

Anthropometry PROTOCOL

Adapted from: Anthropometric Standardization Reference Manual. TG Lohman, AF Roche and R Martorell (Eds.) 1988; Human Kinetics Book, Champaign Il.

OVERVIEW

- The following anthropometric measurements should be performed on each participant:
 1. Weight
 2. Height
 3. Circumferences: Mid-arm, hip, waist, thigh
 4. Skinfold thickness: Triceps, subscapula, suprailiac, abdomen, thigh
 5. Bioelectrical impedance analysis (BIA). *See separate BIA protocol for specifics on this procedure.*
- Use a non-stretch, pliable tape measure. We recommend the Gulick II which has a tensioning device attached to the measuring tape. This allows for repeatable measurements which are accurate and consistent no matter who is doing the measuring.
- Measurements should be taken on the participant's right side. If the participant has a cast on his/her right arm, take the measurement on the left side and write an appropriate comment on your form.
- Go through each measurement. Repeat. Then go through each measurement a **third** time.
- In the case of a pregnant subject, do not take any anthropometric measurements.
- Before getting started, explain to the participant what you will be doing and what they can expect from each measurement procedure. Continue to explain to the participant what you are doing while you are taking the measurements. A well-informed participant is more likely to feel at ease.
- Explain to the participant that the measurements will not be accurate if made over clothing. Ask if they are comfortable removing their outer clothing to their undergarments. If they do not feel comfortable or are not wearing undergarments, offer them hospital pants or johnnies. Or, participants may leave their outer clothing on and lift up a sleeve for the triceps measurements, their shirts for subscapula and waist/abdominal measurements, and lower their pants/skirt for hip and thigh measurements.
- Be tactful. Try to avoid excessive body contact when arranging the measuring tape, finding sites and using the calipers.

Anthropometry Protocol Overview, continued

- Keep all equipment clean. Wipe skinfold caliper heads and measuring tape with an alcohol wipe after each interview.
- Use gloves in the presence of obvious contamination with blood or secretions.
- If subject is too large or too muscular to get a measurement, you need to have a procedure for indicating this on your data entry form. For example, “exceeds caliper scale” can be indicated for very large measurements, or “measurement unreliable” can be indicated for difficult measurements.

Anthropometry Protocol, continued

PROCEDURE FOR MEASURING WEIGHT

- Place scale on a firm, flat surface.
- Make sure the participant removes any coats, heavy sweaters, shoes, keys or heavy pocket contents.
- Ask the participant to stand in the middle of the scale's platform with the body weight equally distributed on both feet. Weigh the participant in kilograms to the nearest 0.1 kg (100 grams).

PROCEDURE FOR MEASURING HEIGHT

The measurement of stature requires a vertical board with an attached metric rule and a horizontal headboard that can be brought into contact with the most superior point on the head. The combination of these elements is called a Stadiometer.

- Make sure the participant's shoes are removed.
- Participant should stand with heels together, arms at sides, legs straight, and shoulders relaxed.
- Participant's heels, buttocks, and shoulder blades and head should be in contact with the vertical board. For participant who cannot place all four body parts against the board, be sure that at least the buttocks and heels or buttocks and head are touching the board.
- Position participant's head so that eyes are looking straight forward, without lifting chin.
- Just before taking the measurement, ask the participant to take a deep breath and hold it. Remind them to keep shoulders relaxed.
- Lower the headboard to the highest point of the head. Make sure the hair is compressed. If participant has thick braids, make as accurate a measurement as possible and make a note on your data form.
- Measure the height to the nearest 0.1 cm. Make sure your eyes are level with the headboard when recording the measurement. If necessary, stand on a foot stool to read the measure correctly.

Anthropometry Protocol, continued

PROCEDURES FOR MAKING MARKS FOR SKINFOLDS AND CIRCUMFERENCES

It is important to take anthropometric measurements at the correct locations. In addition, because multiple measurements should be taken at each site, it is important to measure the exact spot each time. For this reason it is necessary to mark each site before you take a measurement. Some clinicians prefer marking all of the sites first before taking a measure. Others mark each site just before measuring that site. It is up to the individual clinician.

