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.

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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

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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.

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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.

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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

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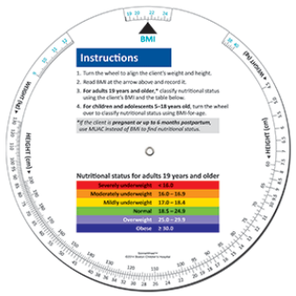
Tools to Assess, Classify, and/or Monitor Nutritional Status of Adults

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

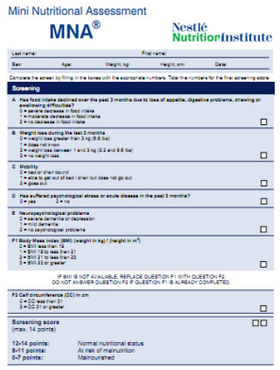
TOOL: **BMI Wheel**



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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