

NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY III

Body Measurements (Anthropometry)

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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 III 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, and other disease, and forms of cancer. 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 III sample.

1.2 Purpose of Anthropometrics

Actual stature, weight, and body measurements including skinfolds, girths, and breadths will be collected in the MEC for purposes of assessing growth, body fat distribution, and for provision of reference data. Measurements of stature and weight will allow for a revision of the child growth charts which are based in part on data collected in NHES cycles II and III and data from the Fels Longitudinal Study. Anthropometric measurements such as skinfolds and circumferences and 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 III will repeat ones made in previous NHANES and HHANES so that trend analyses can be conducted. Some measures have been added to provide further information on body frame size and fat distribution, while others have been dropped because new data have determined that other measures are more informative.

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 table for SP's to sit on. The Toledo scale, stadiometer, and infant measurement board are all contained in this room. The body measurement room is shared with the allergy component and the MEC computer.

2.2 Description of Equipment and Supplies

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

- Body measurement table
- Toledo self-zeroing weight scale
- Stadiometer
- Infant measuring board
- Measurement box for sitting height
- Insertion tape
- Steel measuring tape
- Holtain skinfold caliper
- Holtain small sliding breadth caliper
- 2 Mediform large sliding calipers
- Polaroid Land camera with close-up photographic lens
- Special light attachment for camera
- Polaroid film
- Calculator
- Computer terminal
- Weights for scale calibration
- Calibrations rods
- Step wedge standards
- Cosmetic pencils (wax base)
- Footstool
- Scissors - blunt edge
- Paper tape
- White vinegar
- Alcohol
- Baby oil
- Gauze 4x4

Inventory of Equipment and Supplies

At the beginning of each stand and at the 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 calipers 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

2.3.1.1 Weight Scale

- a. Plug in the power cord.
- b. Untape the weight blocks and move to the front of the scale.
- c. Remobilize the scale platform by removing the table paper between the platform and scale base.

2.3.1.2 Setting the Printer for Weight Scale

The printer comprises a bank of numbers and letters that indicate, from left to right, time (AM or PM), date and weight. To set the time/date function displayed in the LED on the front panel, do the following:

- a. Plug the power cord into the power outlet.
- b. Find the two push buttons on the panel of the printer above the attached power cable. The top one is the "set" button; the bottom one is the "advance" button.

- c. Press the "set" button to cause the right most LED digit to begin blinking. Press the "advance" button to advance the numerals until the correct year designation appears. Press "set" once again to fix that numeral in the LED and cause the second digit from the right to begin blinking.
- d. Follow the above process through the six-digit field that represents the date and the four-digit field that represents the time. Although the time must be set according to a 24-hour clock, time will appear on the AM and PM.
- e. When all the digits have been correctly set, press the "set" button twice to start the timing operation.

2.3.1.3 Stadiometer

- a. Plug the light into the power outlet.
- b. Untape the light from the camera-holding bar.
- c. Untape the horizontal bar.

2.3.2 Calibration Procedures

2.3.2.1 Mediform Large Sliding Caliper

- a. The caliper is calibrated at the beginning of the stand and once every two weeks during the stand.
- b. Use the small and medium calibration rods.
- c. The caliper reading should agree with the known values of the calibration bars.
- d. Record the caliper readings on the Equipment Calibration Log under the appropriate headings.
- e. If the two readings do not agree, inform the MEC manager and use the spare set of calipers.

2.3.2.2 Small Sliding Breadth Calipers

- a. Calibrate the small sliding breadth calipers at the beginning of the stand and once every two weeks during the stand using the step wedge standard.
- b. The caliper reading should agree with the known values of the step wedge standard measurements.
- c. Record the caliper readings on the Equipment Calibration Log.
- d. If any abnormality is noticed, use the spare set of small sliding breadth calipers and notify the MEC manager.

2.3.2.3 Infant Measuring Board

- a. The infant measuring board is checked at the beginning of each stand and once every two weeks by placing the calibration rod(s) on the board to check that the board has not been damaged during transit. Check the digital counter reading against the known values of the calibration rod(s) to make sure they agree.
- b. Record the counter reading on the Equipment Calibration Log under the appropriate heading. If the two readings do not agree, inform the MEC manager.

2.3.2.4 Stadiometer

- a. Calibrate the height scale at the beginning of each stand, once every two weeks, and at the end of each stand after all examinations.
- b. Place the calibration rods separately on the floor of the stadiometer.
- c. Place the horizontal bar of the stadiometer firmly against the top of each calibration rod.
- d. Take a Polaroid photograph of the stadiometer tape. The measurement should be equal to the known value of each calibration rod. If it is not, adjust the sighting window on the height scale until the measurement does agree and rephotograph the stadiometer tape.

2.3.2.5 Digital Weight Scale

- a. Calibrate the weight scale at the beginning of each stand and at the end of each stand.
- b. Place the electronic digital system in the pound mode by pressing the LB/KG button the keyboard until the readout is in tenths. If the digital readout does not register "000.0," press the zero key to automatically balance the scale at zero.
- c. After zeroing the scale properly, print the zero weight on a sheet of 8 1/2 x 11 paper.
- d. Place calibration weights on the scale in increments of 25 pounds, starting with 25 and continuing to 250.
- e. Print the weight in pounds at each increment on the calibration paper by pressing the PRINT key on the time/date unit. At 100 pounds, print the weight in pounds and in kilograms to attest to the accuracy of the pound/kilogram conversion.
- f. If the scale is out of calibration by at least one-half pound at more than three levels, inform the MEC manager.
- g. When a satisfactory calibration is obtained, record the stand number, stand location, date, and tech number on the paper and save it with the Equipment Calibration Log.

2.3.2.6 Skinfold Calipers

- a. Calibrate the Holtain skinfold calipers at the beginning and end of each stand and **once a week** during each stand using the step wedge standard.
- b. Zero the calipers before starting the calibration procedures. Place the step wedge standard between the caliper arms at each of the five steps, and check that the reading on the scale corresponds to the standard measurement.
- c. Record the measurement taken at each step on the Equipment Calibration Log under the appropriate heading. An identical calibration should be done on the spare set of skinfold calipers and the corresponding measurements also recorded on the calibration log sheet. Be careful to record the caliper's values on the correct device identification line. (The spare is not always the B instrument.)
- d. If the calipers are 1 mm or more out of calibration at any level, use the other set of calipers and inform the MEC manager. They will be returned to the manufacturer for adjustment.
- e. If the calipers become too loose, use the spare set of calipers and inform the MEC manager.

2.3.3 Daily Procedures

2.3.3.1 Skinfold Calipers

Before each examining session, the calipers should be "zeroed." 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.

2.3.3.2 Weight Scale

- a. The technician assigned to the body measurement station should apply a random set of the standard weights daily to roughly check the accuracy of the weight scales. This check is noted in the Equipment Calibration Log.
- b. If there is any reason to believe that the scales are not accurate, do a complete recalibration. The recording of the calibration should be recorded in the Equipment Calibration Log and the MEC manager should be contacted.

2.3.3.3 Infant Measuring Board

- a. Each day check that the digital counter and the foot board are operating smoothly. If they are not, a small amount of lubrication can be applied. IF the operation is still not smooth, inform the MEC manager.

2.3.3.4 Stadiometer

- a. Each day check that the upright bar and attached tape measure have not been damaged. This check is noted in the Equipment Calibration Log.
- b. 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 white vinegar.
- c. Check the Polaroid camera and light to see that they produce optimum photos. This check is noted in the Equipment Calibration Log.

2.4 Care and Maintenance

2.4.1 Cleaning of Equipment

- a. At the beginning of each stand and during the stand as necessary, wipe the surfaces of the sliding calipers, skinfold calipers, and tape measures with alcohol.
- b. Clean the equipment with alcohol at the end of each examining day.
- c. Clean the camera roller bars periodically according to the following instructions to assure uniform spreading of the photo developing agent.
 - Open the back of the camera by releasing the lever at the bottom panel of the camera.
 - Grasp the roller springs on the top and bottom of the roller assembly and pull them straight outward, thus allowing the roller bars to swing free of the inside camera body.
 - Clean the roller bars thoroughly using alcohol on gauze to remove the chemical residue.
 - Put the roller assembly against the back panel of the camera body, and press firmly at the center of the roller bars to reseat the rollers.
 - Place the back of the camera against the main body of the camera, and press on it firmly to close the camera.

2.4.2 Malfunctions

Report any malfunctions of the body measurement equipment to the MEC manager. Back-up equipment (i.e., calipers) are provided in each MEC to be used until malfunctioning equipment can be repaired or replaced.

2.5 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 followed.

2.5.1 Pack-Up Calibration

- a. Calibrate completely the weight scale and stadiometer as described in this chapter.
- b. Send the Equipment Calibration Log to Westat at the end of the stand.

2.5.2 Pack-Up Procedures

2.5.2.1 Calipers

- a. Place the mediform calipers and the elbow breadth calipers in the traveling case. Store the case in the body measurement cabinets.
- b. Place the skinfold calipers in their protective case, and store them in the body measurement cabinets.

