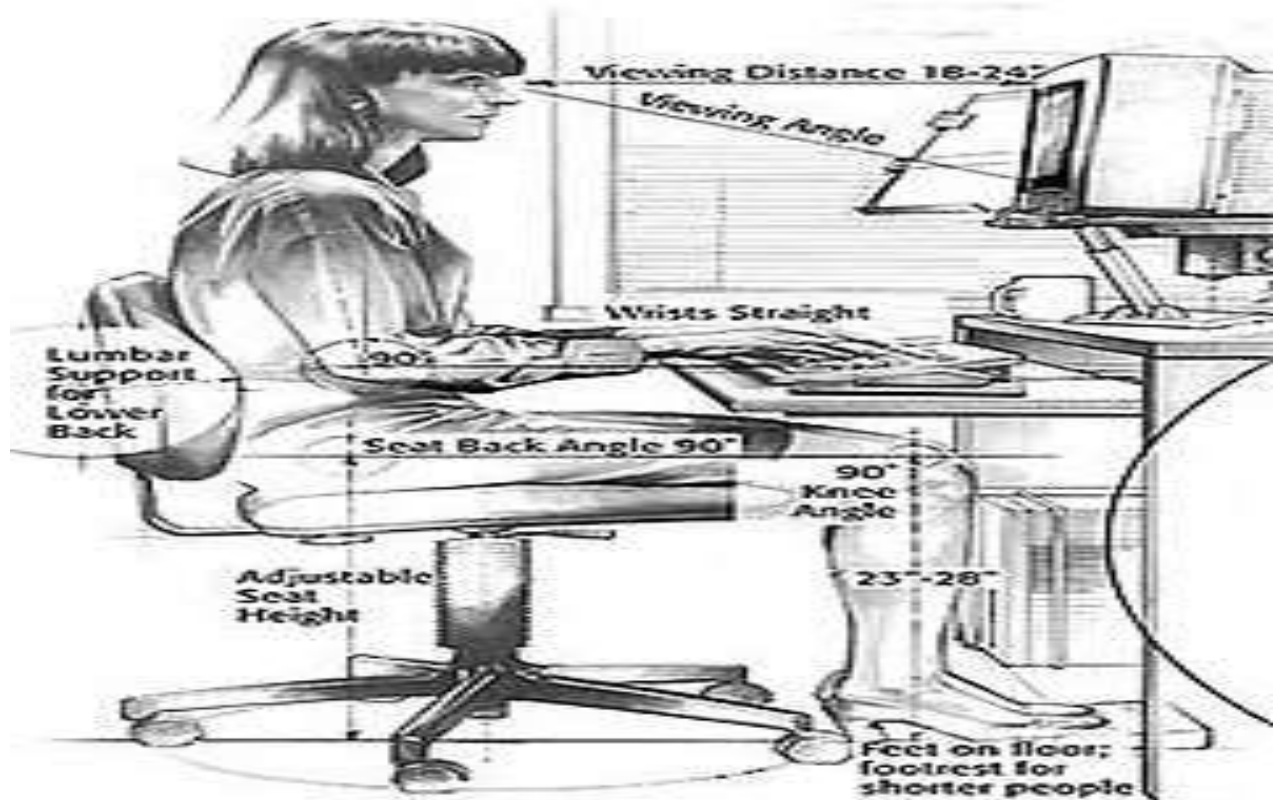


## Measurement of human body and its Biomechanical characteristics

- Anthropos = human
- Metrikos = measuring
- 

**Anthropometry** refers to the measurement of the human individual. It was the first technique of measurement used in physical education. Anthropometry was first introduced in physical education by a physician, Dr. Edward Hitchcock. Today, anthropometry plays an important role in [industrial design](#), [clothing design](#), [ergonomics](#) and architecture where statistical data about the distribution of body dimensions in the population are used to optimize products. Changes in life styles, nutrition and ethnic composition of populations lead to changes in the distribution of body dimensions (e.g. the [obesity epidemic](#)), and require regular updating of anthropometric data collections.



### Kinanthropometry

The term has originated from three Greek words 'Kineen' meaning 'to move', 'anthropos' meaning 'man' and 'metreion' meaning 'to measure'. Thus, Kinanthropometry is the measurement of man with respect to his body movements. Kinanthropometry may be defined as "the application of measurement to the study of human size, shape, promotion, composition, maturation, and gross function to help understand human movement with reference to growth, exercise, performance and nutrition".

