

# *Laboratory Practical*

## **Body Composition**

The measurement of body composition has become a popular and standard practice for many physicians, athletic trainers, allied health professionals and researchers (Graves et al, 2006). Evidence supports the notion that being overweight (i.e. having excess body fat) is related to musculoskeletal injury, non-adherence to exercise training and reduced athletic performance. In addition, numerous health problems are associated with excess body fat, such as hypertension diabetes mellitus, depression, hyperlipidaemia and coronary heart disease (NHS, 2015).

In this laboratory we will examine numerous indicators and measures of body composition.

Measurements Required: (all Right sided)

Each measurement should be repeated 3 times for consistency and the average scored used.

Total mass (kg)

The subject, wearing minimal clothing, stands in the centre of the scale platform. Record clients weight to the nearest tenth of a kilogram. A correction is made for clothing so that nude weight is used in subsequent calculations.

Stature (cm)

Taken against a height scale or stadiometer. Take height with the subject standing straight, against an upright wall or stadiometer, touching the

wall with heels, buttocks and back. Orientate the head in the Frankfort plane (the upper border of the ear opening and the lower border of the eye socket on a horizontal line), and the heels together. Instruct the subject to stretch upward and to take and hold a full breath. Lower the headboard until it firmly touches the vertex.

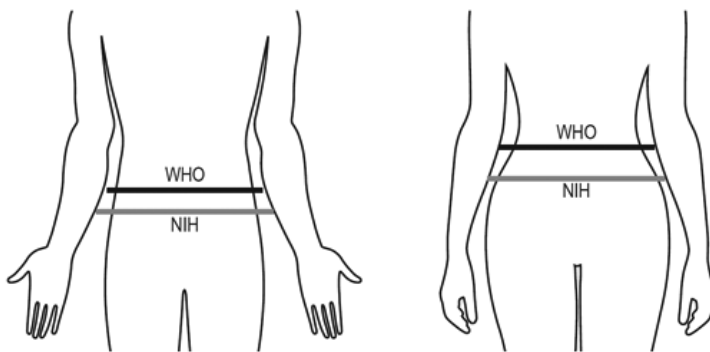
## Waist Circumference

Using the World Health Organisation protocol, take the waist circumference from the mid-point of the iliac crest and the lowest rib.

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Waist circumference measurement sites for men and women based on World Health Organization (WHO) and National Institutes of Health (NIH) protocols

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**Note:** Following the WHO protocol, the measure is taken midway between the highest point of the iliac crest and the bottom of the ribcage. Following the NIH protocol, the measure is taken at the highest point of the iliac crest.

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## SkinFold Measurements

Using a suitable set of Calipers measure the skinfold thickness;

**Biceps**      The anterior surface of the biceps midway between the anterior axillary fold and the antecubital fossa.

|              |                                                                                                                                                                                                             |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Triceps      | The vertical fold on the posterior midline of the upper arm, over the triceps muscle, half way between the acromion and olecranon processes.                                                                |
| Subscapular  | A vertical fold on the diagonal line coming from the vertical border to between 1 and 2 cm from the inferior angle of the scapulae.                                                                         |
| Suprailiac   | A fold above the crest of the ilium at the spot where an imaginary line would come down from the axillary line just above the hip bone and 2-3 cm forward. Runs posterior to anterior. Arms away from body. |
| Supraspinale | Fold is obliquely down and medial across the natural line of the skin. Arms by side.                                                                                                                        |
| Abdominal    | Fold is taken vertically 5cm from the navel. Take a firm grasp, making sure fingers don't go into the navel. Participant's arms by side.                                                                    |
| Front Thigh  | Fold taken down the long axis of the thigh. Seated position and knee extended. The midpoint of ASIS and superior border of patella is made.                                                                 |

Medial Calf      Relaxed standing position. Foot placed on a box and knee bent to 90\*. Vertical fold is taken at the maximal circumference of the calf.