2.5.2.2 Weight Scale

- a. Unplug the power cord, and check that the weight scale is in a vertical position.
- b. Move the weight blocks on the front of the scale to the far right side, and tape them in position.
- c. Immobilize the scale platform by inserting table paper snugly between the platform and the scale base.

2.5.2.3 Printer

- a. Unplug the power cord from the wall outlet.
- b. Disconnect the input cable to the scale, and tape the cable onto the printer shelf.
- c. Put the printer on the floor.

2.5.2.4 Stadiometer

- a. Unplug the light from the power outlet.
- b. Place the light against the camera-holding bar and tape it into position.
- c. Raise the horizontal bar to the top of the upright bar and tape it into position.
- d. Be sure that the camera is securely fastened down for transit.

2.5.2.5 Body Measurement Cabinet

Close and lock the drawers and cabinet doors.

3. EXAMINATION PROTOCOL

3.1 Eligibility Criteria

All SP's aged two months and older 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.

3.2 Pre-Examination Procedures

3.2.1 Role of Anthropometric Examiner and Recorder

The collection of anthropometric data requires two health technicians for the roles of examiner and recorder. Health technicians for NHANES III are trained to perform both roles. However, the original examiner and recorder should complete an examination once it is started.

The examiner is responsible for positioning the SP, taking each measurement, and saying the measurement aloud to the recorder. The recorder repeats the number, enters it into the automated system (or hardcopy form), and says the name of the next measurement listed on the computer screen. The examiner should keep the measuring instrument set on the SP until the recorder repeats the number.

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. The recorder also assists the examiner by checking the tension and horizontal position of the steel measuring tape for girth measurements.

The recorder has the responsibility of ensuring that correct data are entered into the automated system (or recorded on the hardcopy form). The recorder, having had the same training as the examiner, should recognize a gross error in measurement or in reading the different instruments. When an error is recognized, the recorder should call it to the examiner's attention and the measurement should be repeated.

Table 3-1. Body measurements by age

2 mo +	2yr +	4yr +	20yr +	60yr +
+ weight	+ weight	+ weight	+ weight	+ weight
	+ stature	+ stature	+ stature	+ stature
	sitting height	sitting height	sitting height	sitting height
+ recumbent length *(2mo-3yr)	+ recumbent length *(to 3yr)			
+ triceps skinfold	+ triceps skinfold	+ triceps skinfold	+ triceps skinfold	+ triceps skinfold
subscapular skinfold	subscapular skinfold	subscapular skinfold	subscapular skinfold	subscapular skinfold
upper arm length	upper arm length	upper arm length	upper arm length	upper arm length
+ arm circum.	+ arm circum.	+ arm circum.	+ arm circum.	+ arm circum.
	upper leg length	upper leg length	upper leg length	upper leg length
	thigh circumference	thigh circumference	thigh circumference	thigh circumference
	waist circumference	waist circumference	waist circumference	waist circumference
	buttocks circumference	buttocks circumference	buttocks circumference	buttocks circumference
	suprailiac skinfold	suprailiac skinfold	suprailiac skinfold	suprailiac skinfold
	thigh skinfold	thigh skinfold	thigh skinfold	thigh skinfold
	biiliac breadth	biiliac breadth	biiliac breadth	biiliac breadth
	elbow breadth	elbow breadth	elbow breadth	elbow breadth
	wrist breadth	wrist breadth	wrist breadth	wrist breadth

Table 3-1. Body measurements by age (continued)

2 mo +	2yr +	4yr +	20yr +	60yr +
	biacromial breadth *(4 yr+)	biacromial breadth	biacromial breadth	biacromial breadth knee height

3.2.2 Measuring and Recording Guidelines

Body measurements are always taken on the right side of the body. However, some measurements may be taken on the left side of the body because of casts, amputation, or other reasons. When this occurs, the reason is noted in the comments section on the body measurement results screen or hardcopy form by the recorder.

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. Measures that exceed specific limits on the computer will be repeated by each technician.

All skinfold measurements will be done in duplicate (i.e., by two different technicians or twice by the same technician) since these measures have the most variability.

If a skinfold is too tight to be measured the code for "tight skin" should be recorded in the space for that skinfold on the computer or hardcopy form. If a skinfold is above the measurable limits of the calipers, the code for "50+" should be entered in the recording space for that skinfold.

3.3 Examination Procedures

3.3.1 Protocol Procedures

3.3.1.1 Weight

The electronic digital scale should be in the kilogram mode. It is not, press the LB/KG key on the keyboard face. The digital LED readout should show 000.00 before weighing a sampled person. If it does not, press the zero key on the keyboard scale to zero the scale.

Have the sampled person stand on the center of the weight scale platform. Record the weight in kilograms in the automated system or on the body measurement exam form in the appropriate space.

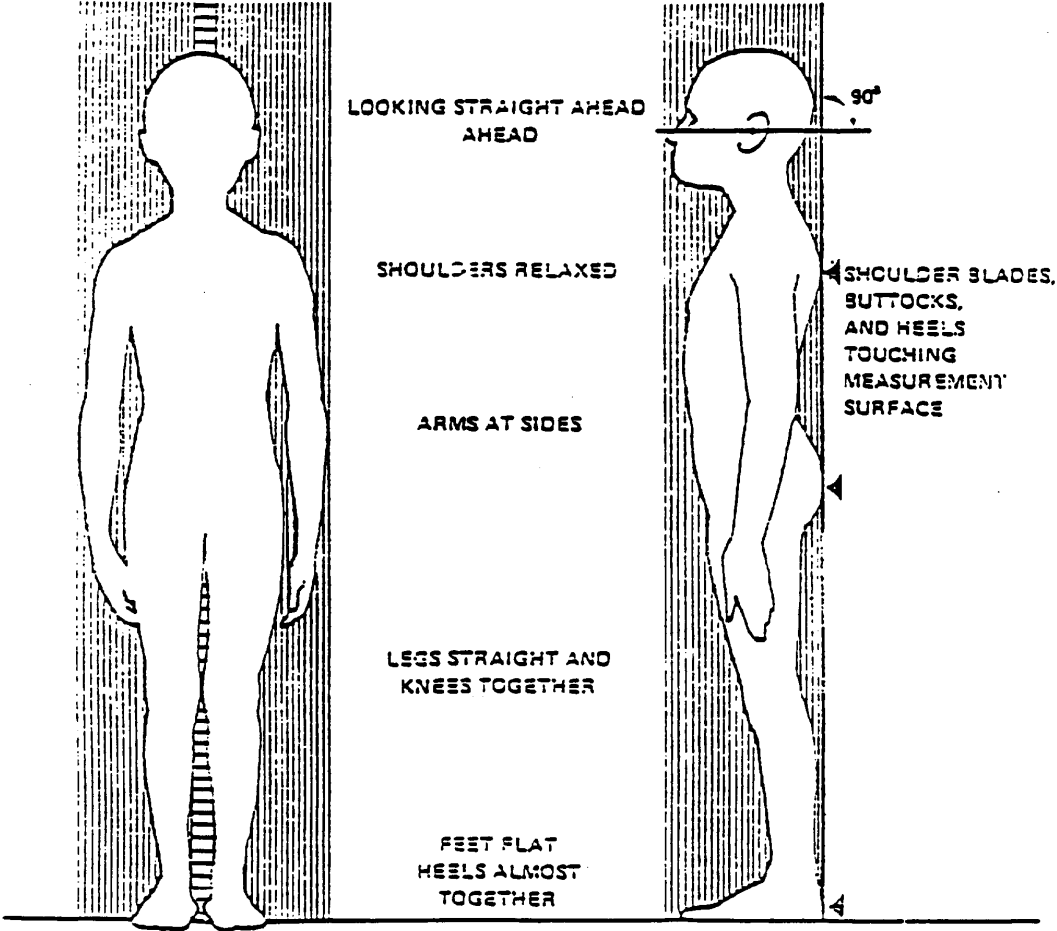
Since the scale printer will only print to 250 pounds, the following procedure must be followed if an SP weighs more than 250 pounds:

1. If the SP weighs more than 250 pounds, but no more than 350 pounds:
 - a. Move the bottom weight on the notched bar on the front of the scale to 100 pounds (far right).
 - b. Weigh the examinee and press the KG key on the keyboard just as though he weighed less than 250 pounds.
 - c. Add 45.36 kilograms (100 pounds) to the weight.
 - d. Record the total weight (stamped weight plus 45.36 kilograms) in the automated system or in the proper space on the body measurement exam form.
2. If the examinee weighs more than 350 pounds, but no more than 400 pounds:
 - a. Move the bottom weight on the notched bar to 100 pounds.
 - b. Move the top weight on the numbered bar to 50 pounds (far right).
 - c. Weigh the examinee and press the KG key just as though he weighed less than 250 pounds.
 - d. Add 68.04 kilograms (150 pounds) to the weight.
 - e. Record the total weight (stamped weight plus 68.04 kilograms) in the automated system or in the proper space on the body measurement exam form.
3. If the examinee weighs more than 400 pounds ask him to estimate his weight and document this estimation in the comments section of the automated system.