### Anthropometric Tests

Tests of anthropometry include measurements of body size, structure, and composition. It is important to be aware of the effects of changes to these factors, and to be able to measure them. For most sports body size is an important factor in success, whether it is advantageous to be short, tall, heavy or light.

The body composition, such as the amount of body fat and muscle mass, can also significantly affect sporting performance. A measure which utilizes both body composition and body size measurements is somatotype.

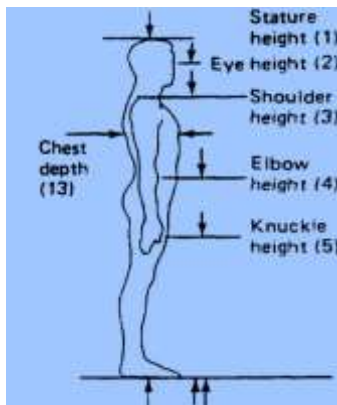
### Somatotype

Somatotyping is a system of classifying body types in terms of three categories: endomorphy, mesomorphy and ectomorphy. Somatotype is most commonly measured using the Heath-Carter measurement system, in which ratings for endomorphy, mesomorphy and ectomorphy are calculated using various anthropometrical measurements and also sometimes in conjunction with standardized photos (photoscopic method).

### Anthropometric Measurement

- For anthropometric measurements (weight, height, waist and hip circumference) the following equipment is needed:
- balanced beam scale;
- portable/wall mounted stadiometer with movable head piece, or measuring rod, typically mounted on balanced beam scales;
- flexible, but non-stretchable measuring tape or insertion tape;
- full body-length mirror with 10cm ´ 10 cm grid lines;
- carpenter's level;
- several calibrated weights (e.g. 10 kg or 20 kg each) that can be combined to give test weights between 50 kg and 100 kg;
- calibrated length rods of 150 cm and 200 cm.

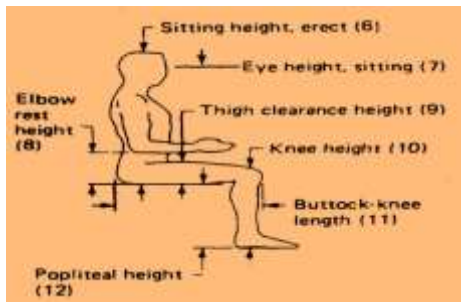
### Anthropometric Data



Anthropometric Data

### Dimension, In

Body dimension	Sex	5th
1. Stature (height)	Male	63.7
	Female	58.9
2. Eye height	Male	59.5
	Female	59.5
3. Shoulder height	Male	52.1
	Female	52.1
4. Elbow height	Male	39.4
	Female	36.9
5. Knuckle height	Male	27.5
	Female	25.3
	27.6	29.9
13. Chest depth	Male	8.4
	Female	8.4



Body dimension	Sex	Dimension, In	
		5th	50th
6. Height, sitting	Male	33.1	35.7
	Female	30.9	33.5
7. Eye height, sitting	Male	28.6	30.9
	Female	26.6	28.9
8. Elbow rest height, sitting	Male	7.5	9.6
	Female	7.1	9.2
9. Thigh clearance height	Male	4.5	5.7
	Female	4.2	5.4
10. Knee height, sitting	Male	19.4	21.4
	Female	17.8	19.6
11. Buttock-knee distance, sitting	Male	21.3	23.4
	Female	20.4	22.4
12. Popliteal height, sitting	Male	15.4	17.4
	Female	14.0	15.7

