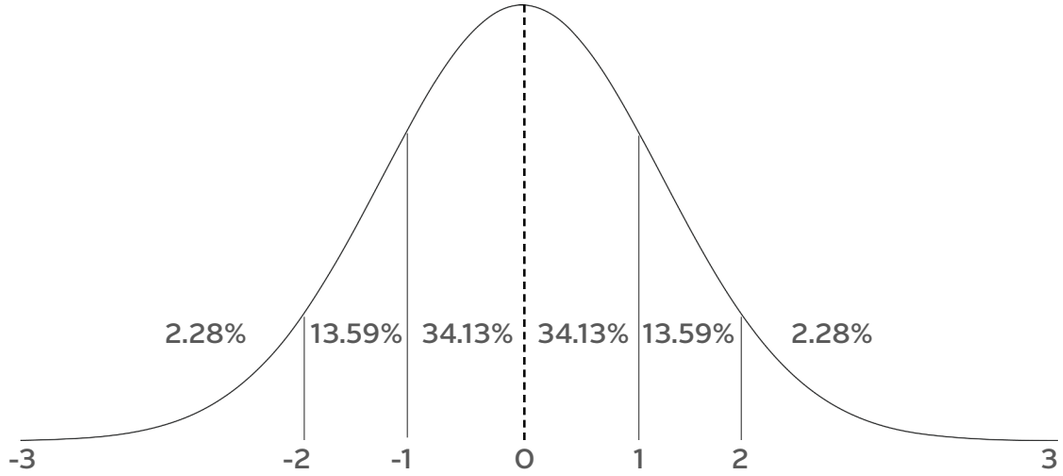
$$\text{Z-score} = \frac{\text{(observed measurement)} - \text{(median reference value)}}{\text{Standard deviation of reference population measurement}}$$

Observed measurement refers to the *actual measurement taken* of that individual.

Median reference value is the *median measurement of all individuals of that age and sex* (i.e., the height measurement that has a z-score of 0 for that age and sex on the WHO Child Growth Standards or WHO Growth Reference charts and tables).

"Standard deviation of a measurement in the reference population can be described as the average of differences in that measurement for each child from the median in the reference population. To find the standard deviation of a particular measurement, refer to the WHO Child Growth Standards tables (0-5 years) or WHO Growth References tables (5-19 years), which provide standard deviations based on age and sex.

Figure 1. Normally Distributed Population



EXAMPLE CALCULATION

A health worker measures the height of a boy named Sam. He is 2 years and 4 months of age. His height is 96.1 cm. The standard deviation of boys' heights at age 2 years and 4 months is 3.3.

To calculate Sam's **height-for-age z-score**:

Observed value = 96.1 cm.

Median reference value = 90.4 cm (the median height of all boys measured who are age 2 years and 4 months), which is taken from the WHO Child Growth Standards height-for-age tables for boys 2–5 years of age.

Standard deviation: 3.3, taken from the WHO Child Growth Standards height-for-age tables for boys 2–5 years of age.

Inserting the above numbers in the formula, Sam's height-for-age z-score is calculated as follows:

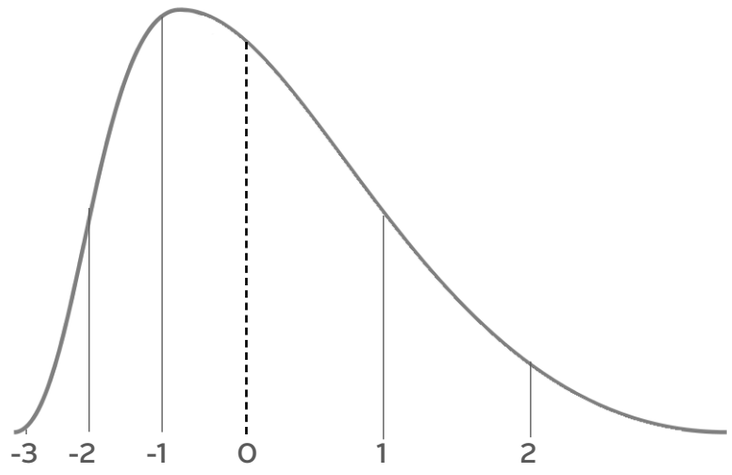
$$\frac{96.1 - 90.4}{3.3} = 1.73$$

Sam's **z-score for height-for-age** is **1.73**, or above 1, indicating that his height currently is normal.

Measurements that Are Non-Normally Distributed in the Reference Population

Not all measurements have a normal distribution. Some measurements, like weight, have a distribution that is "skewed," with one side (tail) longer than the other. In the WHO Child Growth Standards, the weight distribution is "right-skewed," meaning the right side is longer than the left (Figure 2). Although the percentages of individuals falling within each z-score are the same as those in the normal distribution (e.g., 34.13 percent between 0 and 1), the distance between the standard deviations varies and the differences between the standard deviations below the median are shorter than the differences between the standard deviations above the median. This makes it more complicated to calculate an individual's z-score. This applies to the weight-for-age, weight-for-length/height, and BMI-for-age z-scores.

Figure 2. Right-Skewed Distribution



To calculate the z-score for a non-normally distributed measurement, use the following formula:

$$\text{Z-score} = \frac{(\text{observed value} \div \text{M})^{\text{L}} - 1}{\text{L} \times \text{S}}$$

M is the reference median value

L is the power needed to transform the data in order to make it normal (remove the skewness)

S is the coefficient of variation

For the WHO Child Growth Standards, the L, M, and S values can be found in the z-score growth tables for each measure, age, and sex and in the WHO Child Growth Standards Methods and Development documents on the WHO website: http://www.who.int/childgrowth/standards/en/. For the WHO Growth Reference, the L, M, and S values are included in the z-score tables for each measure, age, and sex on the WHO website: http://www.who.int/growthref/en/.

EXAMPLE CALCULATION

Sam is 2 years and 4 months of age and weighs 11.9 kg. For boys age 2 years and 4 months, the M, L, and S values are as follows (note: this will vary according to age and sex):

Observed value = 11.9

M = 12.9303 (Median weight-for-age for boys age 2 years and 4 months.)

L = -0.0337 (power to normalize the data)

S = 0.11664 (coefficient of variation)

$$\frac{(11.9 \div 12.9303)^{-.03} - 1 = -0.63}{-0.0337 \times 0.11664}$$

Sam's weight-for-age z-score is -0.63, which is below the median but still within the normal range of weight-for-age.

References

Cogill, B. 2003. *Anthropometric Indicators Measurement Guide.* Washington, DC: FHI 360/FANTA.

WHO. 2008. *Training Course on Child Growth Assessment: WHO Child Growth Standards.* Geneva: WHO.