
National Health
and Nutrition
Examination Survey

ANTHROPOMETRY
PROCEDURES
MANUAL



(Revised December 2000)

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1. INTRODUCTION TO ANTHROPOMETRY

1.1 Overview of Anthropometry

Nutrition is a major determinant of health, and the resolution of many nutritional issues of public health concern requires survey data. One of the major aims of NHANES is to provide information useful for studying the relationship among diet, nutritional status, and health. In addition to dietary intake methodologies, questionnaire material, hematological tests, and nutritional biochemistries, the assessment of nutritional status requires a series of stature, weight, and other anthropometric dimensions.

Anthropometry is the study of the measurement of the human body in terms of the dimensions of bone, muscle, and adipose (fat) tissue. Measures of subcutaneous adipose tissue are important because individuals with large values are reported to be at increased risks for hypertension, adult-onset diabetes mellitus, cardiovascular disease, gallstones, arthritis, various forms of cancer, and other diseases. Combined with the dietary and related questionnaire data, and the biochemical determinations, anthropometry is essential and critical information needed to assist in describing the data collected from persons in the NHANES sample.

1.2 Purpose of Anthropometrics

Actual stature, weight, and body measurements (including skinfolds and circumferences) will be collected in the MEC for purposes of assessing growth, body fat distribution, and for the provision of reference data. Anthropometric measurements such as skinfolds and circumferences, combined with bioelectrical impedance (a method used to estimate the amount of lean tissue), will allow cross-sectional analysis of the relationship between obesity and risk of disease. Therefore, many of the measurements included in NHANES will repeat ones made in previous NHANES and HHANES surveys so that trend analyses can be conducted. One measure has been added to provide further information on body frame size, while others have been dropped because new data have determined that other measures are more informative.

1.3 Role of Anthropometric Examiner and Recorder

The collection of anthropometric data requires an examiner and recorder. Health technicians for NHANES will be trained to perform both roles. In addition, other MEC staff will be trained to serve

as recorders. It is important when two health technicians are in the room that the examiner assigned to the room complete the examination once it is started.

The examiner will be responsible for positioning the SP, taking each measurement, and stating the measurement aloud to the recorder. The recorder will enter it into the automated system, and if there is no out-of-range message, state the name of the next measurement listed on the computer screen. With the exception of skinfolds, the examiner should keep the measuring instrument set on the SP until the recorder enters the number and the computer repeats it. If there is an out-of-range message, the recorder will repeat the entry and the examiner will check it. The recorder will change the number ONLY if the number the examiner read was incorrect.

It is the recorder's role to "assist" the examiner in obtaining correct measurements. This includes helping the examiner correctly position the SP and checking to make sure the SP is standing or sitting erect for specified measurements, and that the SP is holding onto appropriate bars for support during specified measures. During the exam, it will be the recorder's responsibility to make the midpoint marks on the SP. The recorder will also assist the examiner by checking the tension and horizontal position of the steel measuring tape for girth measurements

2. EQUIPMENT

2.1 Description of Exam Room in MEC

The body measurement room is located in trailer #4 of the MEC. The room is equipped with some unique features designed to facilitate an accurate and efficient measurement procedure. These features include strategically placed mirrors and a custom-built box for SPs to sit on. In addition, the Toledo scale, stadiometer, and infantometer (infant measurement board) are supported by the Integrated Survey Information System (ISIS) for quick and accurate data capture.

2.2 Description of Equipment and Supplies

The equipment and supplies necessary for body measurements are as follows:

- Toledo electronic weight scale
- Seca electronic stadiometer
- Seca electronic infantometer
- Measurement box for upper leg length and calf circumference
- Insertion tape
- Steel measuring tape
- Holtain skinfold caliper
- Holtain small sliding breadth caliper
- Computer terminal
- Weights for scale calibration
- Calibration rods
- Step wedge standards
- Cosmetic pencils (wax base)
- Scissors - blunt edge
- Paper tape
- Baby oil
- Gauze 4x4
- Seca digital scales (2)

2.2.1 Inventory of Equipment and Supplies

At the beginning and end of each stand, the health technician should take an inventory of the equipment and supplies needed for the body measurement examination component as discussed in Standardized Procedures. Any pieces of equipment that are missing should be reported to the MEC manager.

2.3 Start of Stand Procedures

Unpack the equipment and supplies and arrange accordingly in the room. Clean and calibrate the equipment as discussed in this chapter.

2.3.1 Equipment and Setup Procedures

You will need to unpack all the supplies and equipment before starting the first session of the new stand. The procedures are described in this section.

2.3.1.1 Supplies

- Take the stick out of the drawer handles and store in the anthropometry storage box.
- Remove the supplies (e.g., alcohol, gauze pads, cosmetic pencils) and equipment (e.g., small sliding calipers, skinfold calipers, head circumference tape) from the drawers and put them in the baskets mounted on the walls.
- Hang a small plastic bag (found in the second drawer) on the hook under the desk for discarding soiled gauze, cotton, etc.

2.3.1.2 Weights

- Remove the filler from around the weights and store in the anthropometry storage box.
- Remove the weight gate and store in the anthropometry storage box.

2.3.1.3 Measurement Box

- Remove the strap from around the box and the foam pad from behind the box, and store in the anthropometry storage box.

2.3.1.4 Digital Weight Scale

- Lift the cover off the scale and check that all four feet of the base are on the metal platform.

- Adjust the scale if needed and return the cover to the scale.

2.3.1.5 Stadiometer

- Remove the strap from the sitting box and move to the opposite wall. Store the strap in the anthropometry storage box. Push the headpiece of the stadiometer to the top of the measurement column, place the strap (stored in anthropometry storage box) around the headpiece, and attach the strap to the hooks in the wall.

2.3.1.6 Infantometer

- Remove the strap from the infantometer and store it in the anthropometry storage box.

2.3.2 Calibration Procedures

Four pieces of equipment will be calibrated at the start of the stand by the technician assigned to the anthropometry room. They include the scale, the infantometer, the stadiometer, and the skinfold calipers. The calibration procedures for each piece of equipment are described below.

2.3.2.1 Digital Weight Scale

- Place all six of the 50 pound calibrated weights on the scale and capture the weight in the QC Checks dialog box, Start of Stand tab. Click the Done box corresponding to the scale when the calibration is complete.
- If there is any reason to believe that the scale is not accurate, notify the MEC manager to have the scale recalibrated by a service representative.

2.3.2.2 Infantometer

- Move the footboard with the digital display to the head of the infantometer as far as it will go. In MEC 1, the digital display should read 16 cm. In MECs 2 and 3, the digital display should read 0 cm.
- Capture the counter reading in the QC Checks Start of Stand dialog box. Click the Done box corresponding to the infantometer when the calibration is complete. If the infantometer is not measuring correctly, you will need to recalibrate it.

- To recalibrate, adjust the digital display reading to read 16 cm or 0 cm by pressing the + or - button on the infantometer footboard. Note in the comment box that the infantometer was recalibrated to 16 or 0.

2.3.2.3 **Stadiometer**

- Place the calibration rod on the floor of the stadiometer.
- Place the horizontal bar of the stadiometer firmly against the top of the calibration rod. The digital display should read 80 cm.
- Capture the counter reading in the QC Checks Start of Stand dialog box. Click the Done box corresponding to the stadiometer when the calibration is complete. If the stadiometer display does not read 80 cm, you will need to recalibrate it.
- To recalibrate, adjust the stadiometer headpiece digital display reading to read 80 cm by pressing the + or the - button. Note in the comment box that the stadiometer was recalibrated to 80 cm.

2.3.2.4 **Skinfold Calipers**

- Zero the calipers before starting the calibration procedures. Place the step wedge standard between the caliper arms at each of the four steps, and check that the reading falls within the acceptable range.
- Record the measurement taken at each step in the Quality Control Checks Result field. An identical calibration should be done on the spare set of skinfold calipers and the corresponding measurements also recorded in the QC Checks Result field. Click the Done box corresponding to the skinfold calipers when the calibration is complete.
- If the caliper readings fall outside the acceptable range at any level, use the other set of calipers and inform the MEC manager. They will be returned to the manufacturer for adjustment.
- If the calipers become too loose, use the spare set of calipers and inform the MEC manager.
- The acceptable ranges for the step wedge readings are as follows:

first step	9.8 – 10.5	third step	29.9 – 30.5
second step	19.8 – 20.5	fourth step	39.8 – 40.4

2.4 **Mid-Stand Calibration Procedures**

Calibrate the scale using the same procedures as those for Start of Stand Calibration.

- Place all six of the 50 pound calibrated weights on the scale and capture the weight in the QC Checks dialog box, Start of Stand tab. Click the Done box corresponding to the scale when the calibration is complete.
- If there is any reason to believe that the stadiometer is not accurate, notify the data manager to recalibrate the scale.

2.5 Weekly Calibration Procedures

Three pieces of equipment will be calibrated weekly: the infantometer, stadiometer, and skinfold calipers. The calibration procedures are described below.

2.5.1 Infantometer

- Follow the same procedures as for start of stand. Move the footboard with the digital display to the head of the infantometer as far as it will go. The digital display should read 16 cm in MEC 1; in MECs 2 and 3, the digital display should read 0 cm.
- Capture the counter reading in the QC Checks Weekly dialog box. Click the Done box corresponding to the infantometer when the calibration is complete. If the infantometer is not measuring correctly, you will need to recalibrate it.
- To recalibrate, adjust the digital display reading to read 16 cm or 0 cm by pressing the + or - button on the infantometer footboard. Note in the comment box that the infantometer was recalibrated to 16 cm or 0 cm.

2.5.2 Stadiometer

- Follow the same procedures as for start of stand. Place the calibration on the floor of the stadiometer.
- Place the horizontal bar of the stadiometer firmly against the top of the calibration rod. The digital display should read 80 cm.
- Capture the counter reading in the QC Checks Weekly dialog box. Click the Done box corresponding to the stadiometer when the calibration is complete. If the stadiometer display does not read 80cm, you will need to recalibrate it.
- To recalibrate, adjust the stadiometer headpiece digital display to read 80 cm by pressing the + or – button. Note in the comment box that the stadiometer was recalibrated.

2.5.3 Skinfold Calipers

- Follow the same procedures as for start of stand. Zero the calipers before starting the calibration procedures. Place the step wedge standard between the caliper arms at each of the four steps, and check that the reading falls within the acceptable range.
- Record the measurement taken at each step in the QC Checks Weekly dialog box Result field. Click the Done box corresponding to the skinfold calipers when the calibration is complete. An identical calibration should be done on the spare set of skinfold calipers and the corresponding measurements also recorded in the QC Checks dialog box.
- If the caliper readings fall outside the acceptable range at any level, use the other set of calipers and inform the MEC manager. They will be returned to the manufacturer for adjustment.
- If the calipers become too loose, use the spare set of calipers and inform the MEC manager.
- The acceptable ranges for the step wedge readings are as follows:

first step	9.8 – 10.5	third step	29.9 – 30.5
second step	19.8 – 20.5	fourth step	39.8 – 40.4

2.6 Daily Calibration Procedures

The scale is the only piece of equipment that will need to be calibrated daily.

2.6.1 Digital Weight Scale

- The scale is a fairly rugged piece of equipment that does not need frequent formal calibrations. However, to ensure it is functioning properly, you must do a “rough” calibration daily. First, step on the scale and weigh yourself, noting your weight. Second, add one or two 10 pound calibrated weights and check to make sure the displayed weight increases accordingly. Then capture this in the QC Checks Daily dialog box.
- If there is any reason to believe that the scale is not accurate, contact the MEC manager. The scale will need to be recalibrated by the service representative.

2.7 Care and Maintenance

To ensure the equipment functions properly and is hygienic, it must be maintained on a regular basis.

2.7.1 Cleaning Equipment

- At the beginning of each stand, and at the end of each examining day, wipe the surfaces of the sliding calipers, skinfold calipers, and tape measures with alcohol.
- Clean the stadiometer and infantometer aluminum track daily with a damp cloth.
- Lubricate the stadiometer and infantometer aluminum track as needed with CRC 3-36. Do this only at the end of an examination day.
- Clean the acrylic parts of the stadiometer and infantometer with antistatic plastic cleaner.
- Clean the digital displays with a dry cotton cloth. Do not allow any fluids to drip into the display housing.

2.7.1.1 Maintenance for the Infantometer

- Each day check that the foot board moves up and down the track smoothly. If not, apply a small amount of lubrication (see Cleaning Equipment, Section 2.7.1). If the operation is still not smooth, inform the MEC manager.

2.7.1.2 Maintenance for the Stadiometer

- Each day check that the upright Plexiglas bar moves up and down the track smoothly.

- Check that the horizontal bar is firmly attached to the upright sliding section and that the section operates smoothly. If it does not, clean the upright bar with a damp cloth and lubricate the track with CRC 3-36 at the end of the day.

2.7.1.3 Maintenance for the Skinfold Calipers

"Zero" the calipers each time you take a measure. Check to make sure the pointer is clearly reading zero. If not, loosen the flat screw on top of the dial, turn the dial slowly and gently until the pointer reads zero and then turn the screw tight again.

2.7.2 Malfunctions

Report any malfunctions of the body measurement equipment to the MEC manager. Back-up equipment is provided in each MEC to be used until malfunctioning equipment can be repaired or replaced.

2.8 End of Stand Procedures

At the end of each stand, it is the responsibility of the health technicians to prepare the body measurement room and equipment for moving. The following procedures are to be observed.

2.8.1 Calibration Procedures

You will need to calibrate the digital scale before preparing it for travel. Follow the same procedures you used for the Start of Stand and Mid-Stand Calibration.

- Place all six of the 50 pound calibrated weights on the scale and capture the weight in the QC Checks dialog box, Start of Stand tab. Click the Done box corresponding to the scale when the calibration is complete.
- If there is any reason to believe that the scale is not accurate, notify the MEC manager to have the scale recalibrated by a service representative.

2.8.2 Pack-Up Procedures

You will need to pack-up all the supplies and equipment before closing up the MEC. Remove the supplies (e.g., alcohol, gauze pads, cosmetic pencils) and equipment (e.g., small sliding calipers, skinfold calipers, head circumference tape) from the baskets and put them in the drawers. Discard any leftover CRC 3-36; leaving it in the MEC or in a vehicle can be a fire hazard.

Additional procedures are needed for the calipers, scale, stadiometer, infantometer, and measurement box. These are described below.

2.8.2.1 Calipers

- Place the mediform calipers in the protective cases; store them in the third drawer of the cabinet.
- Place the skinfold calipers in the protective cases; store them in the third drawer of the cabinet.

2.8.2.2 Digital Weight Scale

- Place the cover on the scale.
- Put the seat above the scale down.

2.8.2.3 Stadiometer

- Push the headpiece to the bottom of the measurement column.
- Check to ensure that the screws at the top of the measurement column are in place. If necessary, tighten by giving them a few turns.

2.8.2.4 Infantometer

- Push the footpiece to the far left side of the infantometer.
- Place the strap around the metal base of the footpiece and attach the ends of the strap to the hooks on the wall.

- Wrap the bar code wand in padding and place between the footpiece and the end of the infantometer.