3.3.1.2 Standing Height

Have the SP stand erect on the floor board of the stadiometer with his or her back to the vertical backboard of the stadiometer. The weight of the participant is evenly distributed on both feet. The heels of the feet are placed together with both heels touching the base of the vertical board. Place the feet pointed slightly outward at a 60 degree angle (see Exhibit 3-1). If the SP has knock knees, the feet are separated so that the inside of the knees are in contact but not overlapping. The buttocks, scapulae, and head are positioned in contact with the vertical backboard. It may not be possible for

Exhibit 3-1. SP position for standing height



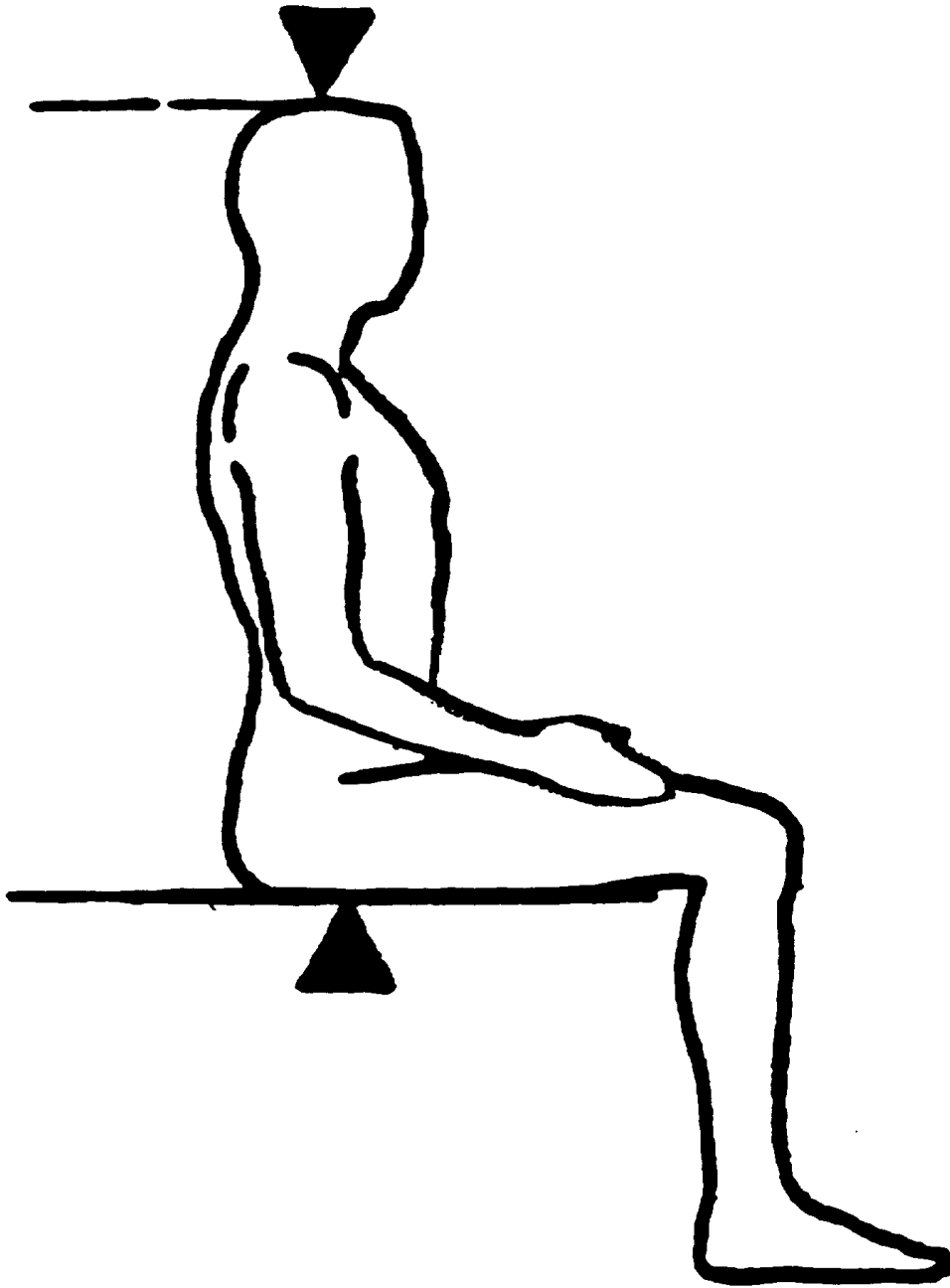
some children and most adults to place their heels, buttocks, scapulae and the posterior aspect of the head against the backboard while maintaining normal stature. Such SP's are positioned so that only the heels and buttocks are in contact with the vertical board, and the body is positioned vertically above the waist. The arms hang freely by the sides of the trunk with palms facing the thighs.

The SP is asked to inhale deeply and to stand fully erect without altering the position of the heels. The SP's head is maintained in the Frankfort Horizontal Plane position while the examiner lowers the horizontal bar snugly to the crown of the head with sufficient pressure to compress the hair. Hair ornaments, buns, braids, etc. must be removed to obtain an accurate measurement. The bar is locked in place and one of the sample number labels placed next to the tape on the upright bar so that the label can be read on the standing height measurement photograph. The examiner needs to make sure that the hair of the SP does not obscure the scale when the photograph is taken. After the measurement is read from the photograph by the examiner and recorded by the recorder to the nearest 0.1 cm.

3.3.1.3 Sitting Height

For measuring sitting height, the examiner moves the specially-made measurement box onto the floor board of the stadiometer. The right leg of the SP's exam pants need to be cut up the leg so that the skin can be marked for thigh and calf measurements. Reassure the sampled person that the pant leg will be re-taped after the body measurements are completed. The SP then sits on the box with his or her back and buttocks to the backboard of the stadiometer. The SP sits as erect as possible with the head in the Frankfort Horizontal Plane. The knees are directed straight ahead with the arms and hands resting at the sides (see Exhibit 3-2). Ask the SP to sit tall, take a deep breath, and then bring the horizontal bar down snugly to the head. The SP's head is maintained in the Frankfort Horizontal Plane position while the examiner lowers the horizontal bar snugly to the crown of the head with sufficient pressure to compress the hair. The bar is locked in place and one of the sample number labels placed next to the tape on the upright bar so that the label can be read on the measurement photograph. The examiner needs to make sure that the hair of the SP does not obscure the scale when the photograph is taken. After the sitting height measurement is photographed and the film processed, the sample number label from the upright bar is placed on the photo. The measurement is read from the photograph by the examiner and recorded by the recorder to the nearest 0.1 cm.

Exhibit 3-2. SP position for sitting height



3.3.1.4 Upper Leg Length

The SP sits straight on the measuring box with the right knee bent at a 90 degree angle. The small sliding caliper (used to measure elbow breadth) is positioned as if one were to measure the breadth of the patella. The blades of the caliper are positioned 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 on the anterior surface of the thigh. The steel measuring tape is placed at the inguinal crease which is easily located if the hips are in a sitting position. No pressure is to be applied at the inguinal crease; however, folds of fat tissue may have to be lifted on some obese SP's to measure at the crease. The exam gown should be lifted and the pants slightly pulled to smooth out gathers. The tape is extended along the midline of the thigh to the line just proximal to the patella (see Exhibit 3-3). The length of the upper leg is called to the recorder and the examiner also makes a (+) at the mid point of the thigh with the cosmetic marker. This point will be used at a later time for the thigh circumference and the thigh skinfold.

3.3.1.5 Knee Height

Knee height is only measured on adults 60 years of age and older. To obtain the measurement, the SP sits on the examination table with both legs dangling. The SP may require the assistance of the examiner to help him onto the table. The examiner places the fixed blade of the large sliding caliper under the heel of the right leg just below the lateral malleolus of the fibula. From a squatting position, the examiner raises the leg so that the knee and ankle are both at a 90 degree angle (see Exhibit 3-4). This is best accomplished by resting the SP's foot in the palm of the examiner's hand. The moveable blade of the caliper is placed on the anterior surface of the right thigh, above the condyles of the femur, about two inches above the patella. The shaft of the caliper is held parallel to the shaft of the tibia so that the shaft of the caliper passes over the lateral malleolus of the fibula and just posterior to the head of the fibula. Pressure is applied to compress the tissue. The recorder checks the positioning of the leg and the caliper. Knee height is recorded to the nearest 0.1 cm.