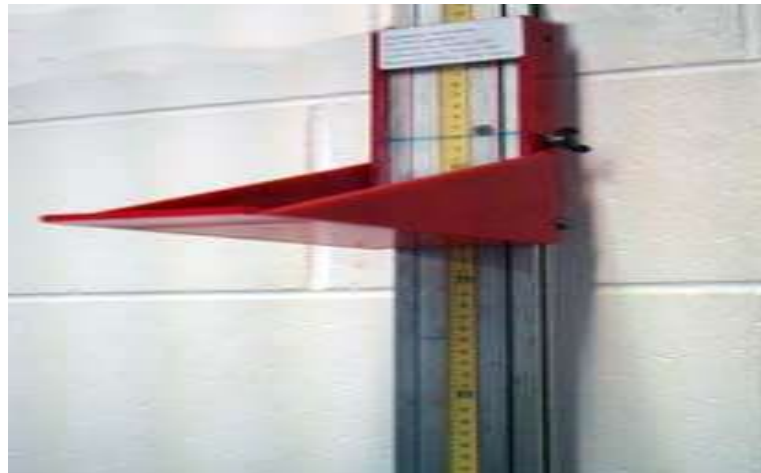
Measurement procedures

### Standing Height (Stature) Measurement

- The measurement of height is a standard component of most fitness assessments. Height (or lack of height) is an important attribute for many sports.
- **equipment required:** stadiometer (or steel ruler or tape measure placed against a wall).
- **procedure:** standing height is the measurement the maximum distance from the floor to the highest point on the head, when the subject is facing directly ahead. Shoes should be off, feet together, and arms by the sides. Heels, buttocks and upper back should also be in contact with the wall when the measurement is made.
- **reliability:** Height measurement can vary throughout the day, usually being higher in the morning, so to ensure reliability height should be measured at the same time of day.
- **advantages:** this is a low cost and quick test to perform.
- **comment:** if the subject is unable to stand (such as for infants and with illness, injury), then recumbent length can be measured.



- **Sitting Height Measurement**
- Sometimes sitting height measurement is conducted in addition to the [standing height](#). Sitting height gives a measure of the length of the trunk. It is a measurement of the distance from the highest point on the head to the base sitting surface.
- procedure: The subject sits with both feet on the floor, the lower back and shoulders against the wall, looking straight ahead. Distance can be measured from the floor, and the height of the box measured and subtracted from the total distance.
- equipment required: [stadiometer](#) or ruler placed against a wall, box or chair.
- reliability: Height measurement can vary throughout the day, being higher in the morning, so should be measured at a consistent time of day.
- advantages: low costs, quick test
- other comments: Upper body length or proportionally long legs is an important attribute for



many sports.

#### Weight measurement

- Weight should be measured in all participants, except pregnant women, wheelchair bound individuals, or persons who have difficulty standing steady

- **Normal weighing procedure**
- Participants are asked to remove their heavy outer garments (jacket, coat, trousers, skirts, etc.) and shoes. If subjects refuse to remove trousers or skirt, at least make them empty their pockets and record the fact in the data collection form
- The participant stands in the centre of the platform, weight distributed evenly to both feet. Standing off-centre may affect measurement.  
The weights are moved until the beam balances (the arrows are aligned). The weight is recorded to the resolution of the scale (the nearest 0.1 kg or 0.2 kg).



### Girth / Circumference Measures

- Girths are circumference measures at standard anatomical sites around the body, measured with a tape measure. Girth measurements can be used in determining body size and composition, and to monitor changes in these parameters.
- **equipment required:** flexible metal tape measure and pen for marking the skin. If a plastic or cloth tape is used, it should be checked regularly against a metal tape as others may stretch over time. The Myotape is useful for the self-assessment of girth measurement.
- **procedure:** First mark the sites to be measured. When recording, you need to make sure the tape is not too tight or too loose, is lying flat on the skin, and is horizontal. For descriptions of the procedure for measuring specific girths see the list below.



### Forearm Girth

- **aim:** To measure the circumference of the forearm, as a measure of the underlying musculature and adipose tissue. Girth measurements combined with [skinfold measurements](#) can give a clearer picture of changes in tissue composition and distribution of muscle and fat.
- **equipment required:** flexible metal [tape measure](#) and pen suitable for marking the skin. If a plastic or cloth tape is used, it should be checked regularly against a metal tape as they may stretch over time.
- **procedure:** This girth measurement is usually taken on the right side of the body. The subject holds the arm out with the palm facing upwards. The measurement is taken along the forearm at the point of the largest circumference. The maximal girth is not always obvious, and the tape may need to be moved up and down along the forearm to find the point of maximum circumference, which will usually be found closer to the elbow. When recording, you need to make sure the tape is not too tight or too loose and is lying flat on the skin.



**advantages:** low costs involved in the testing procedure.

**comments:** Clothing over the site should be removed if possible to make sure measuring tape is positioned correctly and that the correct circumference is determined.