2.8.2.5 Measurement Box

- Push the box up against the stadiometer with the square piece of foam padding separating the two pieces of equipment. Secure the box by placing the strap around two legs of the box and attaching each end of the strap to a hook on the wall.

2.8.2.6 Body Measurement Cabinet

- All the equipment and supplies will be placed in the body measures cabinet for storage between stands. Each piece of equipment and all supplies will have a designated and labeled space for storage.
- Discard the plastic trash bag hung under the desk.

3. EXAMINATION PROTOCOL

3.1 Eligibility Criteria

All SPs are eligible for the body measurement component. Specific measurements are completed dependent on the age of the SP. Table 3-1 lists the SP age groups and the corresponding measurements, in the sequence they will be measured.

3.2 Pre-examination Procedures

Table 3-1. Body measurements, by age

Birth+	2mo+	2yr+	4yr+	8yr+
Weight	Weight	Weight	Weight	Weight
Recumbent length	Recumbent length	Recumbent length (through 47mos)		
Head circumference	Head circumference (through 6mo)			
		Standing height	Standing height	Standing height
				Upper leg length
				Maximal calf circumference
	Upper arm length	Upper arm length	Upper arm length	Upper arm length
	Arm circumference	Arm circumference	Arm circumference	Arm circumference
		Waist circumference	Waist circumference	Waist circumference
				Thigh circumference
	Triceps skinfold	Triceps skinfold	Triceps skinfold	Triceps skinfold
	Subscapular skinfold	Subscapular skinfold	Subscapular skinfold	Subscapular Skinfold

3.2.1 Measuring and Recording Guidelines

Body measurements are always taken on the right side of the body unless the SP has a cast, amputation, or for some other reason the measurement cannot be taken on the right side. When this occurs, take the measurement on the left side of the body.

All measurements, except skinfolds, should be taken to the nearest tenth of a centimeter or 1.0 millimeter. Skinfold measurements are taken to the nearest 0.1 millimeter. The computer will alert the recorder to all measures that are less than the 1st percentile or greater than the 99th percentile. The examiner will verify the measurement before going to the next measure

3.3 Examination Procedures

This section includes the protocol procedures and the examination screens. The protocol procedures explain in detail how to take the body measures. The examination screens illustrate how to enter the data and move through the screens.

3.3.1 Protocol Procedures

A total of 12 body measures will be collected in the Anthropometry exam. Depending on the SP's age, a minimum of 3 and a maximum of 10 measures will be taken.

3.3.1.1 Weight

The SP's weight will be taken on a Toledo digital scale. Weight will be measured in pounds and converted to kilograms in the automated system. Infants should wear only diapers and children and adults should wear only underwear, disposable paper gowns, and foam slippers. (Women should wear underpants only.) Infants and toddlers who can't stand unassisted will be weighed with an adult. Have the parent or technician stand alone on the platform, tare the scale, and have the person on the scale hold the infant or toddler to obtain only the child's weight. Holding the child will provide greater security and reduce movement that might otherwise affect the accuracy of the measurement. Instruct older children and adults to stand still in the center of the scale platform facing the recorder, hands at side, and looking straight ahead. When the SP is properly positioned and the digital readout is stable, the recorder will click

on the capture button on the screen. If the examinee weighs more than 440 pounds, use two Seca digital scales (located in the fourth drawer of the cabinet), have the SP stand with one foot on each scale, and add the weight on each scale to obtain an approximation of their weight. Enter this into the weight box of the screen. Do not weigh examinees in torso casts, but ask them to estimate their weight and then document this estimation in the comment section of the automated system. In the event of a power outage or if the scale is not functioning properly, use a Seca digital scale. Turn the scale on by pressing the "On" button, and have the SP stand on the scale as described above. Call the weight to the recorder, who will enter it into the weight box of the automated system.

3.3.1.2 Standing Height

Standing height is an assessment of maximum vertical size. Take this measure on all SPs 2 years and older, who are able to stand unassisted. Standing height is measured with a fixed stadiometer with a vertical backboard and a moveable headboard. Have the SP move or remove hair ornaments, jewelry, buns, braids, and corn rolls from the top of the head in order to measure stature properly.

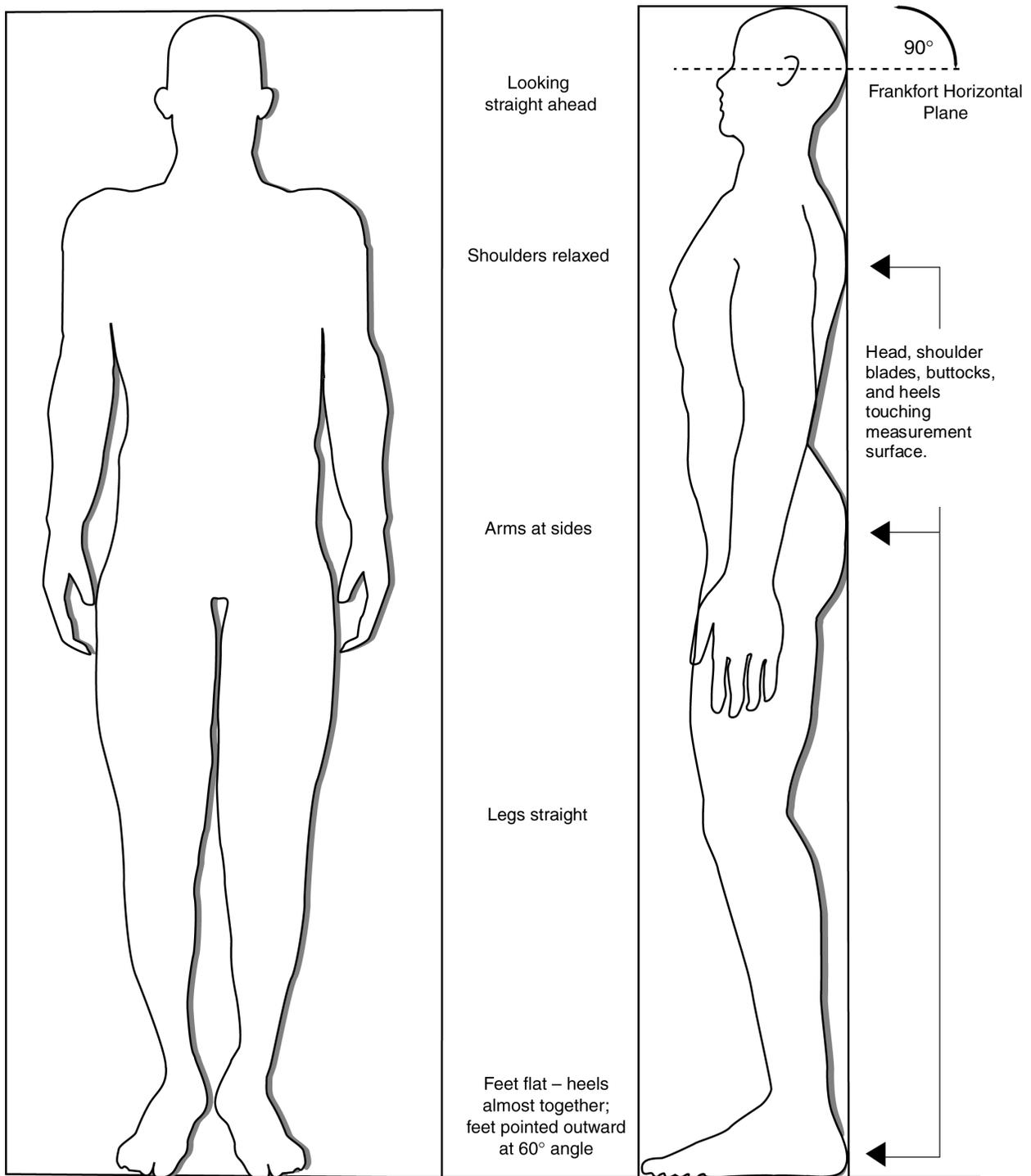
Have the SP stand on the floor (see Exhibit 3-1) with the heels of both feet together and the toes pointed slightly outward at approximately a 60° angle. Make sure the body weight is evenly distributed and both feet are flat on the floor. Check the position of the heels, the buttocks, shoulder blades, and the back of the head for contact with the vertical backboard. Depending on the overall body conformation of the individual, all points may not touch. In such case, make sure the SP's trunk is vertical above the waist, and the arms and shoulders are relaxed.

Align the head in the Frankfort horizontal plane. The head is in the Frankfort plane when the horizontal line from the ear canal to the lower border of the orbit of the eye is parallel to the floor and perpendicular to the vertical backboard. Many people will assume this position naturally, but for some it may be necessary to make a minor adjustment. If required, gently tilt the head up or down until proper alignment is achieved with eyes looking straight ahead. Once correctly positioned, lower the headboard and instruct the SP to take a deep breath and stand as tall as possible. A deep breath will allow the spine to straighten, yielding a more consistent and reproducible stature measurement. Position the headboard firmly on top of the head with sufficient pressure to compress the hair. When the SP is properly positioned, tell the recorder to "capture" the height. Hold the headpiece in position until the computer verifies the reading. Then have the SP relax and step away from the stadiometer. In the event of a power outage or if the stadiometer is not functioning properly, push the headpiece to the top of the measurement

column and obtain the SP's height using the tape measure mounted on the right side of the measurement column. Call the height to the recorder, who will enter it in the height box of the automated system.

Some SPs may have conditions that interfere with the specific procedures for measuring stature. One of the more common conditions is kyphosis. Kyphosis is a forward curvature of the spine that appears as a hump or crooked back condition. Kyphosis most frequently occurs in the elderly, and in women the condition is commonly referred to as dowager's hump. In these cases it is important to get the best measure possible according to the protocol. Then select the "NS" (not straight) comment.

Exhibit 3-1. SP position for standing height



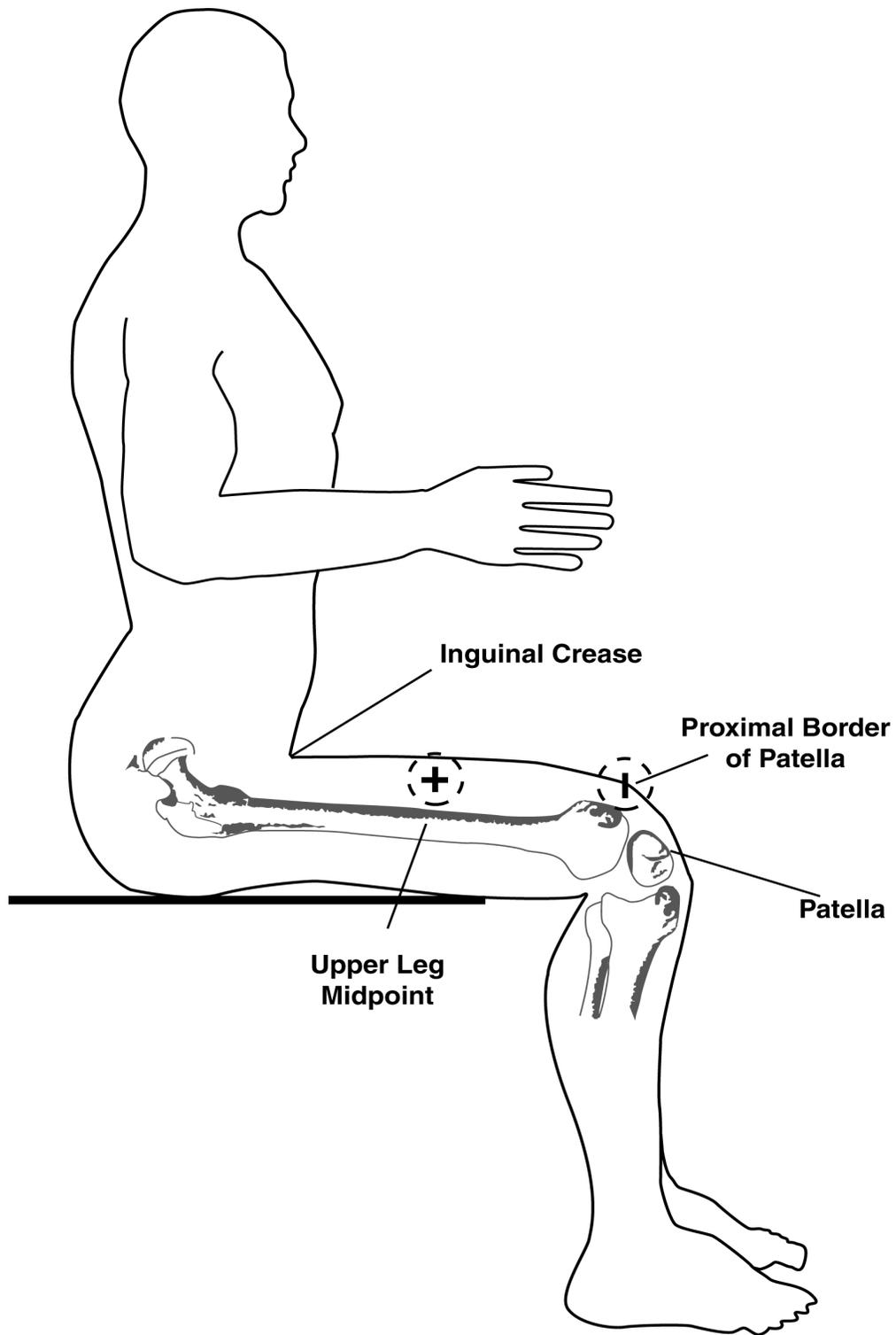
3.3.1.3 Upper Leg Length

To reliably measure circumferences on the legs, the leg length must first be measured and the midpoint located and marked. The measuring box should be against the far wall near the exit door

when the SP enters the room. Have the SP sit on the measuring box with the right knee bent at a 90° angle. Cut the right leg of the SP's exam pants up the leg so that the skin can be marked. Reassure the SP that the pant leg will be retaped after the body measurements are completed.

Position the small sliding caliper as if you were measuring the breadth of the patella. Position the caliper blades against the distal end of the femur on either side of the patella. The horizontal bar of the caliper should be touching, or close to the anterior surface of the thigh, proximal to the patella. Using the superior edge of the horizontal bar of the caliper as a guide, mark a line with a wax-based cosmetic pencil on the anterior surface of the thigh. Place the zero end of the steel measuring tape at the inguinal crease, just below the anterior superior iliac spine (this is easily located if the hips are in a sitting position). Do not apply pressure at the inguinal crease. However, folds of fat tissue may have to be lifted on some obese SPs to measure at the crease. Lift the exam gown and pull the pants slightly to smooth out gathers. Extend the tape down the anterior midline of the thigh to the mark that was previously made proximal to the patella (see Exhibit 3-2). To check for proper location of the zero end, firmly place the thumb over the measuring tape at the site and instruct the SP to raise the thigh slightly. Positioned correctly, a tightening of the muscle tendon will be clearly felt. Call the length of the upper leg to the recorder to the nearest millimeter. The computer will divide this distance by two (which indicates the midpoint of the thigh) and will call out the midpoint. Make a mark on the skin at this midpoint before removing the measuring tape. Cross this mark (+) with another mark which should extend on a line between the anterior superior iliac spine and the middle of the patella. This point defines the point at which the midthigh circumference is measured. After measuring upper leg length, move the measuring box to the stadiometer, pushing it up against the measurement column. This will make more space available to take the remaining measurements.