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

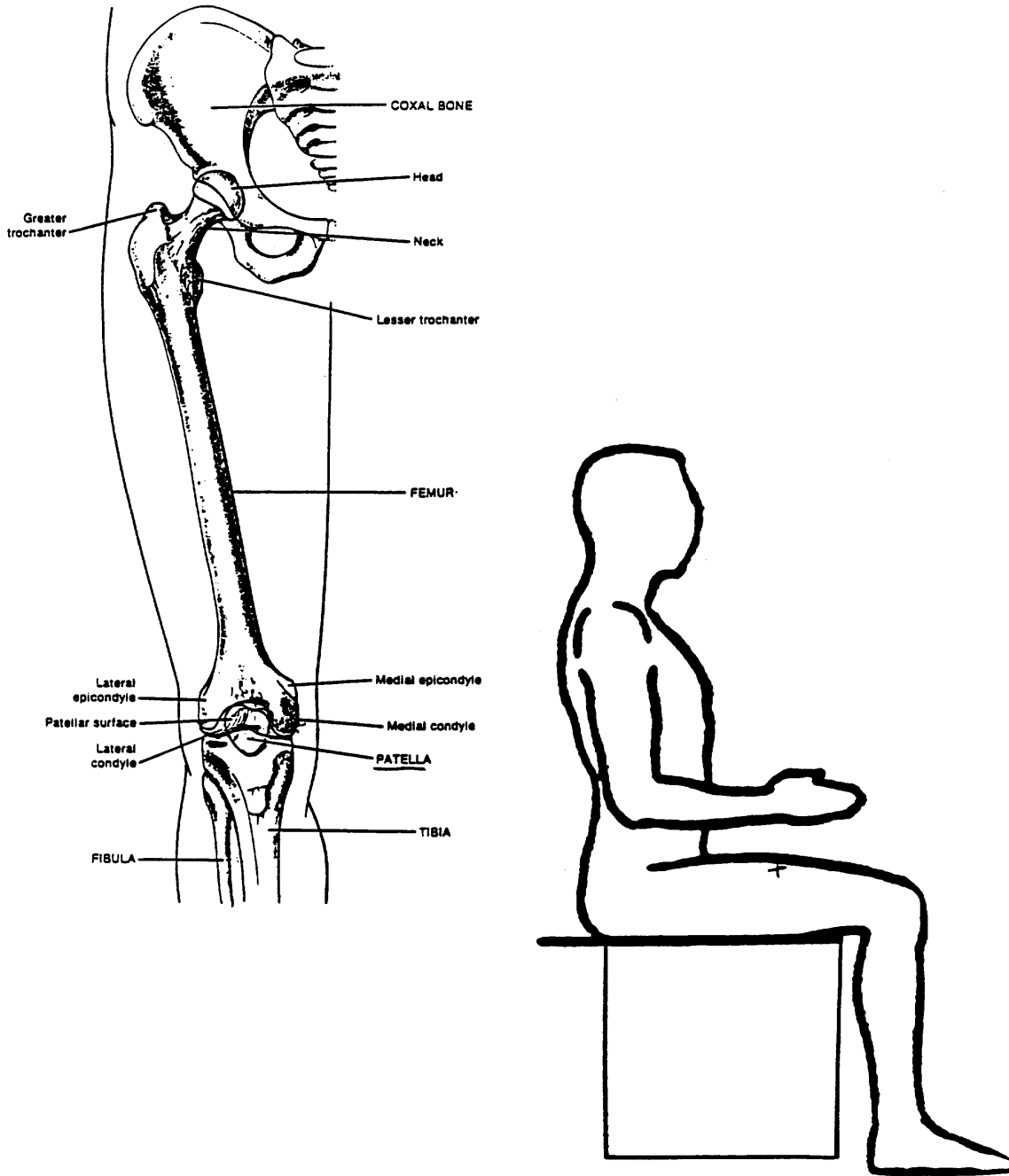
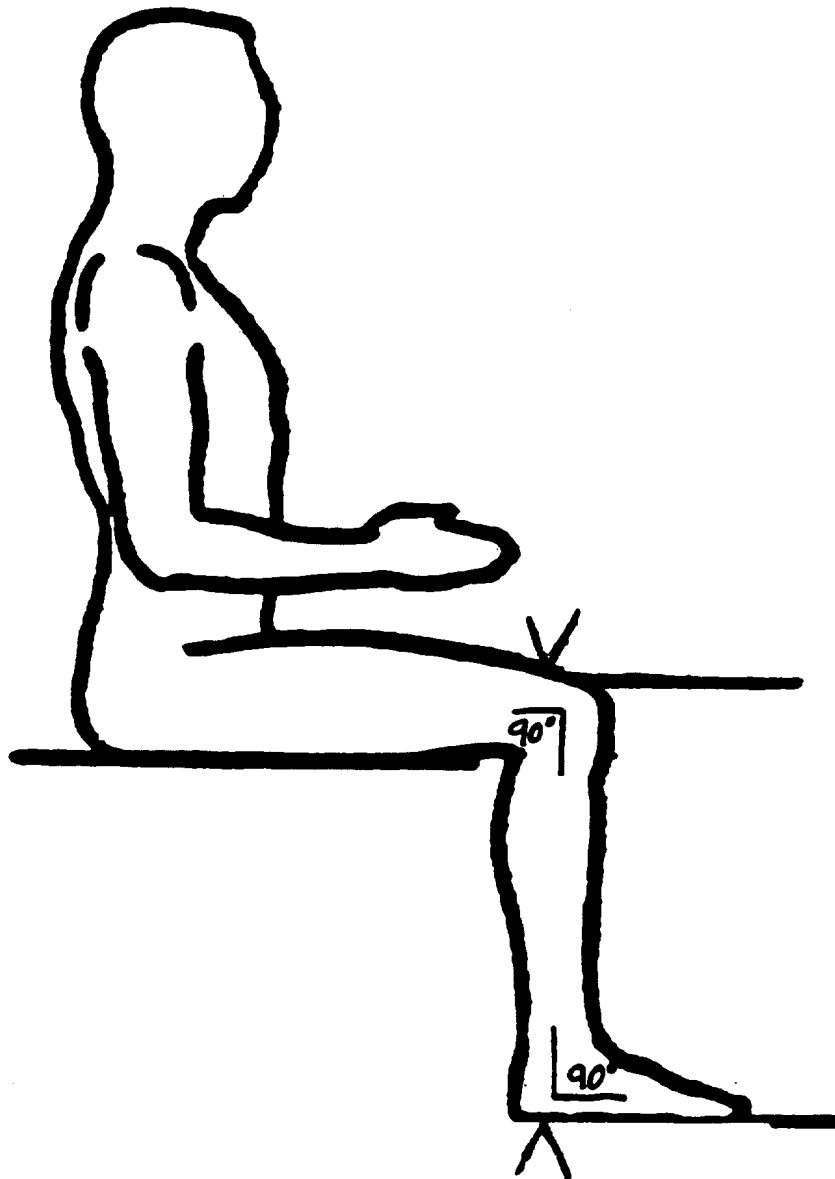


Exhibit 3-4. SP position for knee height



3.3.1.6 Biacromial Breadth

The SP sits on the body measurement table which is approximately chair height. The SP is asked to sit erect with the arms hanging freely at the sides. The examiner stands behind the SP with the mediform sliding calipers. The examiner checks the posture of the SP making sure that the shoulders are neither too far back nor forward, and that there is a noticeable curvature in the lower back. The objective is to have the SP relaxed with the shoulders downward and slightly forward so that the reading is maximal. The sleeves of the exam gown are pulled up towards the neck rather than pulling the gown down over the shoulders. The examiner then locates the acromial process. The caliper rests gently between the thumb and forefinger of the examiner. This allows the examiner to palpate the bony ridges with his other fingers. The examiner locates the lateral border of the acromial process on each shoulder. The arms of the sliding caliper are placed directly on the skin next to the lateral border of each acromial process and pressure is applied to compress the soft tissue over the acromial processes without hurting the SP. The maximum breadth across the lateral borders of the acromial processes is measured to the nearest 0.1 cm.

