# Nutrition Assessment Module 7

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References: Lee RD, Nieman DC. Nutritional assessment. 6th ed. New York, NY: McGraw-Hill; 2013.

**Lecture Notes: Fundamental Anthropometry**

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## 1.1 What is Anthropometry?

Anthropometry[1] is the measurement of body size, weight, and proportions. In clinical practice, these measurements are used to:

- Evaluate nutritional status (detecting obesity or malnutrition).
- Monitor the effects of nutrition interventions or disease.
- Assess growth and development in children.

## 1.2 Core Measurements

- **Stature (Standing Height):** Measured using a stadiometer. The subject must stand barefoot with heels, buttocks, and shoulder blades touching the vertical rod.
- **Recumbent Length:** Used for infants (0–24 months) or patients who cannot stand. The subject is measured while lying face-up (supine).
- **Weight:** Best measured using a calibrated electronic scale. It is a gross measure of the body's fluid and tissue mass.

## 1.3 Practical Tools for Ideal Weight

### Understanding BMI

Body Mass Index, commonly known as BMI, is a simple tool used to estimate whether a person has a healthy body weight for their height. Doctors and health experts around the world use it to check for potential weight problems.

How is BMI calculated? It is a mathematical formula. You divide a person's weight in kilograms by the square of their height in meters. The formula is: **BMI = weight (kg) / height ($m^2$)**. For example, if you

[1] Anthropometry: The science of measuring body size and proportions.

weigh 70 kg and are 1.75 m tall, your BMI is about 22.9. For those using pounds and feet, there are online calculators that do the conversion automatically.

Once you have the number, it falls into one of four main categories:

- **Below 18.5** → Underweight
- **18.5 – 24.9** → Normal (healthy weight)
- **25.0 – 29.9** → Overweight
- **30.0 and above** → Obese

BMI is useful because it is cheap, fast, and non-invasive. You only need weight and height. It helps identify people who may have a higher risk of health problems like diabetes, high blood pressure, or heart disease.

However, BMI has limitations. It does not measure body fat directly. It also does not distinguish between muscle and fat. This means a very muscular athlete may have a high BMI but be very healthy. Similarly, an older person may have a normal BMI but low muscle mass. BMI also does not consider age, gender, or where fat is stored in the body.

In conclusion, BMI is a helpful starting point for checking your health, but it is not a perfect test. It is best to use BMI together with other measurements, such as waist circumference and overall lifestyle habits. For a complete health assessment, you should always consult a doctor or a health professional.

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**1.4 Waist circumference (WC):**

While Body Mass Index (BMI) tells you if your weight is healthy for your height, it does not show *where* your body stores fat. This is where waist circumference becomes very important. Waist circumference is simply the measurement of your waist. It helps doctors understand if you have too much fat around your stomach, which is called abdominal obesity.

Why is this important? Fat around your abdomen (belly) is not just under the skin. It surrounds your internal organs, like the liver and pancreas. This type of fat is more dangerous than fat on your hips or thighs. A large waist circumference increases the risk of serious health problems, including type 2 diabetes, heart disease, high blood pressure, and even some cancers.

How do you measure your waist circumference correctly? It is easy and requires only a soft measuring tape. Follow these steps:

1. Stand up straight and breathe out normally.
2. Find the top of your hip bones on each side.
3. Place the measuring tape around your bare stomach, at the midpoint between the top of your hip bone and the bottom of your ribs. (A simple method is to measure at the level of your belly button).
4. The tape should be snug but not pressing into your skin. Keep it parallel to the floor.
5. Read the measurement after you breathe out.

What is a healthy measurement? The recommended limits are different for men and women:

- **For men:** Less than 94 cm is low risk. Above 102 cm (40 inches) is high risk.
- **For women:** Less than 80 cm is low risk. Above 88 cm (35 inches) is high risk.

These numbers vary slightly between different ethnic groups. For example, some Asian populations use lower limits because they have a higher risk of disease with less belly fat.

In conclusion, waist circumference is a powerful and simple health tool. While BMI tells you *how much* fat you have, waist circumference tells you *where* the fat is located. For the best understanding of your health, use both measurements together. If your waist circumference is above the healthy limit, talk to a doctor. Reducing belly fat through better diet and more exercise can greatly lower your health risks.

**Other Anthropometric Measurements Using Waist Circumference**

WC alone is useful, but it becomes even more powerful when combined with other measurements like height, hip circumference, or neck circumference. These combinations help doctors predict health risks more accurately than BMI or WC alone.

Here are the three most common anthropometric measurements that use WC:

**1. Waist-to-Hip Ratio (WHR)**

This compares the size of your waist to the size of your hips.

- Formula: WHR = Waist Circumference ÷ Hip Circumference
- How to measure hip circumference: Measure around the widest part of your buttocks and hips.
- What it means: A higher number means more fat is stored around the abdomen (an "apple" shape), which is more dangerous. A lower number means fat is stored around the hips and thighs (a "pear" shape).
- Healthy limits:
    - Men: Below 0.90
    - Women: Below 0.85
- Advantage: Better than WC alone because it accounts for body shape and muscle.