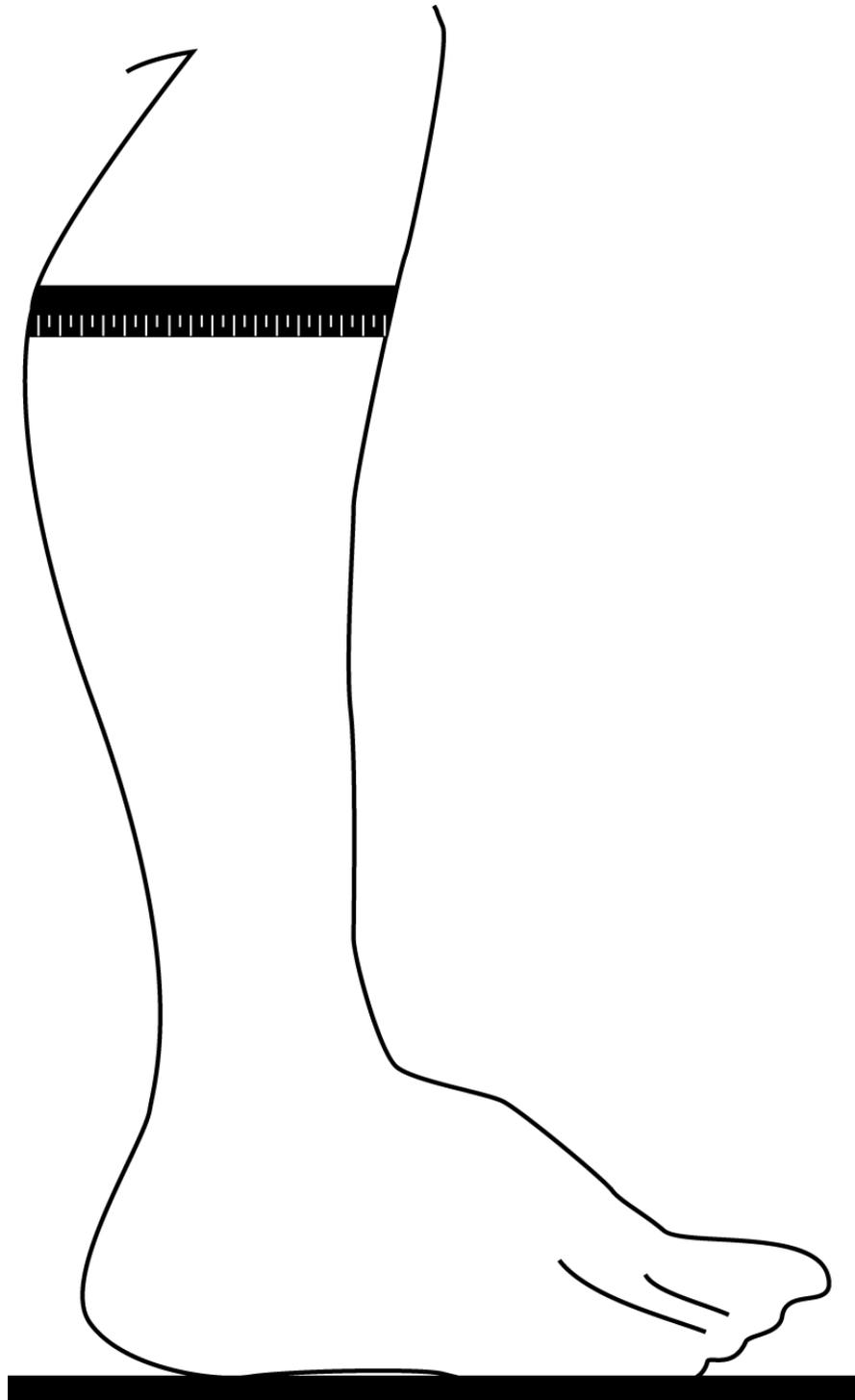
Exhibit 3-2. SP position for upper leg length location and upper leg midpoint



3.3.1.4 Maximal Calf Circumference

Measure the maximal calf circumference on the right calf (see Exhibit 3-3). While the SP is sitting, place the measuring tape around the calf and move it up and down to locate the maximum circumference in a plane perpendicular to the long axis of the calf. Hold the zero end of the tape below the measurement value, snugly but not tight. Call the calf circumference to the recorder to the nearest 0.1 cm. Ask the SP to stand, move away from the box, and turn toward the wall. Move the box to the base of the stadiometer. Then have the SP move toward the mirror, continuing to face the wall.

Exhibit 3-3. Measuring tape position for maximal calf circumference



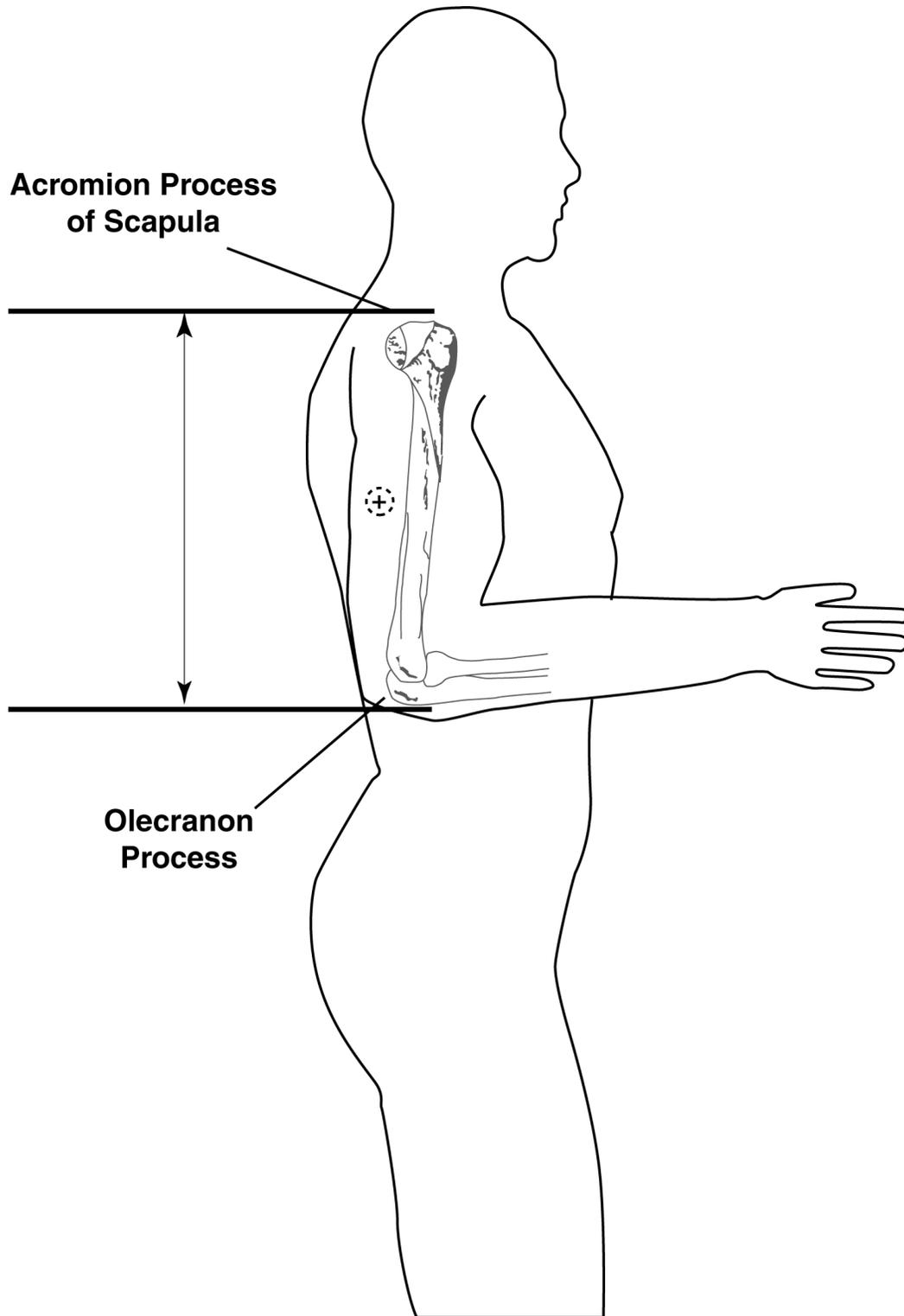
3.3.1.5 Upper Arm Length

To reliably measure circumferences and skinfolds on the arm, upper arm length must first be measured and the midpoint located and marked. Stand behind the SP to locate the middle of the upper arm. Have the SP stand erect with feet together and the right arm flexed 90° at the elbow with the palm facing up. On the right scapula, locate and mark with a horizontal line the uppermost edge of the posterior border of the acromion process (see Exhibit 3-4). This is also the best point at which to mark the inferior angle of the scapula in preparation for measuring the subscapular skinfold (see Section 3.3.1.9.2). Hold the zero end of the measuring tape at this mark and extend the tape down the posterior surface of the arm to the tip of the olecranon process (the bony part of the mid-elbow). Call the length of the upper arm to the recorder to the nearest millimeter, keeping the tape in position. The computer will divide the distance by two and call out the midpoint. Make a horizontal mark with a cosmetic pencil at the midpoint at the posterior aspect of the arm. Cross this mark (+) with another mark that lies in a plane extending from the acromion to the olecranon process. This point defines the site at which both the midarm circumference and the triceps skinfold are measured.

3.3.1.6 Arm Circumference

Measure the arm circumference with the subject standing upright, shoulders relaxed, and the right arm hanging loosely. It is important to be certain that the muscle of the arm is not flexed or tightened, which could yield a larger and inaccurate reading. Stand facing the SP's right side and place the measuring tape around the upper arm at the crossed point (+), perpendicular to the long axis of the upper arm. Hold the measuring tape gently on the skin's surface. Pull the two ends of the overlapping tape together so that the zero end is held below the measurement value and the measurement is taken on the lateral aspect of the arm. Use care not to compress the skin and the underlying subcutaneous tissue. Call the arm circumference measurement to the recorder to the nearest millimeter. Write the arm circumference on the gown for all SPs aged 8 years or older; this measurement will be used in the Physician and LED components if the SP is sent to them after completing the Anthropometry component.

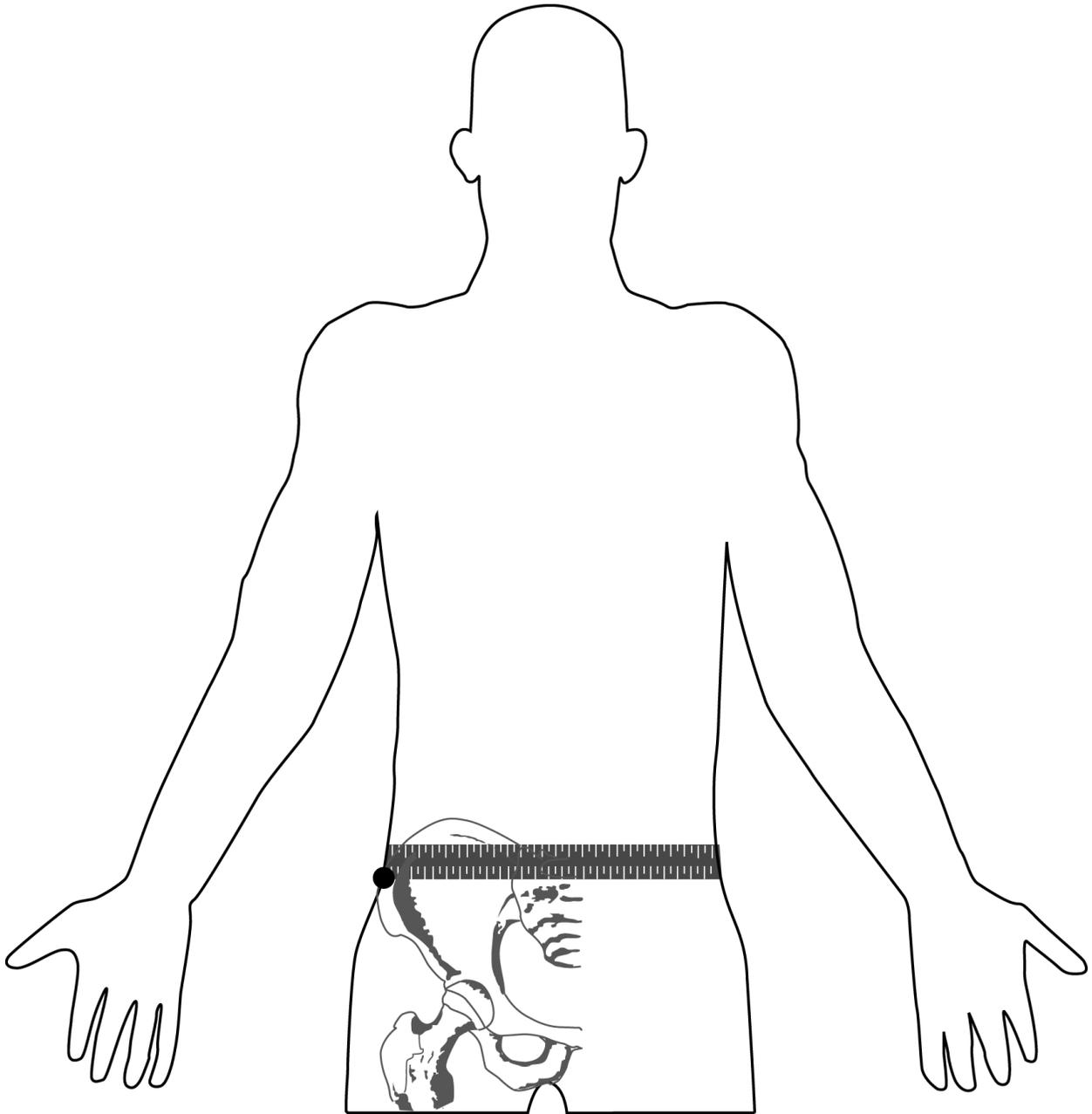
Exhibit 3-4. SP position for arm length and location of upper arm midpoint



3.3.1.7 Abdominal (Waist) Circumference

To define the level at which the waist or abdominal circumference is measured, you must first locate and mark a bony landmark, the lateral border of the ilium. Have the SP stand and hold the examination gown above the waist. Lower the pants and underclothing of the SP slightly, and standing behind and to the right of the SP, palpate the hip area to locate the right ilium (see Exhibit 3-5). Draw a horizontal line just above the uppermost lateral border of the right ilium and then cross the line to indicate the midaxillary line of the body. Standing on the SP's right side, place the measuring tape around the trunk in a horizontal plane at the level marked on the right side of the trunk. Hold the zero end below the measurement value. Use the mirror on the wall to ensure correct horizontal alignment of the measuring tape. This is especially useful when measuring overweight SPs or women with hourglass-shaped torsos. The recorder should also observe the SP to make sure that the tape is parallel to the floor and that the tape is snug, but does not compress the skin. Make the measurement at the end of a normal expiration and call it to the recorder to the nearest millimeter.