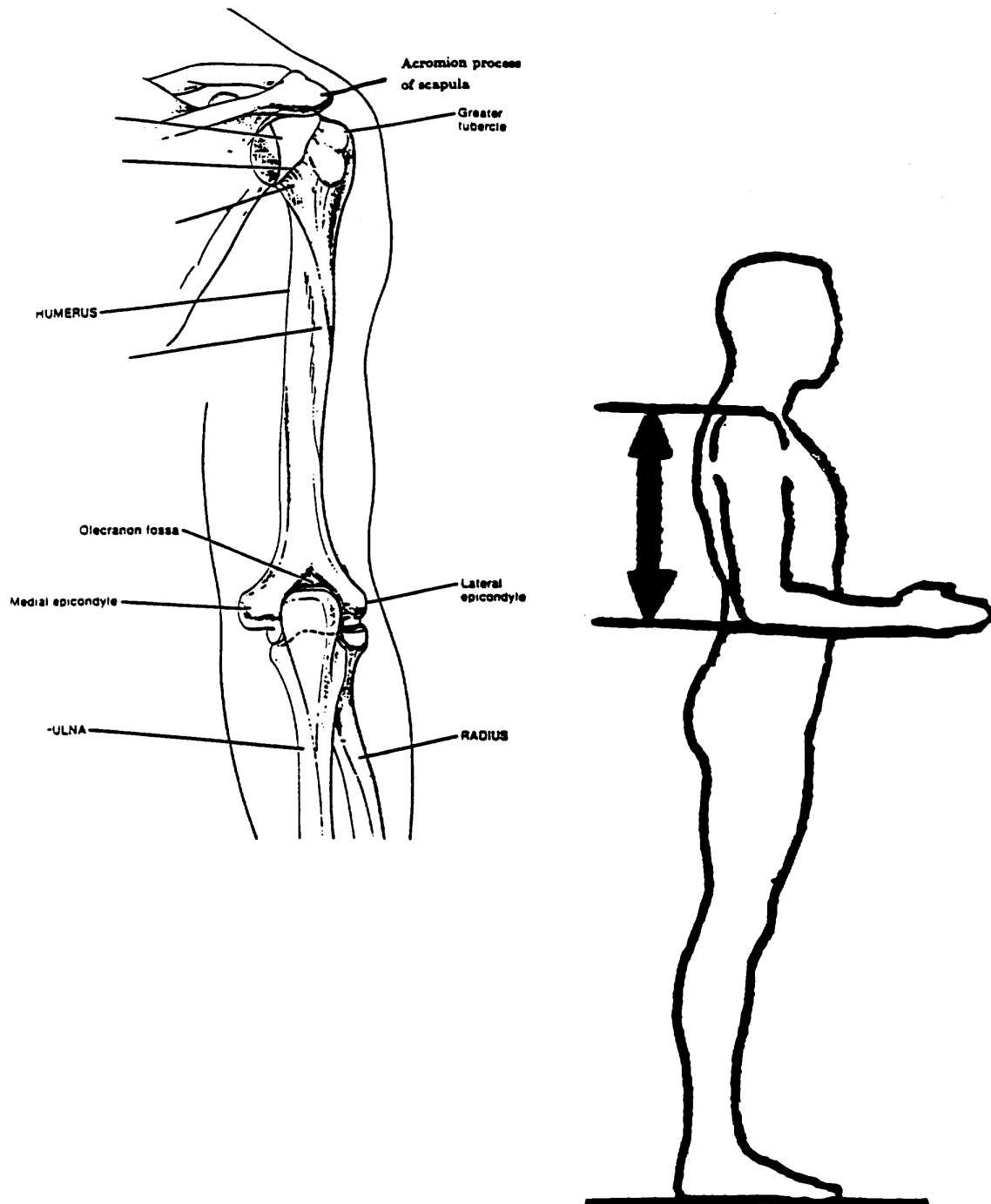
3.3.1.7 Biliac Breadth

The SP stands erect with feet together. The SP needs to hold the examination gown up so that the waist and top of hips are exposed. The examiner stands behind the SP holding the large sliding calipers. At the same time, the examiner locates the right side of the iliac crest at its highest point. At this point, the arms of the sliding caliper are placed on the lateral borders of each iliac crest. The soft tissue is compressed to obtain the bone measurement without hurting the SP. The maximum breadth at the highest point of the iliac crests is measured to the nearest 0.1 cm.

3.3.1.8 Upper Arm Length

Have the SP stand erect with feet together and the right arm flexed 90 degrees at the elbow with the palm facing up. The examiner is positioned behind the SP. The most upper edge of the posterior border of the acromion process of the scapula is located and marked (see Exhibit 3-5). 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). Read the measurement aloud

Exhibit 3-5. SP position for arm length position and location of upper arm midpoint



to the recorder. Keep the tape in position and locate half the distance from the acromion to the olecranon processes, i.e., the midpoint of the upper arm. With the cosmetic pencil, mark (+) at the midpoint on the posterior of the arm. This location will be the site for the mid arm circumference and triceps skinfold.

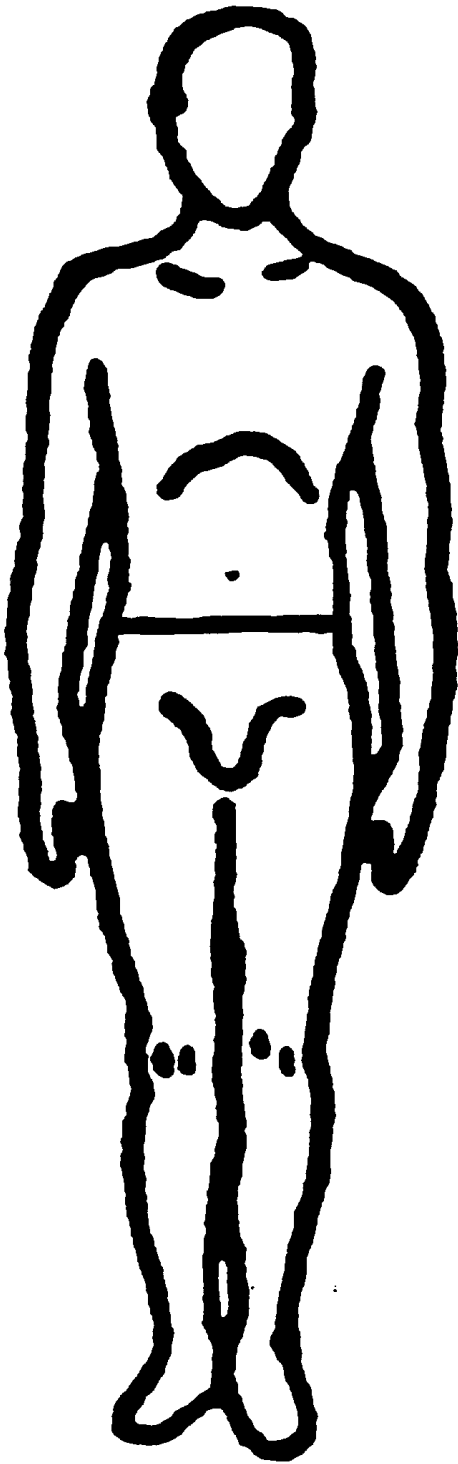
3.3.1.9 Arm Circumference

The SP is standing with the elbow relaxed so that the right arm hangs freely to the side. The examiner stands facing the SP's right side. The measuring tape is placed around the upper arm at the marked point perpendicular to the long axis of the upper arm (+ from upper arm length). The tape is again held so that the zero end is held below the measurement value. The tape rests on the skin surface, but is not pulled tight enough to compress the skin. The arm circumference is recorded to the nearest 0.1 cm.

3.3.1.10 Abdominal (Waist) Circumference

The SP is in a standing position. The SP is asked to hold up his gown. The examiner stands behind the SP and palpates the hip area for the right iliac crest (see Exhibit 3-6). The examiner marks a horizontal line at the high point of the iliac crest and then crosses the line to indicate the midaxillary line of the body. The pants and underclothing of the SP must be lowered slightly for the examiner to palpate directly on the hip area for the iliac crest. The examiner then stands on the SP's right side and places the measuring tape around the trunk in a horizontal plane at this level marked on the right side of the trunk. The recorder walks around 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. The measurement is made at minimal respiration to the nearest 0.1 cm.

Exhibit 3-6. Measuring tape position for abdominal (waist) circumference



3.3.1.11 Buttocks (Hip) Circumference

The SP stands erect with feet together and weight evenly distributed on both feet. The SP is holding up the examination gown. The recorder stands in back of the SP and gathers the side seams of the exam pants together above the hips and places the thumb in the fabric to make a fold. The recorder holds the folded sides of the pants snugly while the examiner squats on the right side of the SP and places the measuring tape around the buttocks. The tape is placed at the maximum extension of the buttocks (see Exhibit 3-7). The recorder then adjusts the sides of the tape and checks the front and sides so that the plane of the tape is horizontal. The zero end of the tape is held under the measurement value. The tape is held snug but not tight. The examiner takes the measurement from the right side and calls it to the recorder.

3.3.1.12 Thigh Circumference

The SP is standing with the right leg just in front of the left leg and the weight shifted back to the left leg. This instruction should be demonstrated by the examiner. The edge of the examining table may be used for the SP to hold onto to maintain his balance. The examiner stands on the SP's right side and the measuring tape is placed around the midthigh at the point that is already marked by a (+). The tape is positioned perpendicular to the long axis of the thigh with the zero end of the tape held below the measurement value. The tape rests firmly on the skin without compressing the skin. The recorder checks to make sure the tape is positioned correctly. The thigh circumference is measured to the nearest 0.1 cm.

3.3.1.13 Skinfolts

All skinfolts are measured with the Holtain skinfold calipers. The measurements are taken on the right side of the body. The fold of skin and underlying subcutaneous adipose tissue should be gently grasped between the examiner's left thumb and forefingers. The amount grasped depends upon the thickness of the subcutaneous adipose tissue. The examiner grasps 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 is grasped 2.0 cm above the place the measurement is to be taken and

Exhibit 3-7. Measuring tape position for buttocks circumference



is held gently with the thumb and forefinger. The jaws of the calipers are placed at the marked level, perpendicular to the length of the fold, and the skinfold thickness is measured to the nearest 0.1 mm while the fingers continue to hold the skinfold. The actual measurement is read from the caliper about 3 seconds after the caliper tension is released. A young child is unfamiliar with this procedure; therefore explain the procedure and demonstrate the use of the caliper on the child's palm. All skinfolds are recorded to the nearest 0.1 mm.