| Measure                   | Trial 1 | Trial 2 | Trial 3      | Mean         |
|---------------------------|---------|---------|--------------|--------------|
| Triceps                   |         |         |              |              |
| Subscapular               |         |         |              |              |
| Biceps                    |         |         |              |              |
| Supralliac                |         |         |              |              |
| Supraspinale              |         |         |              |              |
| Abdominal                 |         |         |              |              |
| Front Thigh               |         |         |              |              |
| Medial Calf               |         |         |              |              |
| Sum of 7                  |         | FEMALES | Body Density | Body Fat (%) |
| Withers et al             |         |         |              |              |
| Jackson and Pollack       |         |         |              |              |
| Jackson, Pollack and Ward |         |         |              |              |
|                           |         | MALES   | Body Density | Body Fat (%) |
| Withers et al             |         |         |              |              |
| Durnin and Womersley      |         |         |              |              |
| Katch and McArdle         |         |         |              |              |

Withers et al., 1987 – X1 in mm (Tri,Subscap,Supraspin,Abdo,FT,MC)

$$\text{Body Density} = 1.20953 - [0.08294 \times (\log_{10} X1)]$$

Jackson and Pollack 1985 - X1 in mm (Tri,Supralliac,FT)

$$\text{BodyDensity} = 1.099421 - [0.0009929 \times (X1) + (0.0000023 \times [X1]^2) - [0.0001392 \times (\text{age})]]$$

Jackson, Pollack and Ward, 1980 - X1 in mm (Tri,Supralliac,Abdo,FT)

$$\text{BodyDensity} = 1.096095 - [0.0006952 \times (X1) + (0.0000011 \times [X1]^2) - [0.0000714 \times (\text{age})]]$$

Withers et al., 1987 – X1 in mm

(Tri,Subscap,biceps,Supraspin,Abdo,FT,MC)

$$\text{Body Density} = 1.0988 - [0.0004 \times [X1]]$$

Durnin and Womersley, 1974 – X1 (Tri,Subscap,Biceps,Supralliac)

$$\text{Body Density} = 1.1765 - [0.0744 [\log_{10} X1]]$$

Katch and McArdle, 1973

$$\text{BodyDensity} = 1.09665 - [0.00103 \times X1] - [0.00056 \times X2] - [0.00054 \times X3]$$

Where X1-Triceps X2-Subscap X3-Abdominal

To Estimate Body Fat use the following equation:

$$\% \text{body fat} = [(4.95 / \text{body density}) - 4.5] \times 100$$

INPUT VALUES INTO THE TABLE

Locate each location, measure and record the distances from defined anatomical structures for future reproducibility and reliability.

Record each measurement 3 times and average the values before summing and referring the tables.

#### INTERPRETATION

Comparison should be made between recorded percentage fat and those recommended. If actual fat is high then following equation can be used to calculate desired weight (assuming no change in lean mass;

Target weight = Lean mass + [fat mass x (desired % fat / actual % fat)]

#### **Body Mass Index**

Body Mass Index, or BMI, is a popular method of establishing relative size based on the mass and height of an individual and is the standard index of measurement used in epidemiological research.

To calculate your BMI you will need the measurement for weight (Kg) and height (converted to Meters from centimetres) taken earlier in this session. Enter these values in to the equation below to calculate your BMI:

$BMI = \text{Mass (Kg)} / (\text{Height}^2) \text{ M}$  Or  $BMI = \text{Mass (Kg)} / (\text{Height} \times \text{Height}) \text{ M}$

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Once the BMI of the patient is calculated it is compared to normative data to classify their relative size:

BMI range – kg/m<sup>2</sup>

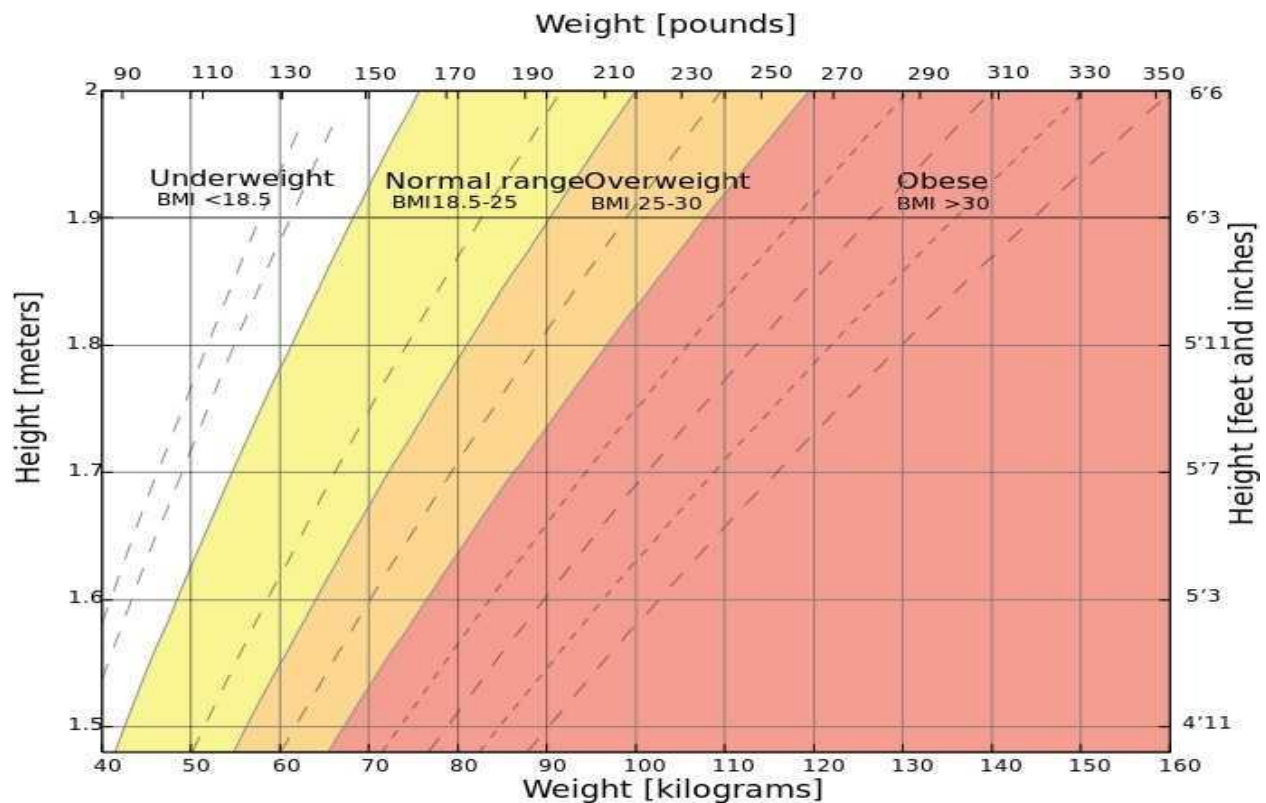
less than 15   from 15.0 to 16.0   from 16.0 to 18.5   from 18.5 to 25   from 25 to 30   from 30 to 35   from 35 to 40   over 40

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## Category

| BMI range         | category             |
|-------------------|----------------------|
| less than 16.5    | severely underweight |
| from 16.5 to 18.5 | underweight          |
| from 18.5 to 25   | normal               |
| from 25 to 30     | overweight           |
| from 30 to 35     | obese                |
| from 35 to 40     | clinically obese     |
| above 40          | dangerously obese    |

Or plotted on a graph:



## Waist Circumference

According to the National Obesity Forum, the following results should be

| Health risk   | WOMEN              | MEN                 |
|---------------|--------------------|---------------------|
| Low Risk      | below 31.5 inches  | below 37 inches     |
| Moderate Risk | 31.5 to 35* inches | 37 to 40 inches     |
| High Risk     | 35* inches or more | 40.2 inches or more |

noted:

## Bio-electrical Impedance

Increasingly popular measure and relatively easy to use. Safe and non-invasive, assessing physical traits based of varying electrical conductivity of Fat Mass (FM) and Fat Free Mass (FFM).

FFM \_\_\_\_\_ kg \_\_\_\_\_ %

FM \_\_\_\_\_ kg \_\_\_\_\_ %

### **TASK**

Perform a comparison of the various skinfold measurements including the TANITA body composition, skinfold, waist hip and BMI.

Discuss the accuracy of and usage of such measures

### **CASE STUDY**

38 year old male training for weight lifting competition. Has been performing 2 aerobic sessions and 6 weight training sessions per week for last 4 months. He calculated his BMI from a phone app and was given a BMI of  $27\text{kg/m}^2$ . He is concerned that he may be at risk of diabetes, hypertension, CV disease. What tests would you perform and why?