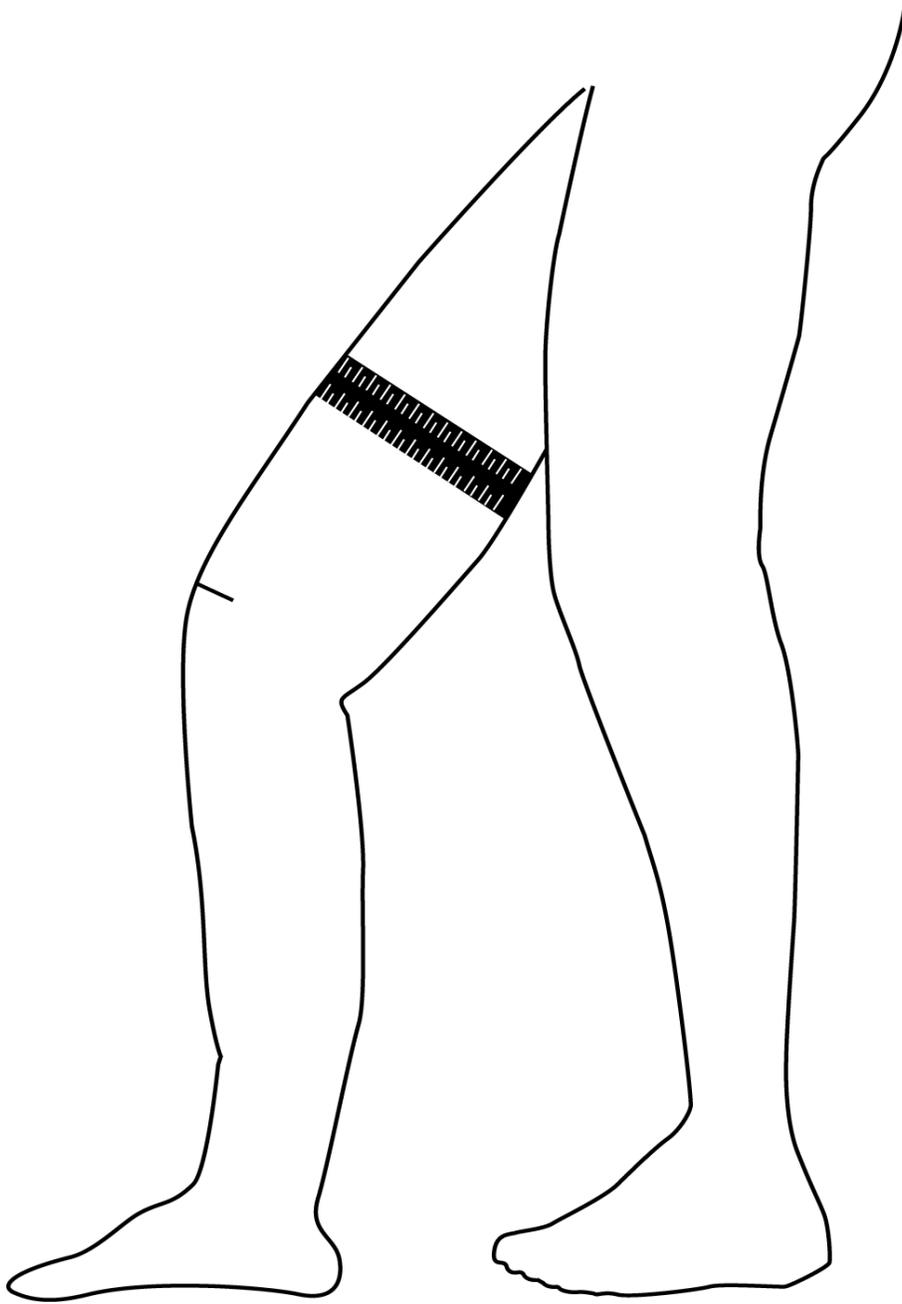
Exhibit 3-5. Measuring tape position for abdominal (waist) circumference



3.3.1.8 Thigh Circumference

For thigh circumference (see Exhibit 3-6), a standardized position is required. Explain this to the subject while demonstrating the position. Have the SP turn towards the recorder. Tell him/her to stand with most of the weight on the left leg with the right leg forward, knee slightly flexed, and soles of both feet flat on the floor. The bar on the exit door or the edge of the examining table may be used for the SP to hold onto to maintain balance. Stand on the SP's right side and place the measuring tape around the midthigh at the point that is already marked by a (+). Position the tape perpendicular to the long axis of the thigh with the zero end of the tape held below the measurement value. Rest the tape firmly on the skin but without compressing it. The recorder should check to make sure the tape is positioned correctly. Call the thigh circumference to the recorder to the nearest millimeter.

Exhibit 3-6. Measuring tape position for thigh circumference



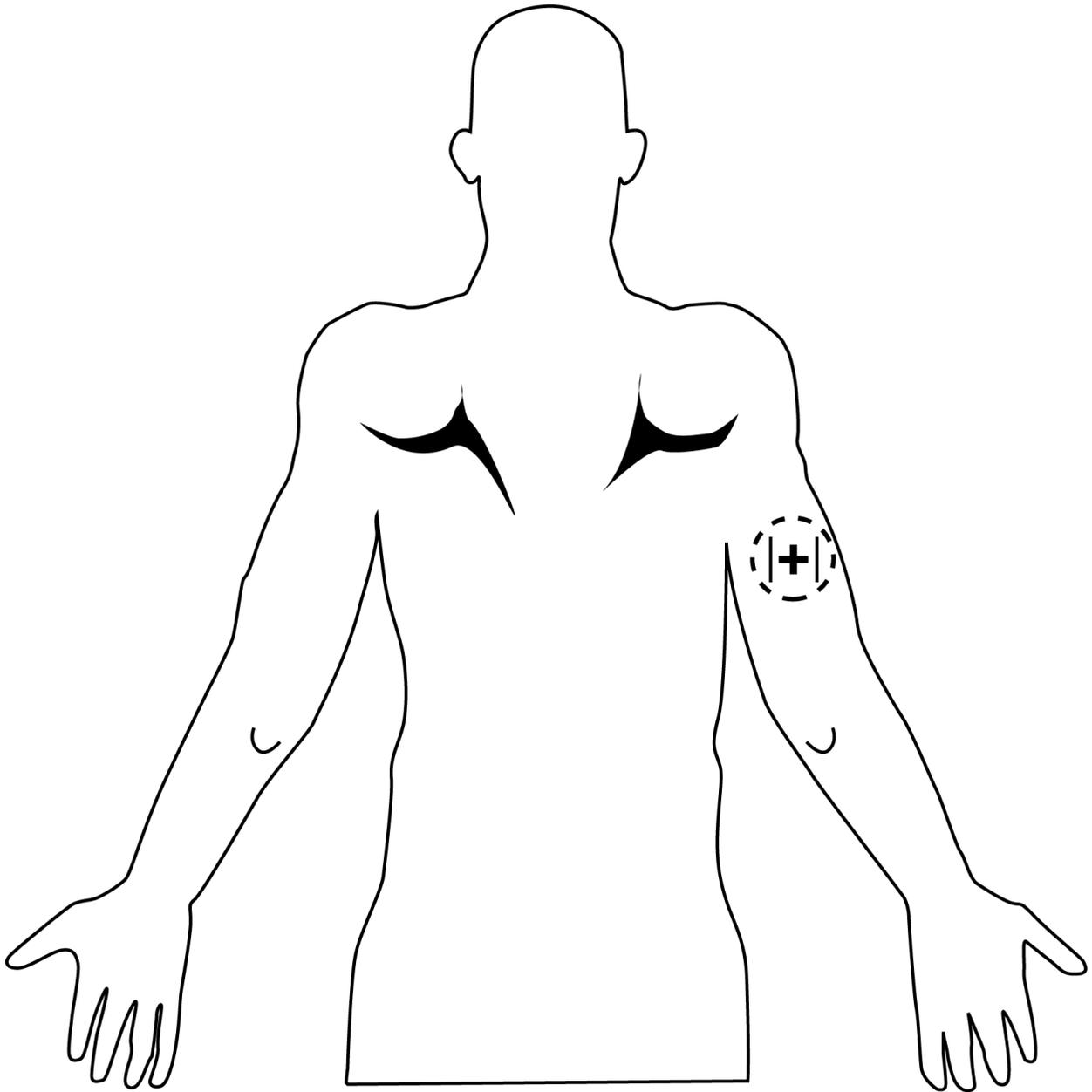
3.3.1.9 Skinfolds

Prior to measuring the skinfolds, you must mark each site carefully. Make all marks on the right side of the body. Use either a bony landmark on the trunk of the body or midpoints between two well defined bones on the limbs. In order to make young children comfortable with the measurement, explain the procedure and demonstrate the use of the caliper on the child's palm. Take all measurements with the Holtain skinfold calipers. Gently grasp the fold of skin and underlying subcutaneous adipose tissue between your left thumb and index finger. The amount grasped will depend upon the thickness of the subcutaneous adipose tissue. Grasp enough skin and adipose tissue to form a distinct fold that separates from the underlying muscle. The sides of the fold should be roughly parallel. The skinfold should be grasped 2.0 cm above the place the measurement is to be taken, and gently held with the thumb and forefinger. Place the jaws of the calipers perpendicular to the length of the fold. Measure the skinfold thickness to the nearest 0.1 mm while the fingers continue to hold the skinfold. Read the actual measurement from the caliper about 3 seconds after the caliper tension is released. Call the skinfold measurement to the recorder before releasing the fold. Remove the caliper, then release the fold of skin and subcutaneous fat. Measure to the nearest 0.1 mm. When a distinct fold of skin and subcutaneous fat cannot be made with confidence, enter the appropriate comment code that explains the situation

3.3.1.9.1 Triceps Skinfold

Measure the triceps skinfold on the posterior surface of the right upper arm, at the point previously marked for the mid upper arm circumference. Have the SP stand upright with weight evenly distributed and feet together, shoulders relaxed, and the arms hanging freely at the sides. Stand behind the SP's right side and gently grasp a fold of skin and subcutaneous adipose tissue with thumb and index finger, approximately 2.0 cm above the marked point. The skinfold should be parallel to the long axis of the arm (see Exhibit 3-7). Place the tips of the caliper jaws over the marked point, perpendicular to the length of the fold. Measure the skinfold thickness to the nearest 0.1 mm while the fingers continue to hold the skinfold. Call the measurement to the recorder before releasing the fold and the caliper.

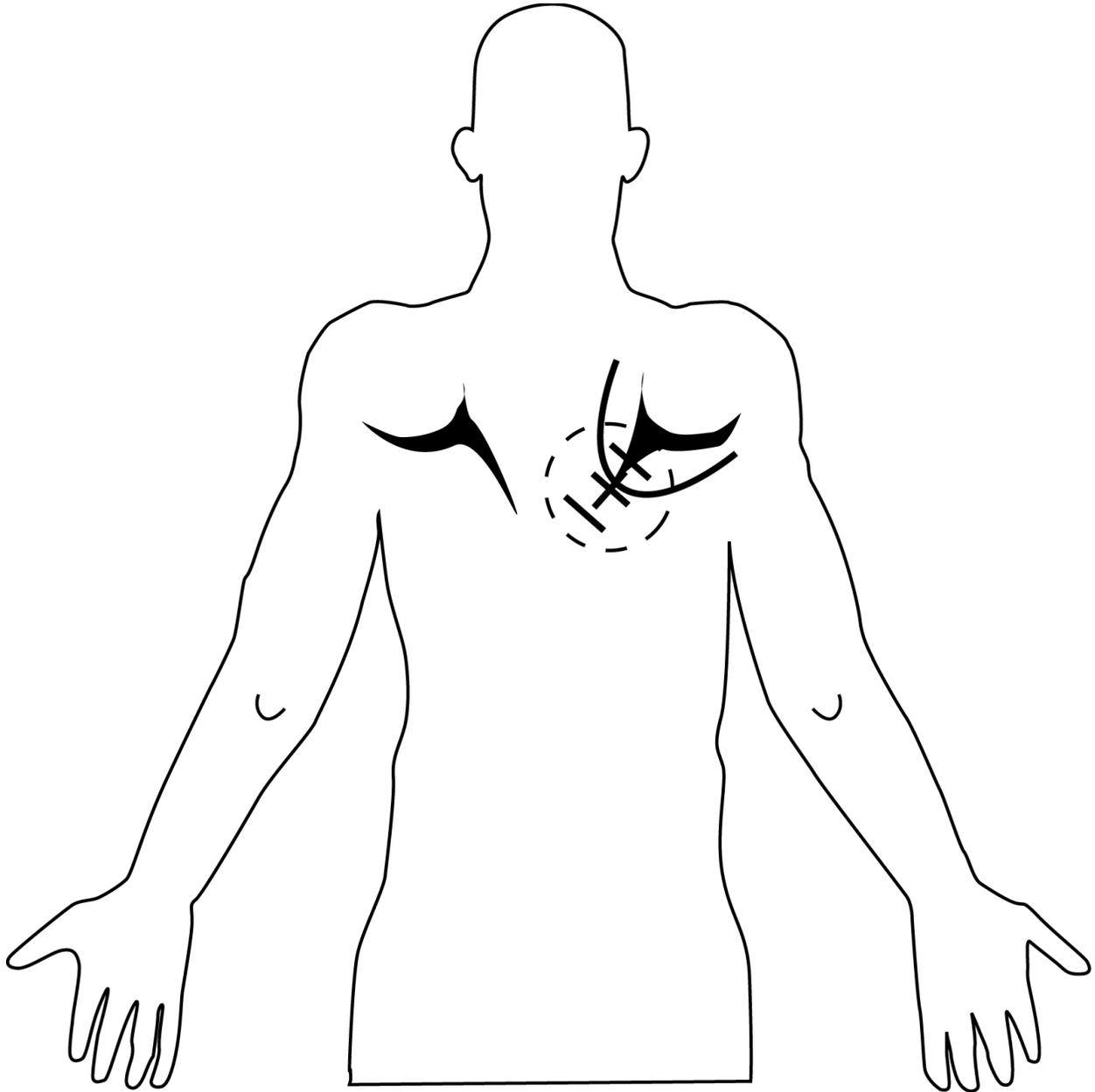
Exhibit 3-7. Location of triceps skinfold



3.3.1.9.2 Subscapular Skinfold

Measure the subscapular skinfold with the SP standing erect with shoulders relaxed and arms hanging loosely at the side. Open the back of the examination gown and palpate for the inferior angle (or triangle portion) of the right scapula. Make a cross (+) on the inferior angle of the scapula with the cosmetic pencil marker. (The measures flow more smoothly if this mark is done after marking the acromium process of the scapula, prior to measuring upper arm length.) Gently grasp a fold of skin and subcutaneous adipose tissue with the index finger directly above (1.0 cm) and medial to the inferior angle of the scapula, with the thumb reaching toward the spine. The skinfold should form a line about 45 degrees below the horizontal extending diagonally toward the right elbow (see Exhibit 3-8). Place the tips of the caliper jaws perpendicular to the length of the fold about 2.0 cm lateral to the fingers with the top jaw of the caliper on the mark over the inferior angle of the scapula. Measure the skinfold thickness to the nearest 0.1 mm while the fingers continue to hold the skinfold. Call the measurement to the recorder before releasing the fold and the caliper.