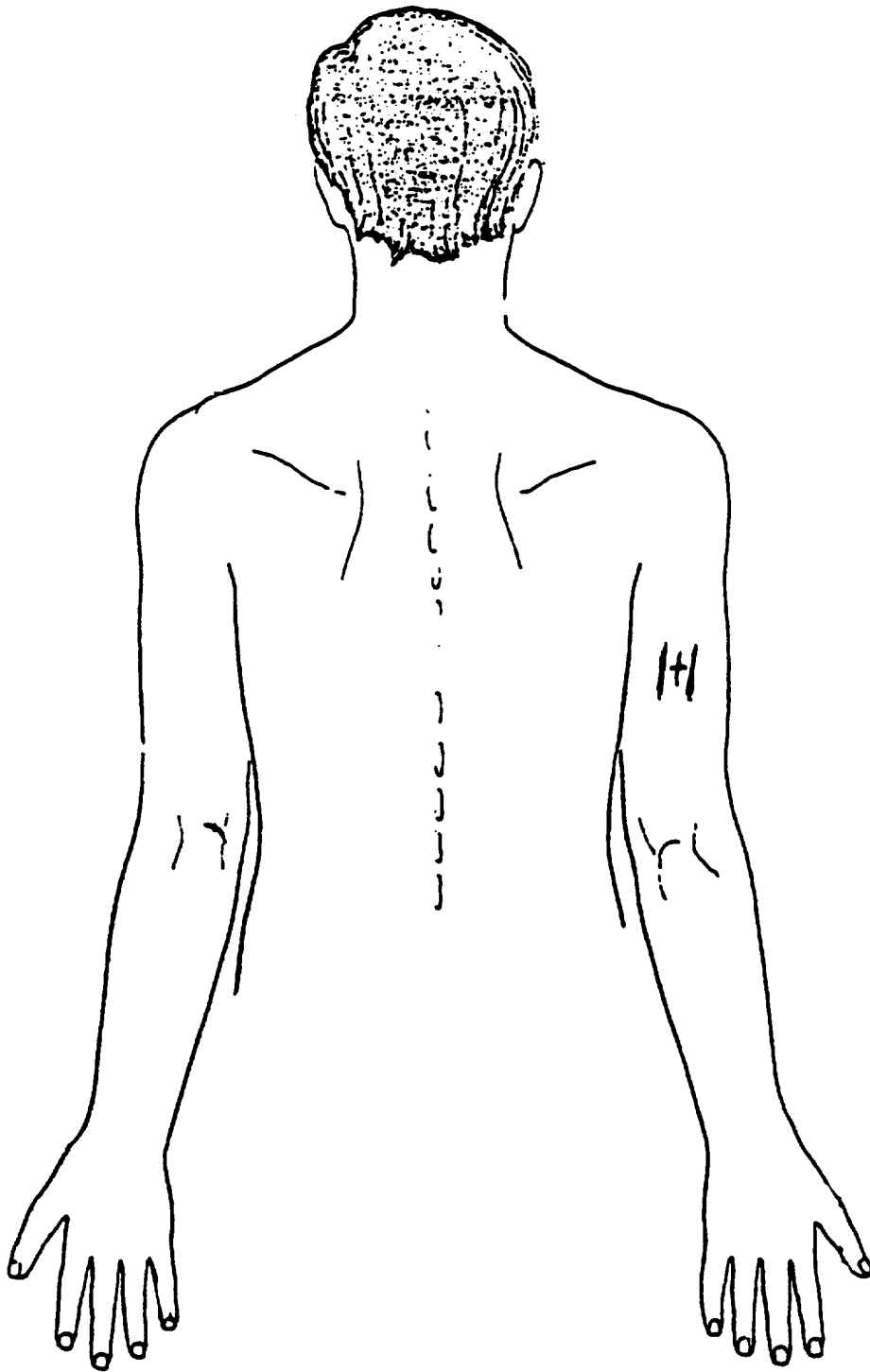
■ **Thigh Skinfold**

The thigh skinfold is measured in the midline of the anterior aspect of the right thigh. This level has already been marked from the thigh circumference measurement. The SP stands with his weight shifted back on the left leg with the right leg forward, knee slightly flexed, foot flat on the floor. Some SP's will need to hold onto the edge of the table to maintain their balance in this position. This is the same position used for measuring the thigh circumferences. A fold of skin and subcutaneous tissue is grasped in the midline about 2.0 cm above the marked point. The jaws of the skinfold calipers are placed perpendicular to the length of the fold and the shaft of the thigh over the marked point. Skinfolds are recorded to the nearest 0.1 mm.

■ **Triceps Skinfold**

The SP stands erect with feet together, shoulders relaxed and the arms hanging freely at the sides. The examiner stands behind the SP's right side. The point on the posterior surface of the right upper arm is located in the same area as the marked midpoint for the upper arm circumference. A fold of skin and subcutaneous adipose tissue is grasped gently with thumb and fingers approximately 2.0 cm above the marked level with the skinfold parallel to the long axis of the arm (see Exhibit 3-8). The jaws of the calipers are placed at the marked level, perpendicular to the length of the fold, and the skinfold thickness is measured to the nearest 0.1 mm while the fingers continue to hold the skinfold.

Exhibit 3-8. Location of triceps skinfold



■ **Subscapular Skinfold**

The SP stands erect with shoulders and arms relaxed at the side. The examiner opens the back of the examination gown and palpates for the inferior angle (or triangle portion) of the right scapula. The examiner makes a (+) on the inferior angle of the scapula with the cosmetic pencil marker. The examiner grasps a fold of skin and subcutaneous adipose tissue directly below (1.0 cm) and medial to the inferior angle. The skinfold forms a line about 45 degrees below the horizontal extending diagonally toward the right elbow (see Exhibit 3-9). The jaws of the caliper are placed 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. The skinfold thickness is measured to the nearest 0.1 mm while the fingers continue to hold the skinfold.

■ **Suprailiac Skinfold**

The SP stands and holds the right side of the examining gown up so that the right hip area is exposed. It may be necessary to lower the exam pants slightly to expose the area. The iliac crest had already been marked from previous measurements. The examiner places his/her thumb (left) on the intersecting marks and picks up the skinfold with the thumb and fingers. The skinfold should slope downward and forward at a 45 degree angle extending toward the pubic symphysis (see Exhibit 3-10). The caliper is placed perpendicular to the skinfold about 2.0 cm medial to the fingers and the skinfold is measured to the nearest 0.1 mm.

3.3.1.14 Elbow Breadth

The SP stands erect with feet together facing the examiner. The right arm is extended forward until it is perpendicular to the body. The examiner then flexes the right arm of the SP so that the elbow forms a 90 degree angle with the fingers pointing up and the posterior part of the wrist toward the examiner. With the small sliding caliper held at a 45 degree angle to the plane of the long axis of the upper arm, the greatest breadth across the epicondyles of the elbow are measured to the nearest 0.1 cm. This measurement is taken with the calipers at a slight angle because the medial condyle is more distal than the lateral condyle (see Exhibit 3-11).