Arm:

- Ask the participant to stand up straight and sideways to you, with arms relaxed and legs slightly apart.
- Ask the participant to bend the right elbow to a 90-degree angle with palms facing up. On the participant's right side, locate the projection of the *acromion process of the scapula* (bump on the backside of the shoulder) and the *olecranon process of the ulna* (pointy part of the elbow).
- Place the tape with its zero mark just under the acromion process and extend the tape along the upper arm until just below the pointy part of the elbow, without wrapping the tape around the elbow.
- Keeping the tape straight, read the length to the tip of the elbow.
- Mark the midpoint with a (+) using a pen or marker.

Subscapula:

- With the back exposed, locate the participant's scapula. For some subjects, especially the obese, gentle placement of the subject's arm behind the back aids in identifying the scapula. The skinfold site is just inferior (below) to the inferior angle of the scapula.
- Mark a line adjacent to and just below the apex (highest point) of the scapula. This mark will make approximately a 45-degree angle in relation to the spine. Cross the line at the apex (+).

Suprailiac:

- While standing to the right of the participant, palpate the hip area for the right iliac crest. If very large subject, you may want to ask him/her to locate top of right hip bone. Using thumbs, palpate iliac crest to midline.
- Mark a horizontal line at the high point of the iliac crest and then cross the line (+) to indicate the midaxillary line of the body.

Anthropometry Protocol

Making Marks, continued

Abdomen:

- Make sure the participant's weight is evenly distributed on both feet and that the abdominal muscles are relaxed. Ask participant to breathe normally. You may ask participant to hold his or her breath near the end of expiration if movement of the abdomen interferes with the measurement.
- Find the point that is 3 cm to the right of and 1 cm below the midpoint of the umbilicus. Mark a (+) at this point.

Thigh:

- Ask the participant to sit in a chair or on examining table, with back straight.
- Mark a horizontal line just at the superior edge of the patella (knee cap).
- Place the zero end of the measuring tape at the inguinal crease, which is easily located if the hips are in a sitting position. If necessary on obese subjects, lift folds of fat to measure at the crease.
- Extend tape along the midline of the thigh to the line just proximal to the patella.
- Mark a (+) at the midpoint of the thigh.

Anthropometry Protocol, continued

PROCEDURES FOR MEASURING CIRCUMFERENCES

Circumferences are important measurements that record the size of cross-sectional and circumferential dimensions of the body. Circumferences used alone, in combination with skinfold measurements taken at the same location or in combination with other circumferences, can provide indices of nutritional status and levels of fat patterning. Circumferences of the limbs, together with skinfold measures of subcutaneous adipose tissue thicknesses at corresponding levels, can provide cross-sectional areas of adipose tissue or areas of the underlying “muscle plus bone”.

- Measurements should be taken on the right side of the body.
- Positioning of the tape for each specific circumference is important for an accurate measure. For each circumference, place the plane of the tape around the site perpendicular to the long axis of that part of the body. For those circumferences typically measured with the subject erect (waist, hip), the plane of the tape is also parallel to the floor.
- The tension applied to the tape by the measurer affects the validity and reliability of the measurements. As stated previously, we recommend the Gulick II tape as this applies a consistent amount of tension (4 ounces) each time. If you do not have a tape with a tension device, hold the tape snugly around the body part, but not tight enough to compress the subcutaneous adipose tissue. For the arm circumference there may be gaps between the tape and the skin in some individuals. If the gap is large, a note should be made on the data form, but in most instances, this gap is small and of little concern. Attempting to reduce the gap by increasing the tension of the tape is not recommended.

Arm Circumference:

- Extend the right arm of the participant so that it is hanging loosely by his/her side, with the palm facing inward.
- At the previously measured midpoint mark, wrap the measuring tape around the arm. The zero end of the tape is in your right hand. Once tape is around the appendage, switch hands so that the zero end of the tape is in the left hand, other end of tape in the right hand. Pull tape slightly with the left hand until the appropriate tension is achieved. Hold tape in place with the right hand.
- Record the measurement to the nearest 0.1 cm.

Anthropometry Protocol Circumferences, continued

Waist Circumference:

This measurement is easiest to make with the participant's shirt removed. If not, you will have to make this measurement underneath the shirt, while lifting and resting it on your left arm. Women may be willing to tuck the shirt underneath their bra strap. In addition, participant may need to lower the waistband of his/her underclothing.