Exhibit 3-8. Location of supscapular skinfold



3.3.1.10 Sequence of Measurement Components, SP Position, and Examiner Equipment for SPs 4+

Measurement	SP Position	Equipment
1. Weight	Standing	Scale
2. Standing height	Standing	Stadiometer
3. Upper leg length (mid-mark is placed on SP) (8 + only)	Sitting on box Right pant leg open	Small sliding caliper Cosmetic pencil Measurement box
4. Maximal calf circumference (8+ only)	Sitting on box	Steel tape
5. Upper arm length (mid-mark is placed on SP)	Standing	Steel tape Cosmetic pencil
6. Arm circumference	Standing	Steel tape
7. Waist circumference (mark iliac crest)	Standing Hold gown up	Steel tape Cosmetic pencil
8. Thigh circumference (8+ only)	Gather side seams of exam pants Standing Hold gown up Right pant leg open	Steel tape
9. Triceps skinfold	Standing	Skinfold calipers
10. Subscapular skinfold	Standing	Skinfold calipers

3.3.1.11 Measuring Children under 8 Years of Age

The same procedures are followed for measuring stature and weight of children aged 2 through 7 years, as used for older SPs. For measuring circumferences or skinfolds, the child may stand on the measuring box to allow the examiner to obtain measures at eye level. If the child is going to stand on the box, move it towards the mirror so that the child can hold onto the bar on the wall for support. If the child is too young to sit or stand by himself, take the measurements with the child sitting in the parent's lap. The examiner's eyes must be level with the calipers to prevent parallax. Otherwise, use the same procedures as that for older SPs.

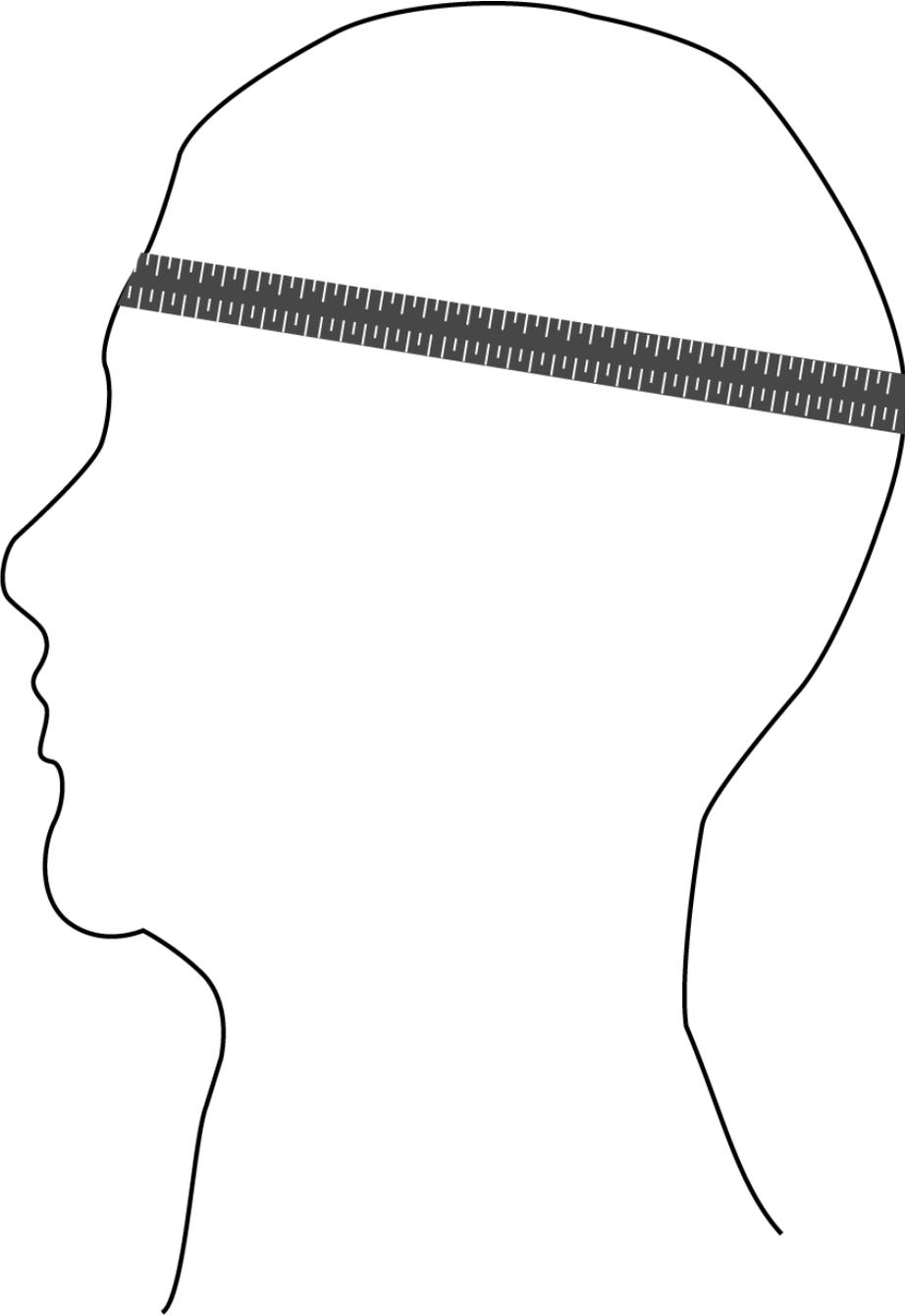
3.3.1.11.1 Recumbent Length

Recumbent length is measured on children less than 4 years of age (birth to 47 months). An Infantometer is used to take the measure. The measuring board has a fixed headpiece, a horizontal back piece, and a moveable foot piece. Placing infants and small children in a recumbent position frequently generates a sense of insecurity and consequently invokes a crying response. When measuring recumbent length the parent or other caretaker of the child should be positioned between the examiner and recorder. The parent should encourage and comfort the child by making eye contact, talking to, and if necessary, holding the head of a restless child. The recorder supports the child's head. Similar to the procedure with standing height, the child's head is positioned in the Frankfort plane. Gentle traction is applied to bring the top of the head in contact with the fixed headpiece. The child's head must be firmly held in this position by gently cupping the palms of the hands over the ears and holding the head in proper alignment. Simultaneously, the examiner aligns the child's legs by placing one hand gently but firmly over the knees. The toes point directly upward with the soles of the feet perpendicular to the horizontal backpiece of the measuring device. Gentle pressure is applied at the knees to keep the legs straight. The examiner then slides the moveable foot piece to rest firmly at the child's heels. When the child is properly positioned, the recorder will click on the capture button on the screen. In the event of a power outage or if the infantometer is not functioning properly, the examiner will position the child as described above and read the length using the tape measure mounted on the board of the infantometer. The examiner will then call this measurement to the recorder, who will enter it in the recumbent length box.

3.3.1.11.2 Head Circumference

This measurement is done on children from birth through 6 months (see Exhibit 3-9). The child either sits in the parent's lap, on the footstool, or stands, depending upon age and activity level. The insertion tape is placed across the frontal bones just above the eyebrows, around the head above the ears on each side, and over the occipital prominence at the back of the head. The examiner holds the insertion tape snugly around the head. Hair ornaments and braids should be removed. The insertion tape is moved up and down over the back of the head to locate the maximal circumference of the head. The insertion tape should be perpendicular to the long axis of the face and should be pulled firmly to compress the hair and underlying soft tissues. Record the measurement to the nearest 0.1 cm.

Exhibit 3-9. Insertion tape position for head circumference



3.3.1.12 Measuring Handicapped SPs

Only limited anthropometric data can be collected on those SPs who are handicapped (in wheelchairs):

- Upper arm length is measured as if the SP were standing. It is necessary to position the SP over to the right side of the wheelchair so that the arm of the chair does not restrict the right arm.
- Arm circumference is also measured as if the SP were standing. The SP should be in the same position in the wheelchair as for measuring upper arm length. Again, it is important that the right arm is extended so that it is not restricted by the arm of the wheelchair.
- The triceps skinfold is measured on the back of the right arm as if the SP were standing. The position of the SP and the right arm are the same as for measuring arm circumference.
- Head circumference can be recorded in the same manner as an ambulatory child.

3.3.1.13 Measuring Amputees

Although the number of people with these conditions will be small, for SPs who have any part of a limb on the right side amputated, the procedure is to collect the data on the SP's left side. This will, in most cases, eliminate the possibility of missing data (i.e., CNO [could not obtain]) for these situations.

For example, if the SP has any part of his/her right arm missing, you would do the Upper Arm Length measure, and mark the midpoint on the left arm. Additionally, you would measure the Arm Circumference and Triceps Skinfold on the left arm. If however, the SP has both arms missing, you would need to enter CNO in the Comment box for these three measures.

Be sure to enter this information accurately in the Amputations Screens before entering the status and finishing the exam. In these screens you will need to indicate the specific extremity(ies) which were missing. (see Section 3.3.2 and Exhibit 3-22)

3.3.1.14 Tips for Anthropometry

3.3.1.14.1 General Comments

- Talk to the SP as you are moving through the measurements. Explain why and what you are doing, especially when locating the leg tendon in the groin area, and before *adjusting the pants down* to feel for the hip bone.
- Remain completely professional and unaffected by tattoos, body piercings etc. DO NOT COMMENT about the SP's body.
- When you are taking the circumference and skinfold measurements, remember to stay in one place and move the SP around, rather than moving around the SP.

3.3.1.14.2 General Comments for Children

- Unless they are too big, always place children 2-6 years old on the box so that you can control their movements and take the measurements at eye level. Be sure the box is moved towards the mirror so that the child can hold on to the bar on the wall for balance.
- For maximum control when measuring the arm circumference and skinfold of an infant, have the parent seated on the box with the infant situated over the left shoulder.
- When measuring the length of infants, make sure the head is in the Frankfort plane and that at least one leg is straight and the foot flexed. Remember, to get the child to flex his foot, run your fingernail down the inside of the foot.
- Make sure you have the mouse positioned on the 'GET' button before positioning the child, so that you can quickly capture the length. The only time you should enter the recumbent length manually is when you have no way of holding the children still while you capture the length.
- Do not let the calipers become the object of the child's attention. Keep them behind your body until you are ready to take the measure. It often helps to warm them up by holding them in your hand.

3.3.1.14.3 Standing Height

- Make sure the head and heels are against the stadiometer before taking the height, unless this position is anatomically impossible. DO NOT FORGET to have the SP take a deep breath and hold it while you position the headboard. If the SP is unable to stand with the head and heels against the stadiometer, make sure the trunk is vertical above the waist, and that the arms and shoulders are relaxed.

3.3.1.14.4 Upper Arm Length

- Locate the acromium by following the scapula out to the arm until it makes a sharp turn to the front of the body. Draw the line on the bone before it turns to the front.
- Bring the tape measure out before bringing it down to ensure the tape is in the middle of the arm.
- Place 1-2 fingers under the elbow to make a 90° angle. Take the measure at that point.

3.3.1.14.5 Maximal Calf Circumference

- Slide the tape measure up and down the calf to find the widest point. Take the measure there..

3.3.1.14.6 Skinfolts

- Take the measurements at eye level.
- If the triceps skinfold is hard to separate, start at the elbow (where the skin/fat is looser), and work up to the mark.
- If skinfolts are tight, take measure closer than $\frac{3}{4}$ inch to your fingers.
- For the subscapular skinfold, place the fingers $\frac{3}{4}$ inch above the X; only the top jaw of the caliper needs to be **ON** the X.

3.3.2 Examination Screens

Once the coordinator has assigned an SP to the body measures room, a communication dialog box from the coordinator will appear to let you know that an SP has been assigned to body measures. Click on the Close button to remove the dialog box from the screen.

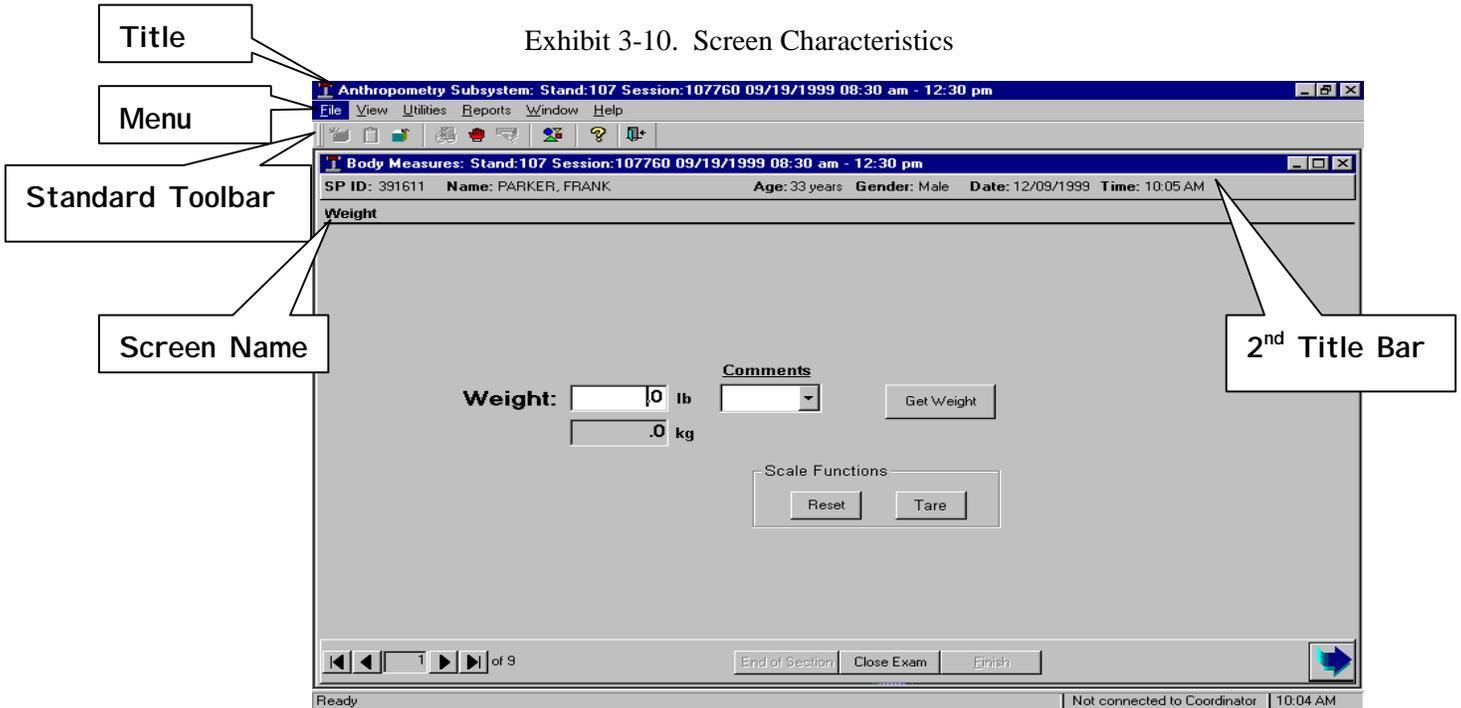
Move the mouse pointer to the first icon on the left in the Standard toolbar. This is the "Logon SP" icon. Click on this button to begin the examination. A dialog box will appear which will ask you for the *Examiner's* name and password. Wand the bar code on the SP's plastic bracelet to enter the ID. This will activate a dialog box containing descriptive information about the SP (i.e. name, SP ID, age, etc.). Confirm the name and check the age and sex to ensure you have the correct SP. Click OK to proceed with the exam.