**2. Waist-to-Height Ratio (WHtR)**

This compares your waist size to your height.

- Formula: WHtR = Waist Circumference ÷ Height
- Important: Use the same units for both (for example, both in centimeters).
- What it means: A healthy waist should be less than half of your height.
- Simple rule: "Keep your waist to less than half your height."
- Healthy limit: Below 0.5 (50%) for everyone, regardless of gender.
- Advantage: Very easy to remember and works for children and adults of all heights. Many experts believe this is better than BMI.

**Health Risks of High WC, High WHR, and High WHtR**

As explained earlier, Waist Circumference (WC), Waist-to-Hip Ratio (WHR), and Waist-to-Height Ratio (WHtR) are tools that measure body fat distribution. When these numbers are too high, they indicate too much fat around your abdominal organs (visceral fat). This is very dangerous for your health.

Below are the specific health risks for each high measurement.

**1. Health Risks of High Waist Circumference (WC)**

A high WC means you have a large belly. Doctors call this "abdominal obesity." The risks include:

- Type 2 Diabetes: Belly fat makes your body resistant to insulin, the hormone that controls blood sugar. This is the strongest risk factor for diabetes.
- Heart Disease: High WC increases bad cholesterol (LDL) and blood pressure, while lowering good cholesterol (HDL). This can lead to heart attacks.
- High Blood Pressure (Hypertension): Fat around the kidneys affects blood pressure control.
- Metabolic Syndrome: This is a combination of high blood sugar, high blood pressure, and abnormal cholesterol. High WC is a main sign of this syndrome.
- Stroke: Reduced blood flow to the brain due to narrowed arteries.
- Certain Cancers: Especially colon, breast (after menopause), and liver cancer.
- Sleep Apnea: Extra fat around the neck and belly can block breathing during sleep.

High risk thresholds: Men > 102 cm; Women > 88 cm

**2. Health Risks of High Waist-to-Hip Ratio (WHR)**

A high WHR means your waist is much larger than your hips (an "apple" body shape). This is even more dangerous than a high WC alone because it compares fat to muscle (hips often have muscle). Risks include:

- All the risks listed above for high WC (diabetes, heart disease, etc.), but at a higher level.
- Heart Attack and Early Death: Studies show that high WHR is a better predictor of heart attack and death than BMI or WC alone.
- Stroke: Especially in people with normal BMI but high WHR.
- Kidney Disease: High WHR is linked to faster decline in kidney function.
- Cognitive Decline: Older adults with high WHR have a higher risk of dementia and memory loss.
- Pregnancy Complications: Women with high WHR before pregnancy have higher risks of gestational diabetes and high blood pressure during pregnancy.

**High risk thresholds:** Men > 0.90; Women > 0.85

**3. Health Risks of High Waist-to-Height Ratio (WHtR)**

A high WHtR means your waist is larger than half your height. Many experts believe WHtR is the best predictor of health risks because it works for all heights, genders, and ages. Risks include:

- All the risks above (diabetes, heart disease, stroke, cancer, etc.).

- Premature Death (All-Cause Mortality): Studies show that people with WHtR above 0.5 have a significantly higher risk of dying earlier than people with a healthy WHtR.
- Fatty Liver Disease: High WHtR is strongly linked to non-alcoholic fatty liver disease (NAFLD), which can lead to liver cirrhosis.
- Heart Failure: Not just heart disease, but the heart's inability to pump blood effectively.
- Inflammation: High WHtR is associated with chronic, low-grade inflammation throughout the body, which damages blood vessels and organs.
- **Arthritis:** Extra belly fat increases joint stress and inflammation, worsening knee and hip arthritis.

**High risk threshold:** WHtR > 0.5 (waist more than half of your height)

**Comparison of Risks**

| **Measurement** | **Main Additional Risk Beyond Others** | **Best Predictor Of...** |
|---|---|---|
| High WC | Metabolic syndrome, sleep apnea | Simple belly fat risk |
| High WHR | Heart attack, kidney disease, dementia | Body shape and heart risk |
| High WHtR | Premature death, fatty liver, heart failure | Overall health and early death |

**Why Are These Risks So Serious?**

The reason is **visceral fat**. This is the fat deep inside your belly, wrapped around your liver, pancreas, and intestines. Unlike fat under the skin, visceral fat:

- Releases toxic chemicals called cytokines that cause inflammation.
- Produces hormones that increase insulin resistance.
- Affects blood pressure by interacting with the kidneys.

BMI cannot see visceral fat. That is why high WC, high WHR, and high WHtR are more important than BMI for predicting serious disease.

**Conclusion**

If your WC, WHR, or WHtR is high, you have a higher risk of diabetes, heart disease, stroke, cancer, and early death. The good news is that visceral fat responds well to lifestyle changes. Even losing 5–10% of your body weight can greatly reduce these risks. The best treatments are:

- Regular exercise (especially walking, running, or swimming)
- Healthy diet (fewer sugars, less processed food, more vegetables)
- Stress management (high stress increases belly fat)

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