Exhibit 3-9. Location of subscapular skinfold

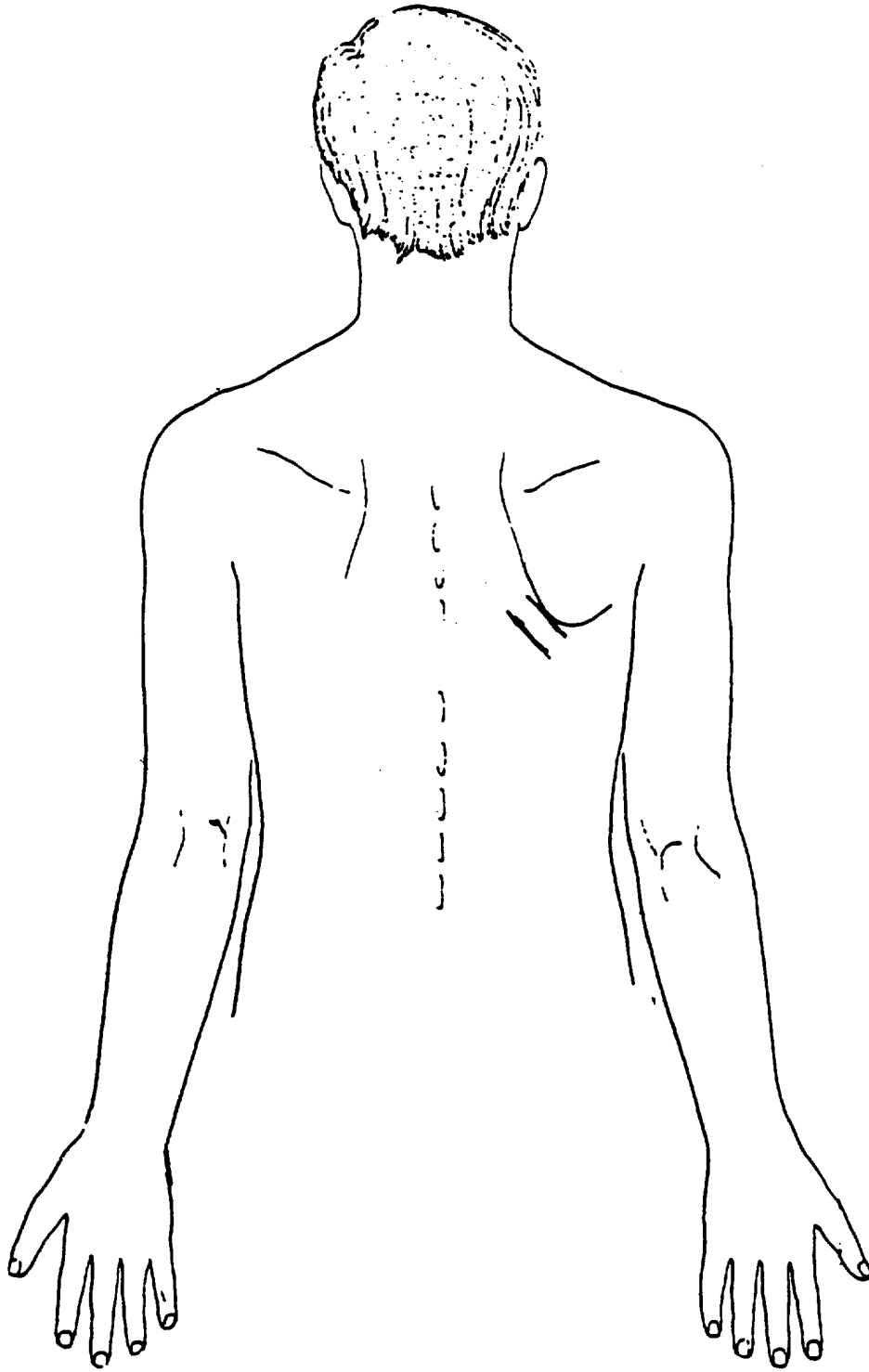


Exhibit 3-10. Location of suprailiac skinfold

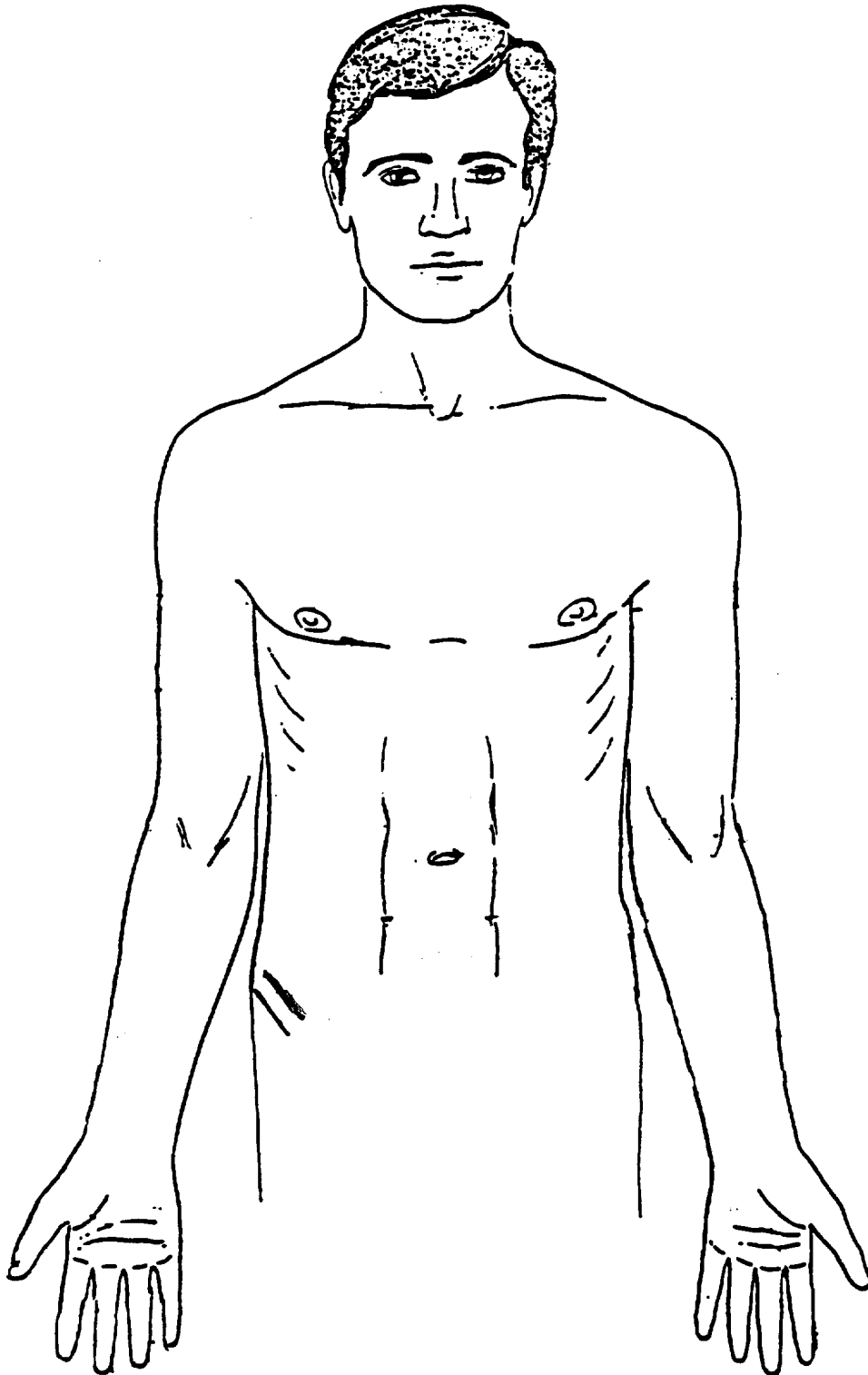
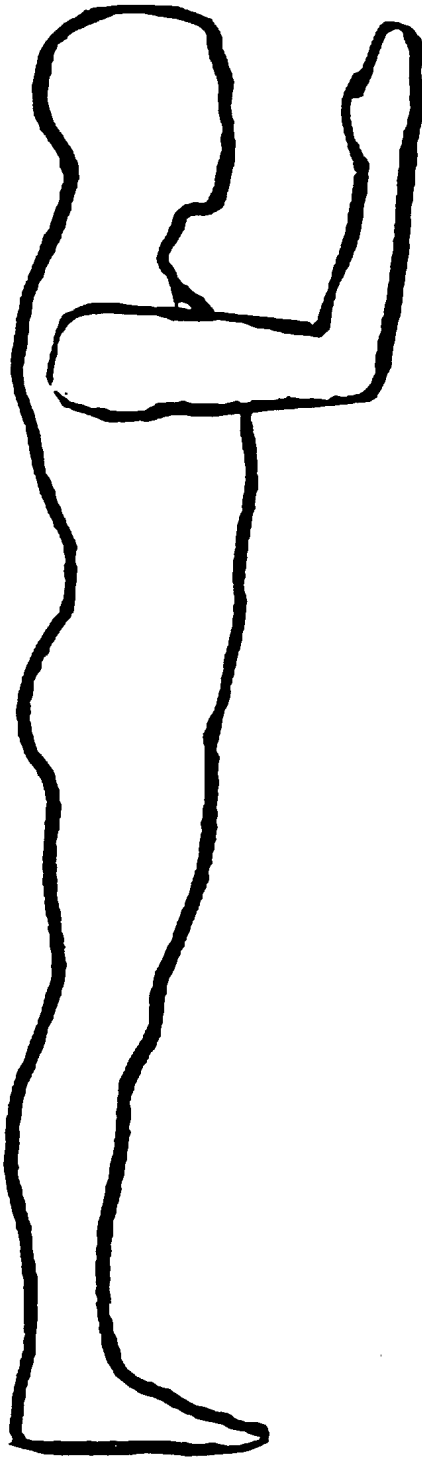