- Ask participant to stand erect, with feet together and abdomen relaxed.
- Stand behind participant and locate the narrowest part of the torso.
- Ask participant to lift arms while you place the measuring tape around the narrowest part of the torso. Hold zero end of the tape in right hand, rest of tape in left hand.
- Once tape is around the torso, ask participant to relax arms at their sides.
- Be sure tape is in a horizontal plane, evenly placed around the body and not catching on any clothing.
- Once set, switch zero end of tape to left hand, rest of tape to right hand.
- Pull tape lightly with left hand until appropriate tension is achieved. Hold tape in place with the right hand.
- Record measurement to the nearest 0.1 cm.

Buttocks (Hip) Circumference:

Ideally, the participant should wear only nonrestrictive underwear (i.e. no "control top" panty hose, girdles, spandex, etc.), or a light smock over underwear.

- Ask participant to stand erect with arms by sides and feet together. Weight should be evenly distributed on both feet.
- Squat or kneel down to the right side of the subject. Locate the level of maximum extension of the buttocks.
- Holding the zero end of the tape in your right hand, extend the measuring tape around the buttocks in a horizontal plane at this level.
- Once set, switch the zero end of the tape to the left hand, rest of tape to right hand.
- Pull tape lightly with left hand until appropriate tension is achieved. Hold tape in place with the right hand.
- Record measurement to the nearest 0.1 cm.

Anthropometry Protocol Circumferences, continued

Thigh Circumference:

- Ask participant to stand with his/her right leg just in front of the left leg, with weight on left leg. Demonstrate this stance for the participant.
- Squat or kneel down to the right of the participant. Holding the zero end of the tape in your right hand, place the measuring tape around the mid-thigh at the point that is marked (+). Make sure the tape is positioned perpendicular to the long axis of the thigh, and not the floor.
- Once set, switch the zero end of the tape to the left hand, rest of tape to right hand.
- Pull tape lightly with left hand until appropriate tension is achieved. Hold tape in place with the right hand.
- Record measurement to the nearest 0.1 cm.

Anthropometry Protocol

PROCEDURES FOR MEASURING SKINFOLD THICKNESS

Skinfold thicknesses, sometimes called “fatfold” thicknesses, are actually the thicknesses of double folds of skin and subcutaneous adipose tissue at specific sites on the body. They provide a relatively simple estimation of general fatness, and can help provide valuable information on the distribution of subcutaneous body fat. (See Skinfold Thickness Illustration on page 12).

Measuring body fat with skinfold calipers is challenging. It is particularly important to standardize site selection and location, because small differences in location can make significant differences in measurement. In addition, the compressibility of both skin and adipose tissue varies with the state of hydration, age, size, and individual. Very lean and very obese individuals pose special measurement problems. In general, the thicker the skinfold the more difficult it is to achieve a reproducible measure.

- Use Lange skinfold calipers for all measurements.
- Start by explaining what you will be doing and show the participant the calipers you will be using.
 - Allow the participant to feel the “pinch” on his/her hand. (The area between the thumb and the index finger is a good place for this).
 - Place the caliper heads on the inside and outside of the hand and release the pressure.
 - Point to the five sites where the measurements will be performed (thigh, abdomen, triceps, subscapula, and suprailiac).
- Follow these general measuring techniques:
 - Measurements should be taken on the right side of the body.
 - Mark each site with a pen or marking pencil. (See markings section).
 - **Grasp the skinfold firmly with the thumb and index finger of your left hand and pull the skinfold away from the body.** The skinfold should have parallel sides. The more fat under the skin, the thicker or wider the fold will be. (See Skinfold Thickness Illustration, page 12).