3.3.2.1 General Screen Information

All screens have similar characteristics. As shown below, at the very top of the screen is a Title bar, with the component name (Anthropometry Subsystem), the Stand number, Session number, and the date and Session times. The Menu bar is just below the title bar, and the Standard toolbar icons are below the Menu bar. The Standard toolbar contains a row of buttons that provide shortcuts to menu commands as well as some other features. The Menu and Standard toolbars are described in the chapter on the MEC Automated System.

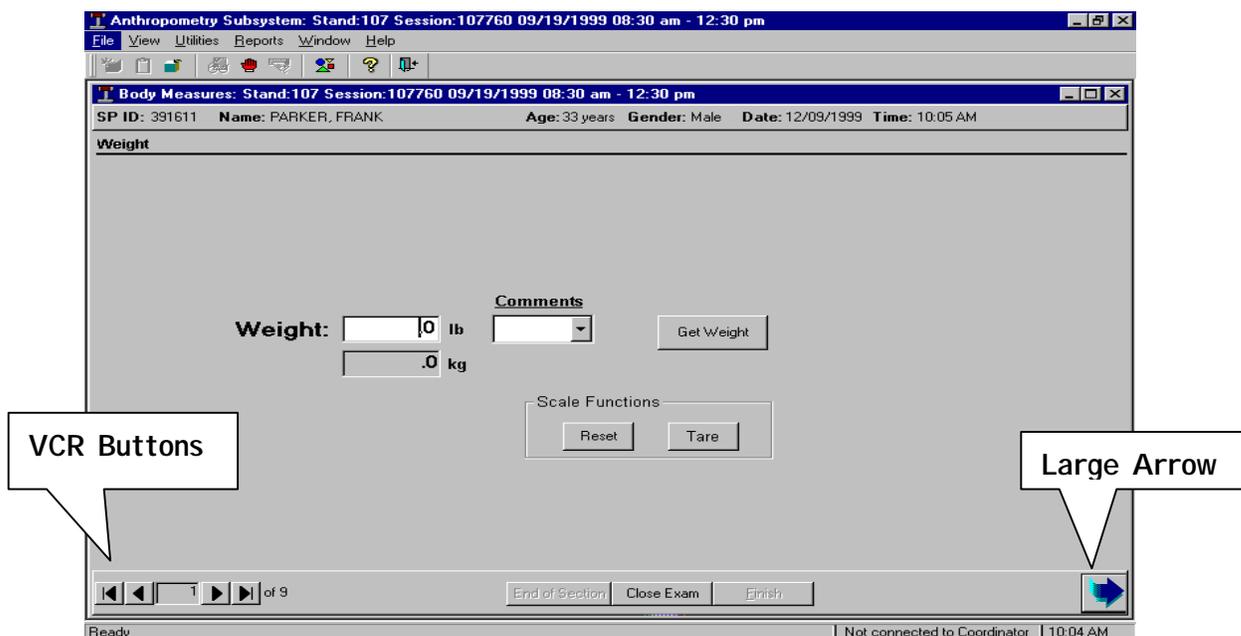
Just below the Standard toolbar is a second Title bar. This Title bar identifies the exam (Anthropometry Exam), the Stand number, Session number and the Session's date and time. Below the Title bar is the SP ID, name, age, gender, and the current date and time. Below this bar, at the top left of the main area of the window, is the screen name.

Exhibit 3-10. Screen Characteristics



At the bottom left side of the screen is a screen number with a set of VCR arrow buttons on each side. These buttons help you navigate through the screens. The button on the far left moves you to the first screen. Likewise, the button on the far right moves you to the last screen. The button directly to the left of the screen number moves you to the previous screen, and the button directly to the right moves you to the next screen. Clicking on the arrow button will move you through the screens. At the bottom of the screen in the middle are two buttons, "Close" and "Finish", and to the far right is a large arrow. Clicking on the large arrow will move you to the next screen.

Exhibit 3-11. Navigation Buttons



As you proceed through the examination entering data, you may activate an Edit Check box. This box will appear if you enter a measure in the system that is out of range (i.e., is less than the 1st or greater than the 99th percentile for the SP's age and sex). As shown below, the box reads "Check that measure." Read the box aloud to prompt the examiner to take another look at the measure.

Exhibit 3-12. Edit Check Box



3.3.2.2 Weight Screen

The **Weight** screen is always the first data entry screen that will appear. Weight is collected on all SPs, regardless of age. The cursor will appear in the Weight field. After the SP steps on the scale, you will move the pointer to the "Get Weight" button, and click. The SP's weight is captured and displayed in the Weight field. If needed, you can select a comment by clicking on the down arrow to the right of the Comments box to activate a drop-down list. If a weight was not captured, you must enter either EC for "exceeds capacity" or CNO for "could not obtain." If the weight was captured, but the SP had on clothes rather than a gown, enter CL for "clothing." If the weight was captured but was inaccurate due to a medical appliance, such as a cast which could not be removed, enter MA for "medical appliance".

If an infant or toddler SP cannot be weighed unassisted, they will be weighed with an adult. The parent or Examiner will stand alone on the scale platform while you click on the "Tare" button. Then the person on the scale will hold the SP while you move the pointer to the "Get Weight" button, and click. The system will capture the child's weight and display it on the screen. This procedure will assure that the weight is accurately collected. You will then move to the next screen by hitting "Enter" on the keyboard, or clicking on the large arrow in the lower right-hand corner.

Exhibit 3-13. Weight Screen

Anthropometry Subsystem: Stand:107 Session:107760 09/19/1999 08:30 am - 12:30 pm

File View Utilities Reports Window Help

Body Measures: Stand:107 Session:107760 09/19/1999 08:30 am - 12:30 pm

SP ID: 391611 Name: PARKER, FRANK Age: 33 years Gender: Male Date: 12/09/1999 Time: 10:05 AM

Weight

Weight: [] lb [] kg

Comments []

Get Weight

Scale Functions

Reset Tare

1 of 9

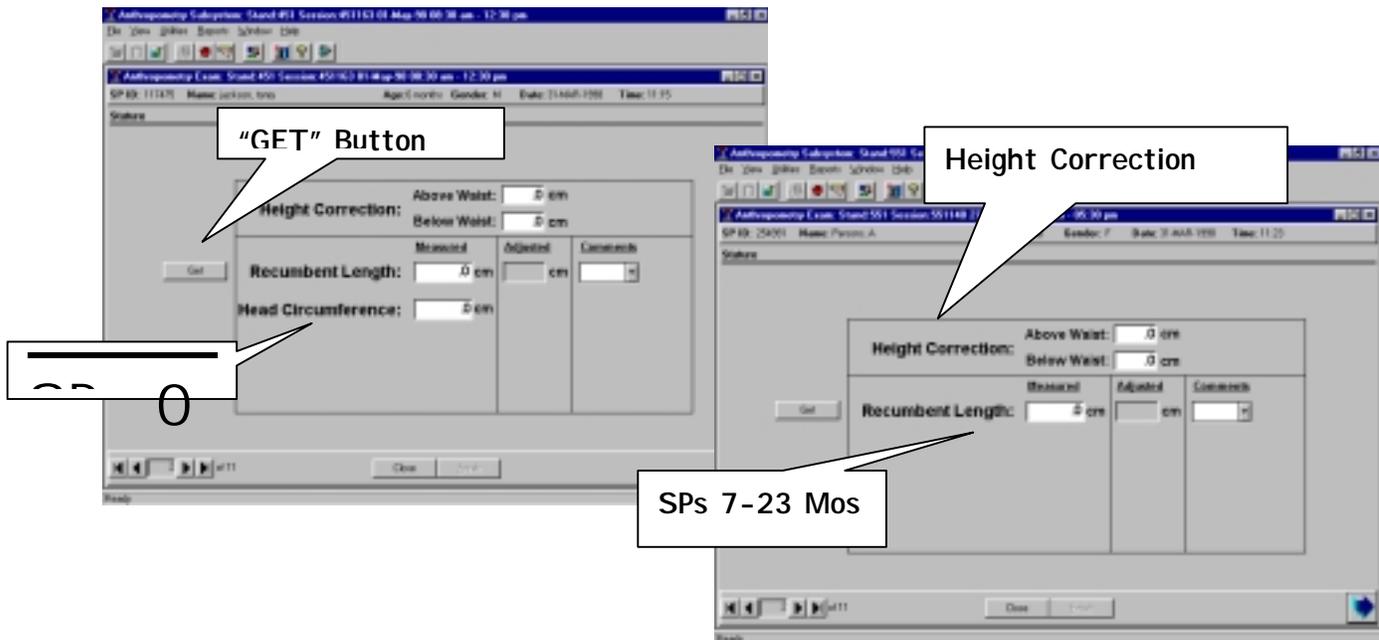
End of Section Close Exam Finish

Ready Not connected to Coordinator 10:04 AM

3.3.2.3 Stature Screen

The **Stature** screen is the second screen to appear. The measures on this screen are dependent on the age of the SP. The screen for SPs 0-6 months old will include Recumbent Length and Head Circumferences; the screen for SPs 7-23 months will only contain Recumbent Length; and the screen for SPs 24-47 months will include Recumbent Length as well as Standing Height. The stature screen displayed for all SPs 4 years of age or older includes Standing Height only.

Exhibit 3-14. Stature Screens, Depending on Age of SP

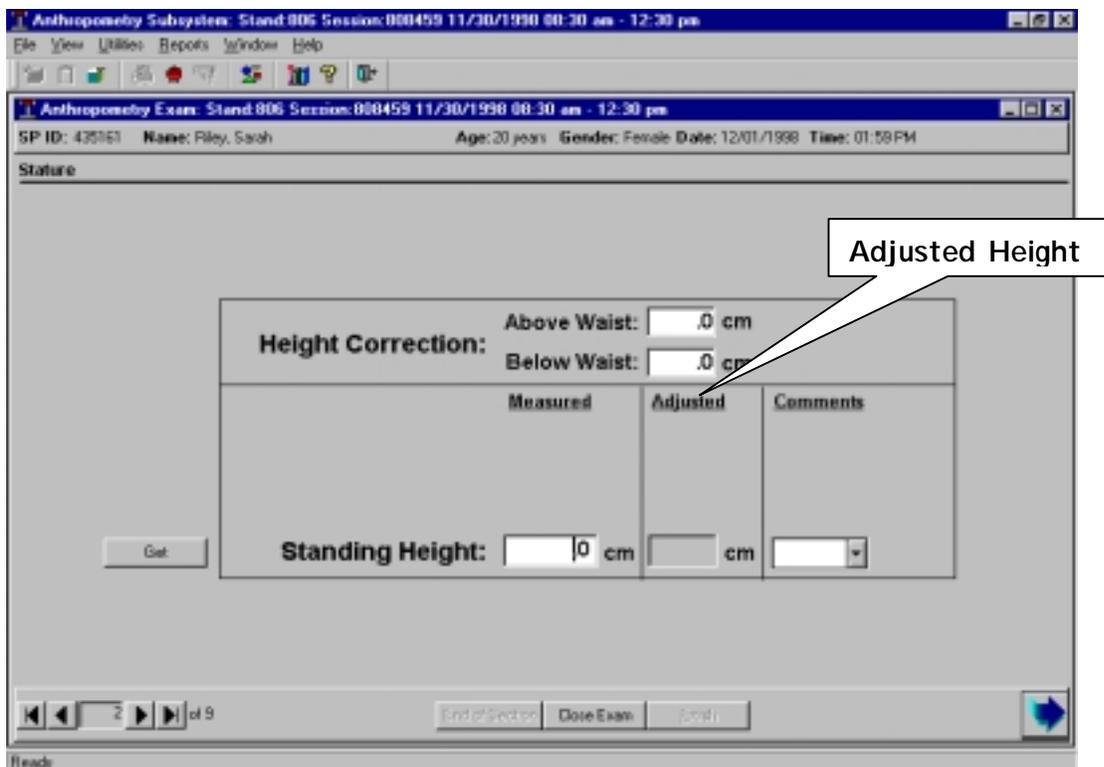


There are two fields for Height Correction located at the top of the screen. If an SP is wearing a hairpiece such as a barrette, braids, or a bun that they decline to remove for the measure, the examiner will measure the hairpiece with a ruler and you will enter the measure in the *Height Correction: Above Waist* field. Likewise, if an SP declines to remove their shoes to be measured, the examiner will measure the height of the heels and you will enter it into the *Height Correction: Below Waist* field.

You will capture the recumbent length and the standing height automatically when you click on the "Get" button to the left of the measure. After each measure is captured or entered into the system, a voice will be activated that says the measurement aloud for confirmation.

There are three columns on the screen: Measured, Adjusted, and Comments. The system will display the captured height in the Measured column. The system will then automatically calculate the adjusted values. Both *Height Correction: Above Waist* and *Height Correction: Below Waist* will be subtracted from the Standing Height measured value. The adjusted height will be displayed in the Adjusted column. If comments are needed for any measure, you will click on the down arrow to the right of the corresponding Comments box and a drop-down list will appear. If you could not obtain a height you must enter either CNO (could not obtain), HTO (hard to obtain), or EC (exceeds capacity). If a measurement was captured but the examiner did not think it was accurate because the SP was not straight, enter NS (not straight).