### Wrist Girth Measurement

- **aim:** to measure the circumference of the wrist, as one of the many measurements of body size.
- **equipment required:** flexible metal [tape measure](#) and pen suitable for marking the skin. If a plastic or cloth tape is used, it should be checked regularly against a metal tape as they may stretch over time.
- **procedure:** This girth measurement is usually taken on the right arm, at a point just distal (away from the body) to the styloid processes. This is usually the minimum circumference in this region, though the tape should be moved around to make sure you have recorded the minimum girth measurement. When recording, you need to make sure the tape is not too tight or too loose, and is lying flat on the skin.



**advantages:** low costs involved in the testing procedure.

**comments:** Girth measurements combined with [skinfold measurements](#) can give a clearer picture of changes in tissue composition and distribution of muscle and fat.

### Calf Girth

- **aim:** To measure the circumference of the calf, as a measure of the underlying musculature and adipose tissue. Girth measurements combined with [skinfold measurements](#) can give a clearer picture of changes in tissue composition and distribution of muscle and fat.
- **equipment required:** flexible metal [tape measure](#) and pen suitable for marking the skin. If a plastic or cloth tape is used, it should be checked regularly against a metal tape as they may stretch over time.
- **procedure:** This girth measurement is usually taken on the right side of the body. The subject stands erect with their weight evenly distributed on both feet and legs slightly apart. The measurement is taken at the level of the largest circumference of the calf. The maximal girth is not always obvious, and the tape may need to be moved up and down to find the point of maximum circumference. When recording, you need to make sure the tape is not too tight or too loose, is lying flat on the skin, and is horizontal. It may help to have the subject stand on a box to make the measurement easier.



**advantages:** low costs involved in the testing procedure, and ease of self testing

**comments:** Clothing over the site should be removed if possible to make sure measuring tape is positioned correctly and that the correct circumference is determined

### **Upper or Gluteal Thigh Girth**

- **aim:** To measure the circumference of the upper thigh, as a measure of the underlying musculature and adipose tissue. Girth measurements combined with [skinfold measurements](#) can give a clearer picture of changes in tissue composition and distribution of muscle and fat.
- **equipment required:** flexible metal [tape measure](#) and pen suitable for marking the skin. If a plastic or cloth tape is used, it should be checked regularly against a metal tape as they may stretch over time.
- **procedure:** This girth measurement is usually taken on the right side of the body. The subject stands erect with their weight evenly distributed on both feet and legs slightly parted. The circumference measure is taken 1 cm below the gluteal line or fold (buttock crease) with the tape held horizontal. When recording, you need to make sure the tape is not too tight or too loose, and is lying flat on the skin.



**advantages:** low costs involved in the testing procedure, and ease of self testing

**comments:** Clothing over the site should be removed if possible to make sure measuring tape is positioned correctly and that the correct circumference is determined. For this girth measurement, due to the location of the measure, care should be taken to maintain personal privacy of the subject, and sometimes it is appropriate to measure over clothing. If so, this should be recorded with the results. It may help to have the subject stand on a box to make the measurement easier.

### **Waist circumference measurement**

- Waist circumference should be measured at a level midway between the lower rib margin and iliac crest with the tape all around the body in horizontal position. **Waist circumference measurement procedure**
- The measurer should stand at the side of the participant in order to have a clear view of the mirror.



- Participants should be standing with their feet fairly close together (about 12-15 cm) with their weight equally distributed to each leg. Participants are asked to breathe normally; the reading of the measurement should be taken at the end of gentle exhaling. This will prevent subjects from contracting their abdominal muscles or from holding their breath.

The measuring tape is held firmly, ensuring its horizontal position. Use the grid lines on the mirror to verify that the tape position is horizontal all around the waist. The tape should be loose enough to allow the observer to place one finger between the tape and the subject's body.



#### Hip circumference measurement

Hip circumference should be measured as the maximal circumference over the buttocks. The grid lines on the mirror are used to verify that the tape position is horizontal all around the body. If the hip circumference exceeds the length of the tape, this fact together with the maximum length of the, should be recorded in the data collection form.



## Somatotype

Somatotyping is a system of classifying body types in terms of three categories: endomorphy, mesomorphy and ectomorphy. Somatotype is most commonly measured using the Heath-Carter measurement system, in which ratings for endomorphy, mesomorphy and ectomorphy are calculated using various anthropometrical measurements and also sometimes in conjunction with standardized photos (photoscopic method).