Anthropometry Protocol

Skinfolds, continued

- Pulling the skinfold away from the body is usually easier in thin persons compared to obese persons. It can also be somewhat uncomfortable for the participant. Explaining to the participant what you are doing will make them feel more at ease.
 - **Hold the caliper in your right hand**, perpendicular to the skinfold, and with the dial face up. Place the caliper heads on the skinfold $\frac{1}{3}$ to $\frac{1}{2}$ inch (1 cm) away from your fingers holding the skinfold. This is important to prevent pressure from the fingers effecting pressure of the caliper heads. During each measurement maintain the pressure of the fingers.
 - Take care not to place the caliper too far into the skinfold. The caliper heads should be placed on the actual double fold of the skin's thickness. (See Using the Calipers Illustration on page 12).
 - Release the lever of the caliper and read the dial after approximately 4 seconds. Waiting longer than 4 seconds will result in inaccurate smaller readings.
 - Record the measurement to the nearest .5 millimeter.
 - Repeat the measurements in the same order for the subsequent readings. Make sure at least 15 seconds have passed before repeating the measurement at the same site so that the skinfold is allowed to “flatten” or return to normal between readings.
 - If repeated measurements differ, additional measurements need to be taken until the readings are consistent. For example, if measures for Tricep or Subscapula differ by more than 3 mm or Suprailiac or Abdominal by more than 5 mm, you may want to take another measure. Be sure the outlier is clearly crossed off with your initials so that the 3 closest measurements are obvious for data entry.
- If the participant is obese, it may be difficult to pull the skinfold. In this situation, attempt the measurement and if unsuccessful, note as “unreliable” on the data form.
 - If the skinfold is above the measurable limits of the calipers (i.e., greater than 67 mm), then note “exceeds caliper” in the recording space for that skinfold.
 - If the participant is pregnant, then no measurements should be taken.
 - Practice the measurement procedures until you are completely comfortable with them. It takes practice to become skillful in measuring skinfolds consistently.

Anthropometry Protocol

Skinfolds, continued

Triceps Skinfold:

- Make sure the participant's right arm is hanging loosely.
- Stand behind the participant and pull a vertical skinfold about half an inch above the previously marked site, with the thumb and index finger pointing downward, centering the mark (+).
- Place the calipers perpendicular to the length of the fold, centering the mark.
- Release the caliper and read the dial after approximately 4 seconds while the fingers continue to hold the skinfold.
- Record the measurement to the nearest millimeter.

Subscapula Skinfold:

- Locate the marked site.
- Pull a skinfold that is at a 45° angle slanting downward to the right side of the body, about ½ inch above and to the left of the previously marked site.
- Place the caliper perpendicular to the length of the fold, centering the mark.
- Release the caliper and read the dial after approximately 4 seconds while the fingers continue to hold the skinfold.
- Record the measurement to the nearest millimeter.

Suprailiac:

- Make sure the participant is standing up straight, with feet together and arms relaxed.
- Pull a diagonal skinfold about ½ inch above the previously marked site, with the thumb and the index finger pointing downward.
- Place the calipers perpendicular to the length of the fold, centering the mark.
- Release the caliper and read the dial after approximately 4 seconds while the fingers continue to hold the skinfold.
- Record the measurement to the nearest millimeter.

Abdomen:

- Pull a horizontal skinfold, about ½ inch to the left of the previously marked site, centering the marked (+).
- Place the calipers perpendicular to the length of the fold, centering the mark.
- Release the caliper and read the dial after approximately 4 seconds while the fingers continue to hold the skinfold.
- Record the measurement to the nearest millimeter.

Anthropometry Protocol Skinfolds, continued

Thigh:

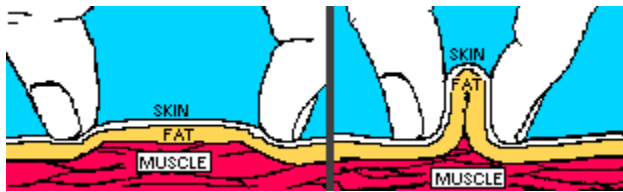
- Ask the participant to stand with weight shifted back on the left leg and the right leg forward and knee slightly bent.
- Grasp a fold about ½ inch above the previously marked site on the mid-thigh.
- Place the calipers perpendicular to the length of the fold, centering the mark.
- Release the caliper and read the dial after approximately 4 seconds while the fingers continue to hold the skin.
- Record the measurement to the nearest millimeter.

Another method for assessing body composition involves the use of Bioelectrical Impedance Analysis or BIA. Please see the *Bioelectrical Impedance Analysis Protocol* for specific information on this procedure.

Illustrations

Below are illustrations of how to correctly pinch a skinfold of fat and where to place the calipers:

Skinfold Thickness Illustration



Using the Calipers Illustration