Exhibit 3-15. Stature Screens, 3 Columns

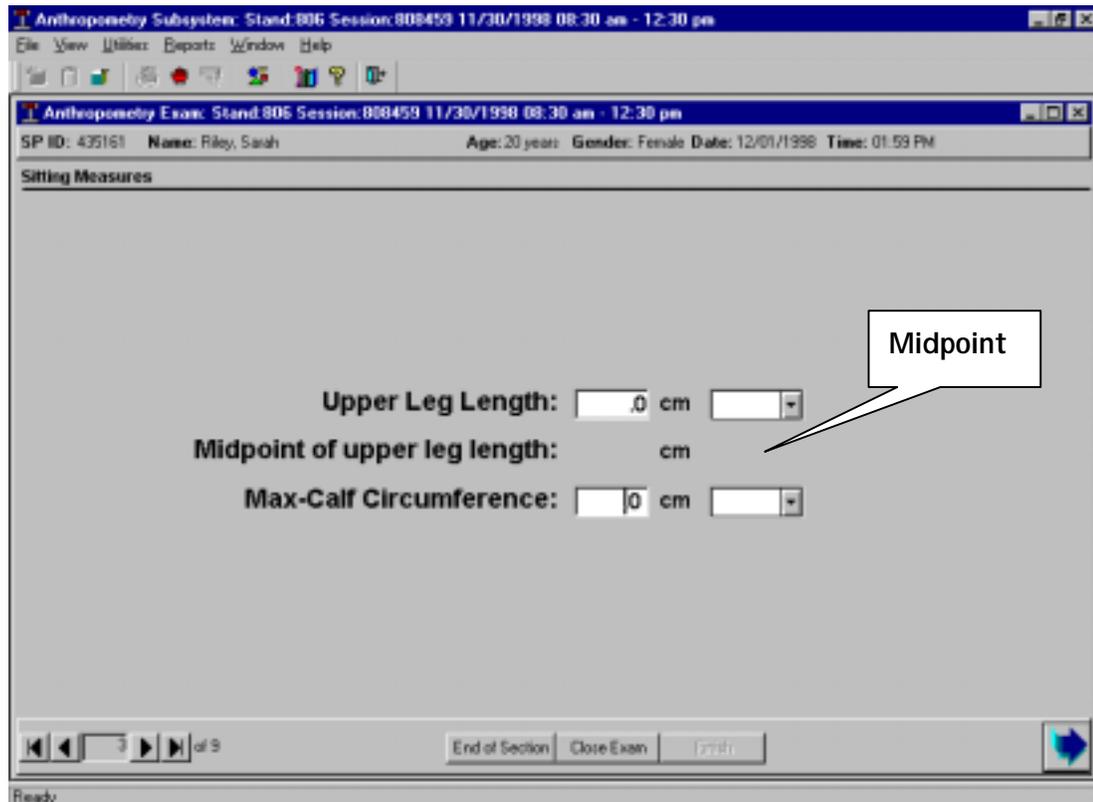


3.3.2.4 Sitting Measures Screen

The next screen is **Sitting Measures**. This screen will be displayed for all SPs 8 years of age or older. This screen displays two measures: Upper Leg Length and Max-Calf Circumference. After you enter the first measurement in the screen, press the **Tab** button on the keyboard to move the cursor to the next measurement field. The system will repeat aloud each measurement as it is entered.

After you have entered the Upper Leg Length, the system will calculate the midpoint of the upper leg length and say it aloud. You (the recorder) will then mark the Upper leg midpoint with a cosmetic pencil for the examiner.

Exhibit 3-16. Sitting Measures Screens



3.3.2.5 Upper Arm Length Screen

The next screen is **Upper Arm Length**. This screen will be displayed for all SPs aged 2 months or older. After you enter the measure in the field, the system will first repeat the measure aloud, and then calculate and say aloud the midpoint of the upper arm length. You (the recorder) will then mark the Upper arm midpoint with a cosmetic pencil for the examiner.

If you can not obtain the measure for some reason (e.g., respondent refuses the measure), you must enter the comment "CNO" for "Could not obtain" in the Comment box.

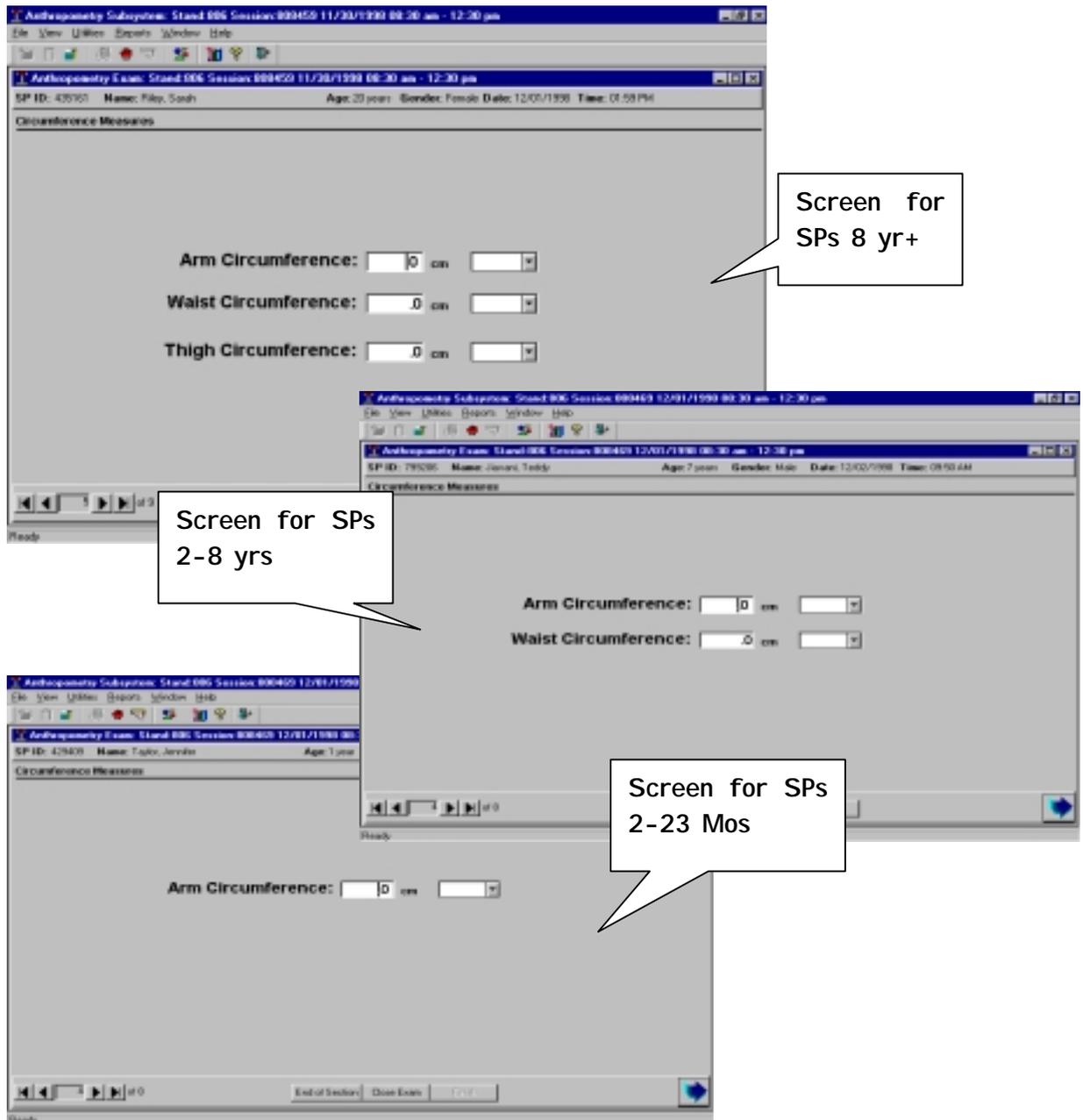
Exhibit 3-17. Upper Arm Length Screen.

The screenshot shows the 'Upper Arm Length' screen within the 'Anthropometry Subsystem'. The window title bar reads 'Anthropometry Exam: Stand: 451 Session: 451253 16-Jul-98 08:30 am - 12:30 pm'. Below the title bar, patient information is displayed: 'SIP ID: 498381 Name: Mayer, Walter Age: 75 years Gender: M Date: 19-MAY-1998 Time: 10:35'. The main area of the screen is titled 'Upper Arm Length' and contains two input fields: 'Upper Arm Length: .0 cm' and 'Midpoint of upper arm length: 0 cm'. A dropdown menu next to the 'Upper Arm Length' field is set to 'CNO'. A callout box labeled 'Comment Box' points to the 'CNO' dropdown. The interface includes a menu bar (File, View, Utilities, Reports, Window, Help), a toolbar, and a status bar at the bottom with navigation controls and 'Close' and 'Finish' buttons.

3.3.2.6 Circumference Measures Screen

The **Circumference Measures** screen will be displayed for all SPs 2 months or older. This screen contains four measures: Maximal Calf Circumference, Arm Circumference, Waist Circumference, and Thigh Circumference. Only the arm circumference field is activated for SPs 2-23 months old. The system will repeat aloud each measure after it is entered. Use the **Tab** button on the keyboard to move the cursor to the next measurement box.

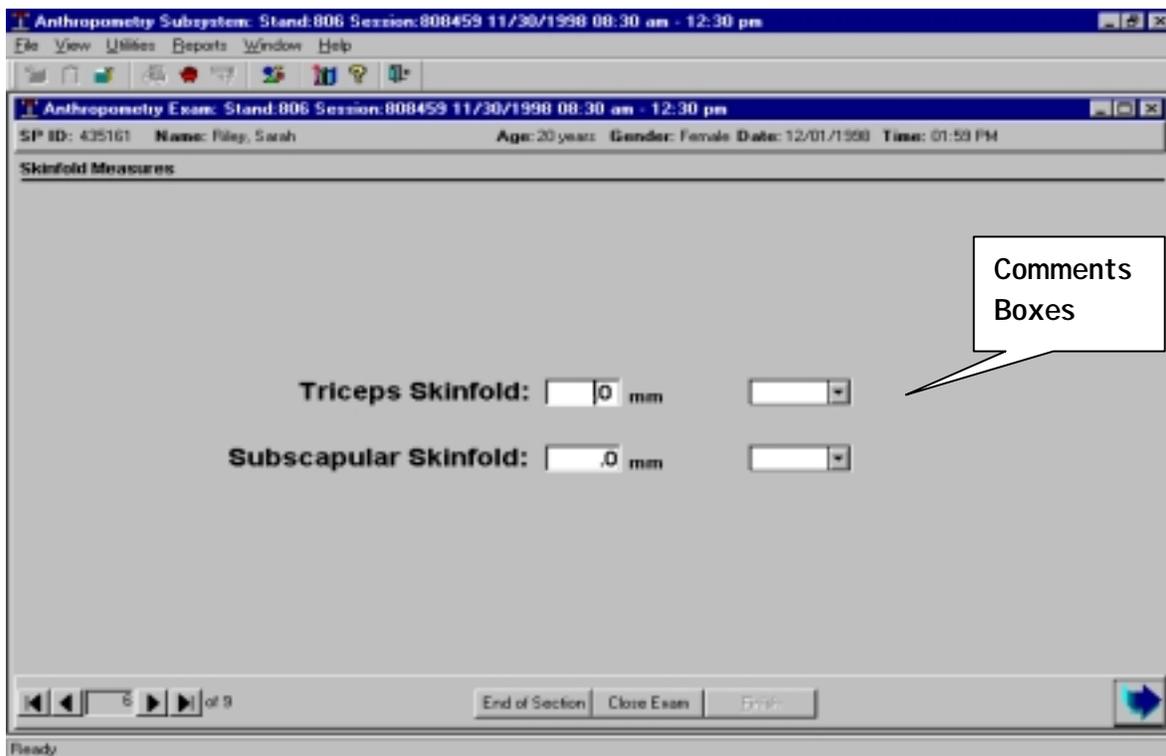
Exhibit 3-18. Circumference Measures Screens



3.3.2.7 Skinfold Measures Screen

The **Skinfold Measures** screen will be displayed for all SPs 2 months and older. Two skinfold measurements will be collected on this screen: Triceps skinfold and Subscapular skinfold. After entering each measurement, the system will repeat aloud the measure for confirmation. Use the Tab button on the keyboard to move the cursor to the next measurement box. Notice that you can enter a comment for any or all of the skinfold measures. If you cannot obtain a measure, either because the SP refused the measure or the skinfold was too large for the caliper, you must enter a comment before leaving the screen.

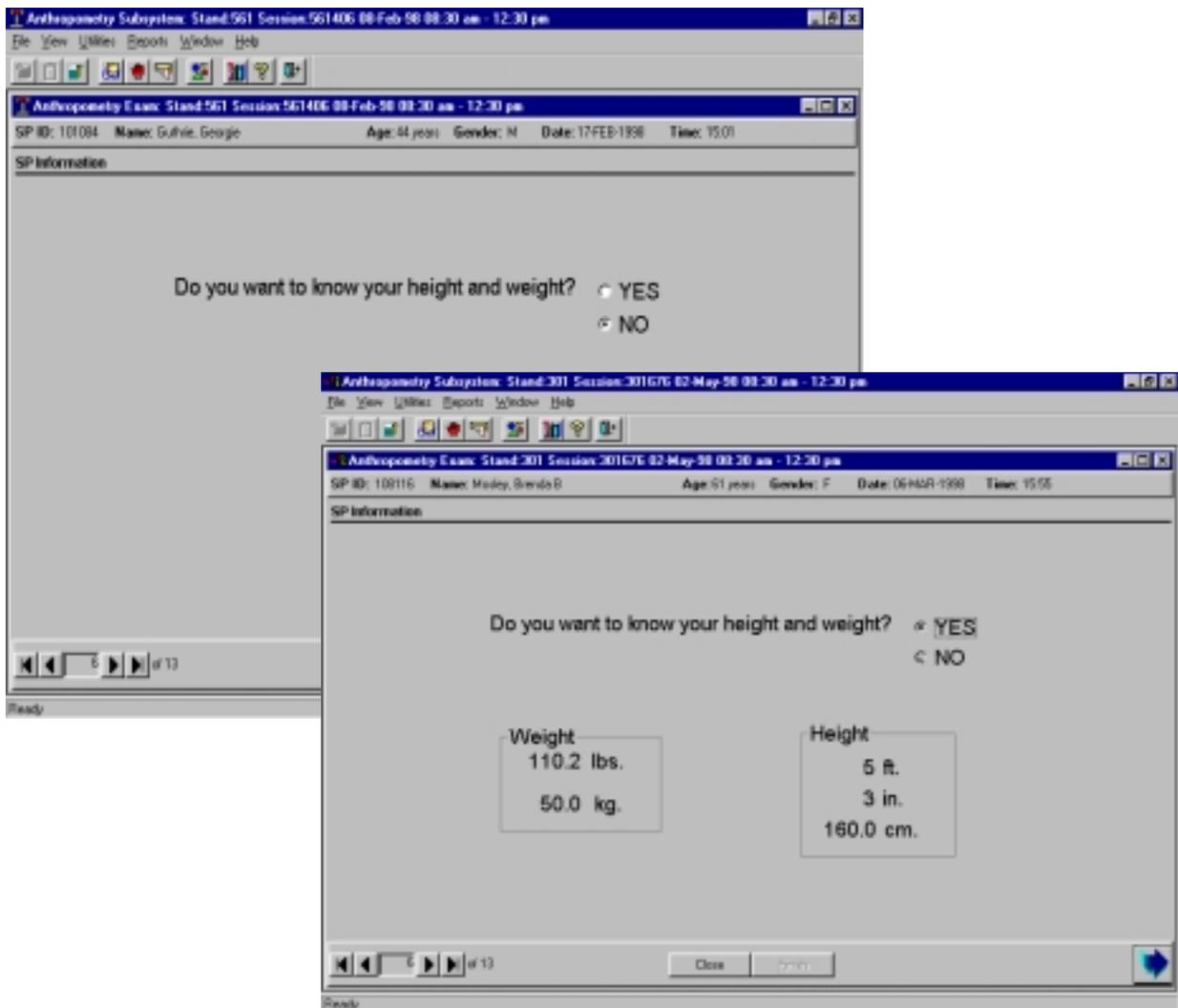
Exhibit 3-19. Skinfold Measures Screens



3.3.2.8 SP Information Screen

The next screen is **SP Information**. This screen displays the question "Do you want to know your height and weight?" Read the question to the SP and click on either "Yes" or "No." If you select "Yes," two pop-up boxes will appear. These boxes display the SP's weight and height, including the metric equivalents of each measurement. If you select "No," the system moves to the Circumference Measures screen.

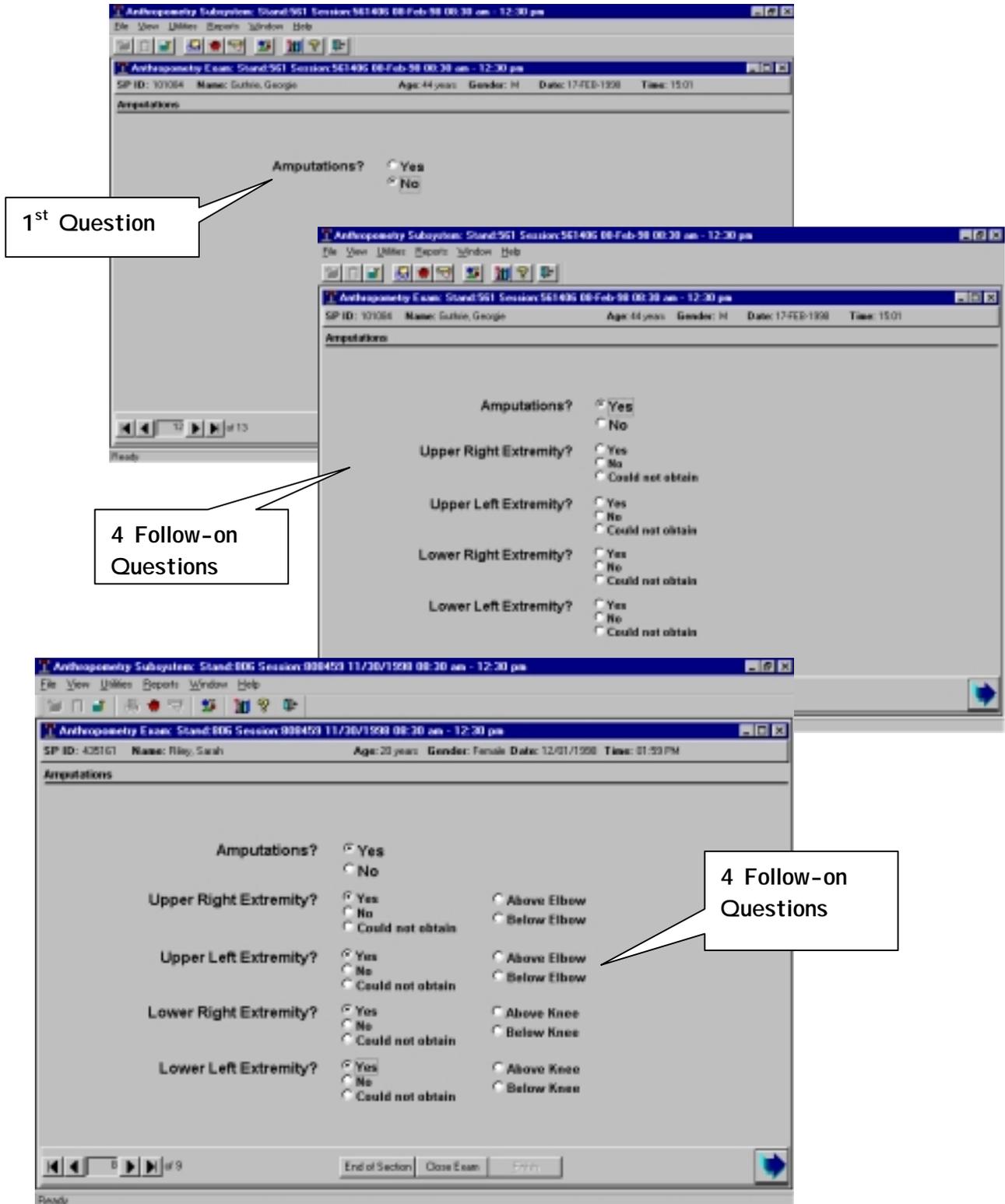
Exhibit 3-20. SP Information Screen



3.3.2.9 Amputations Screen

The next screen is **Amputations**. "Yes" and "No" options are displayed and you will choose accordingly. If you click on "Yes," the system automatically will add four questions to the screen: Upper Right Extremity?, Upper Left Extremity?, Lower Right Extremity?, and Lower Left Extremity? You must choose from one of the three options that follow for each question: "Yes," "No," and "Could not obtain." If you click on "Yes" for either of the upper extremities, the system will automatically add two questions to the screen: Above Elbow? and Below Elbow?; if you click "Yes" for either of the lower extremities, the system will automatically add the options Above Knee? and Below Knee? to the screen. You must choose one of these options each time you click "Yes" for an extremity.

Exhibit 3-21. Amputations Screens

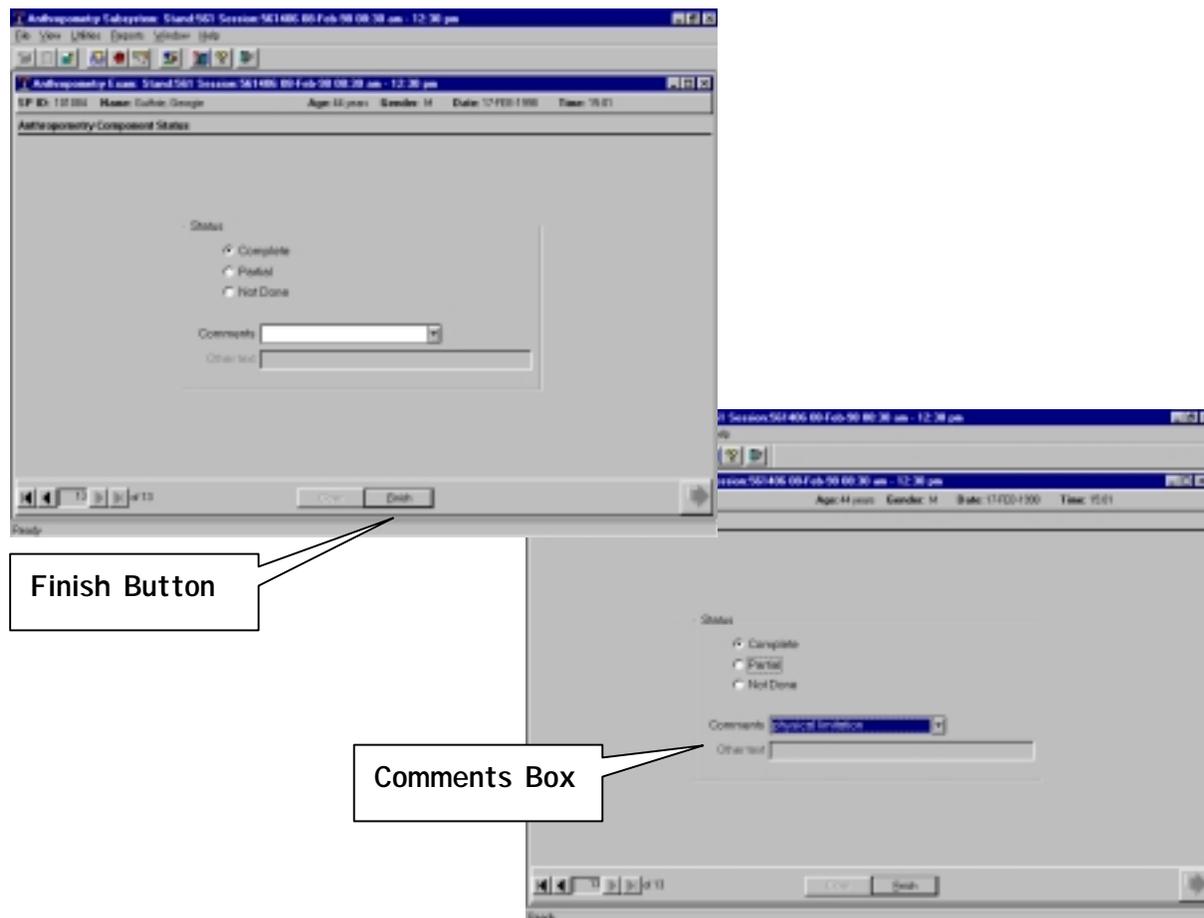


3.3.2.10 Anthropometry Component Status Screen

The last screen displayed is **Anthropometry Component Status**. This screen has three options: Complete, Partial, and Not Done. If the status is Partial or Not Done, you must enter a comment. Click on the down arrow to the right of the Comments box to make a selection. There are eight comments to choose from: safety exclusion, SP refusal, no time, physical limitation, communication problem, equipment failure, SP ill/emergency, or interrupted. You may also select the "Other, specify" comment. If you choose the "Other, specify" comment you must enter text into the "Other text" field to describe the comment. The eight comments in the Comments box should cover most of the comments you need to make. Only use the "Other, specify" comment if your comment does not fit into one of the defined comments. Be as brief as possible when you type a comment in the "Other text" field.

If the SP refuses to complete the anthropometry examination in its entirety, an abridged examination will be done during which only stature and weight will be obtained.

Exhibit 3-22. Component Status Screen



3.4 Postexamination Procedures

After completion of the body measurement examination, and before clicking the Finish box in the Anthropometry Component Status screen, the examiner should remove all cosmetic pencil marks from the SP's skin with some alcohol or baby oil on a piece of gauze. One of the technicians should direct or accompany the SP to their next examination destination as per MEC procedures.

4. QUALITY CONTROL

Quality control procedures for body measurements are extremely important and must be observed. The most common errors in anthropometrics are body positioning, reading measurements, and recording. In order to minimize these errors, standard procedures for obtaining measurements are described in this manual. The goal of the training session is to standardize all examiners to these procedures. Errors made in measuring technique are also minimized by the recorder's role in assisting the examiner. The recorder assists the examiner with positioning of the SP and the examiner's reading process. Reading errors frequently occur as a result of parallax, the phenomenon where an observer sees a different value on a measuring device depending on the angle from which it is viewed. Again, standardization in training will help alleviate this problem.

4.1 Examination Screens

The examination screens are designed to be as recorder-friendly as possible and at the same time ensure that the data entered is as accurate as possible. Following are some quality-control features of the ISIS system

- The weight, length, and height measurements are directly entered into the computer system by clicking on the "Get" buttons.
- You must enter a number or a comment in every field before the program will let you move to the next screen.
- When you move to a new screen the cursor will be in the correct field for data entry.
- A computer voice repeats each measure after it is entered to verify the measure.

4.2 Automated System

The automated system is designed to function as a quality control measure by minimizing possible measuring and recording errors. Edit ranges have been set for all measurements. If a measurement does not fall within the 1st and 99th percentile based on NHANES III data, the system will display an "out of range" message prompting the examiner to recheck the measurement to ensure that it is the "correct" value. It is possible that some SP's (i.e., very small or very large) will not be within the "normal" ranges. Therefore, the examiner and recorder must verify the original measurement value.

It is extremely important to measure skinfolds accurately. Even after extensive practice it is possible to make errors due to slight misplacement of the caliper or misreading the dial. Therefore it is important that examiners are well versed in the examination protocol and take care in obtaining each measurement precisely.

The system also ensures that the placement of decimal points and the number of digits entered are correct. For instance, if the number of positions entered for a measurement exceeds the number of positions allowed for a measurement, it cannot be entered.

4.3 Procedures for Using Hard Copy Forms to Enter Measurements

If the automated system fails during a session, contact the Data Manager. If the Data Manager is unable to correct the problem, perform the examination as usual and enter the measurements on the Body Measures Recording Form (see Appendix A). Several copies of this form should be kept in a drawer in the room; blank forms can be accessed by the Data Manager in the blank forms directory. Use extra care when entering measures on hard copy to minimize the possibility of errors. The MEC manager should notify the Home Office of the situation as quickly as possible. The Home Office will take steps to correct the problem with the automated system and give directions to fax the hard copy forms so the data can be entered into the system.

4.4 Equipment Calibrations

Routine calibrations and checks of the body measurement equipment ensure that the equipment is standardized and producing accurate measures.

4.5 Review, Observations and Replication

Technicians will be periodically observed by the body measurement consultant to ensure standardization. The consultant will review with the technicians any deviations from the protocol.

Replication. Different types of replicates will be utilized in the current NHANES as quality control measures:

- **Complete Replicates** - Replicates who will be scheduled from the pool of volunteers for a complete reexamination at the MEC.
- **"Expert" Replicates** - These are the replications performed by experts, i.e., the body measurement consultant.

4.6 Refresher Sessions

Refresher or retraining sessions will be scheduled when major changes in protocol are introduced or when a lack of standardization is observed among the technicians.

5. SAFETY PROCEDURES

5.1 Equipment Precautions

All equipment in the body measurement room should be checked, maintained, and cleaned on a regular basis to protect the equipment, the SP, and the technician. If any equipment is broken or starts to break, discontinue using it and notify the MEC manager. Broken equipment should be removed from the body measurement room and/or central areas in the MEC.

5.2 SP Movement and Positioning

The process of taking body measurements does not impose any physical harm or risk to the SP. However, there are certain precautions to be observed by the technicians due to specific positioning for the varied measurement components.

SPs that seem unsteady on their feet should be encouraged to hold on to the diagonal bar while their weight is taken, and the horizontal bar while the circumferences and skinfold measurements are taken.

Performing body measurements on children requires additional safety precautions and monitoring. Children in the body measurement room require constant supervision by the technicians. All anthropometric equipment should be placed out of reach of the smaller children. When using the baby board or the body measurement table, children must be carefully held by the technician to prevent any falls. Keep in mind that babies and small children tend to flip themselves over very quickly. NEVER leave an infant/child unattended on the recumbent length board. Again, it is the technician's responsibility to carefully explain and monitor the body measurement procedures to adequately protect the SPs from any physical injury.

5.3 Emergency Procedures

Procedures for medical emergencies and other types of emergency situations are discussed in the Standardized Procedures.

Appendix A
Body Measures Recording Form

Body Measures Recording Form

SP ID: _____ Stand #: _____

Session/Date: _____

MEASURES	BIRTH +	2MO+	7mo+	2YR+	4YR+	8YR+
(BMXWT) Weight						
(BMXRECUM) Recum Length						
(BMXHEAD) Head Circ						
(BMXHT) Height						
(BMXHTCRA) Ht Correction: Above Waist						
(BMXHTCRB) Ht Correction: Below Waist						
(BMXLEG) Leg Length						
<i>Mark Midpt. of Upper Leg Length</i>						
(BMXCALF) Max Calf						
(BMXARML) Upper Arm Length						
<i>Mark Midpt. of Upper Arm Length</i>						
(BMXARMC) Arm Circ						
(BMXWAIST) Waist Circ						
(BMXTHICR) Thigh Circ						
(BMXTRI) Triceps SF						
(BMXSUB) Subscap SF						
(BMXAMP) Amputations? Yes/No						
If Yes:						
(BMXUREXT) Upper R Extremity Yes/No						
(BMXUPREL) Upper R. Above/Below Elbow?						
(BMXULEXT) Upper L Extremity? Yes/No						
(BMXUPLEL) Upper L Above/Below Elbow?						
(BMXLOREX) Lower R Extremity? Yes/No						
(BMXLORKN) Lower R. Above/Below Knee?						

(BMXLEXT) Lower L Extremity? Yes/No						
(BMXLLKNE) Lower L. Above/Below Knee?						