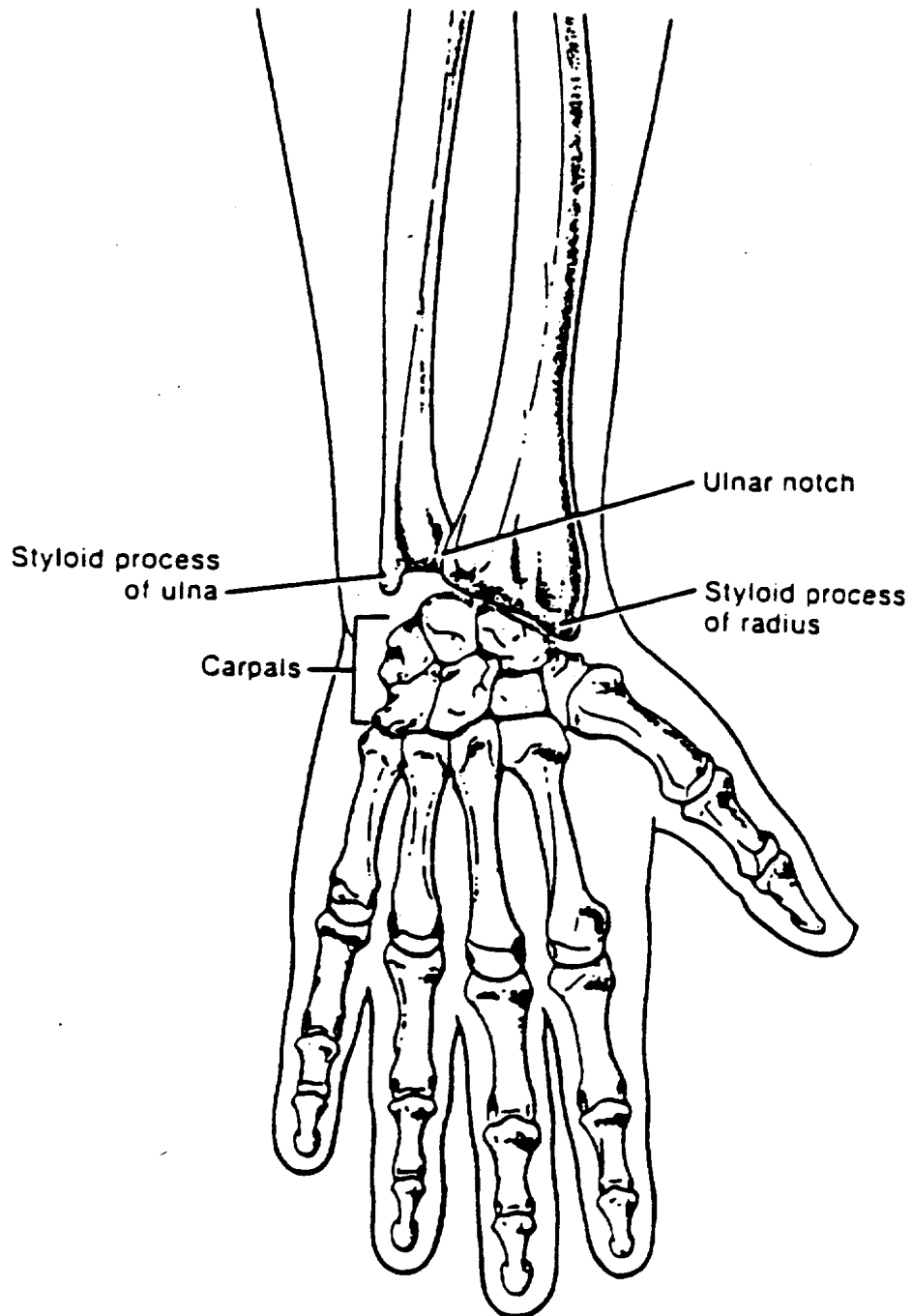
Exhibit 3-11. SP position for elbow breadth



3.3.1.15 Wrist Breadth

The SP stands and extends the right arm keeping the arm straight and near the side of the chest. The examiner stands to the right side of the SP and guides the blades of the small sliding caliper with the thumb and first finger of each hand. The examiner palpates the most prominent aspect of the ulnar styloid process with the middle or index finger of the right hand and slides the right blade of the caliper on to this landmark (see Exhibit 3-12). The most prominent aspect of the radial styloid process is located with the middle or index finger of the left hand. Firm pressure is applied and the breadth is recorded to the nearest 0.1 cm.

Exhibit 3-12. Bones of the wrist



**3.3.1.16 Sequence of Measurement Components, SP Position, and Examiner Equipment for Adults
20+**

Measurement	SP Position	Equipment
1. Weight	Standing	Scale
2. Standing height	Standing	Stadiometer Polaroid Camera
3. Sitting height	Sitting right pant leg open	Measurement box Stadiometer
4. Upper leg length (mid mark is placed on SP)	Sitting on box right pant leg open	Measurement box Small sliding caliper Insertion tape Cosmetic pencil
5. Knee height *60+ only	Sitting on exam table	Mediform sliding caliper
6. Biacromial breadth	Sitting on exam table	Mediform sliding caliper
7. Biiliac breadth	Standing hold gown up	Mediform sliding caliper
8. Upper arm length (mid mark is placed on SP)	Standing	Insertion tape Steel tape Cosmetic pencil
9. Arm circumference	Standing	Steel tape
10. Abdominal circumference (mark iliac crest)	Standing hold gown up	Steel tape Cosmetic pencil
11. Buttocks circumference	Standing hold gown up	Steel tape

Measurement	SP Position	Equipment
12. Thigh circumference	Standing hold gown up right pant leg open	Steel tape
13. Thigh skinfold	Standing hold gown up right pant leg open	Skinfold caliper
14. Triceps skinfold	Standing	Skinfold caliper
15. Subscapular skinfold	Standing	Skinfold caliper
16. Suprailiac skinfold	Standing hold up gown	Skinfold caliper
17. Elbow breadth	Standing	Small sliding caliper
18. Wrist breadth	Standing gown down	Small sliding caliper

3.3.1.17 Measuring Children under Eight Years of Age

The same procedures are followed for measuring stature and weight of children aged two through seven years as used for older SP's. For measuring breadths, circumferences, or skinfolds, the child may stand on a footstool placed in the center of the measuring room. If the child is too young to sit or stand by himself, the measurements are taken 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 SP's.

■ **Recumbent Length**

Place children 3 years of age and younger supine on the infant measuring board. The recorder holds the child's head in the Frankfort plane and applies gentle traction to bring the head into contact with the fixed headboard. The examiner holds the child's legs by placing one hand gently but firmly over the knees with the child's toes pointing directly upward. By applying gentle pressure to the legs to prevent the knees from flexing, the examiner brings the movable footboard to rest firmly against the child's heels. The measurement is recorded to the nearest 0.1 cm from the digital counter on the measuring board. It may be necessary to have a third person help with restless infants to take the measurement as quickly as possible while maintaining accuracy.

■ **Head Circumference**

This measurement is done on children 2 months to 7 years of age. The child either sits in the parent's lap, on the footstool, or stands depending upon age and activity level. The 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 tape snugly around the head. Hair ornaments and braids should be removed. The tape is moved up and down over the back of the head to locate the maximal circumference of the head. The 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.

3.3.1.18 Measuring Handicapped SP's

For those SP's that are handicapped (in wheelchairs) only limited anthropometric data can be collected.

- Weight can be recorded using the tared wheelchair in the MEC.
- 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 right arm is not restricted by the arm of the chair.

- 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.
- 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.
- Knee height can be recorded from the right lower leg as if the SP were ambulatory. It is necessary to remove or rearrange parts of the wheelchair so that there is no interference with the measurements. Again it is important that both the knee and ankle are each at 90° angles.
- Head circumference can be recorded in the same manner as an ambulatory child.
- Wrist and elbow breadths can also be easily recorded from an SP in a wheelchair. The same procedures are followed but the SP is seated rather than standing.

3.3.2 Examination Form

3.3.2.1 Automated System

The automated system for the Body Measurement examination will consist of several screens: an introductory screen, data collection screens and an exit screen. Data collection screens are designed to display descriptions of the measurements to be done for each age group. If an SP is less than two years of age, only the measurements applicable to that age group will be displayed on the screen. Likewise, if an SP is 2+ years of age, only the measurements applicable to each age group will be displayed on the screen. Different measurements are collected for SP's 2 months or greater, 2 years or greater, 60 years or greater, 2 months to 3 years and 2 months to seven years of age.

All measurement entries will be automatically edited for entry of a decimal point. If a decimal point is missing or incorrectly placed, a message will be displayed and the cursor will not advance until the decimal problem is corrected. Measurement entries will also be edited for length. If the number of positions entered for a measurement exceeds the number of positions allowed for that measurement, a message will be displayed and the cursor will not advance until the problem is resolved. Values which fall outside of specified boundaries for body measurements will be flagged for immediate verification. The technician will either verify the original value or enter the second "correct" value.

Every other day, one SP will be selected by the computer to have body measurements replicated by another technician. This selection will be made after the first set of measurements are completed. All body measurements will be repeated for these SP's.

■ **Introductory Screen**

Five procedures or functions are automated for the body measurement examination room. These functions will be performed under the control of a menu system. When a function is selected from the main menu, screens for the selected application will be displayed.

Selecting "data collection" from the main menu will bring up the introductory screen and allow entry into the data collection forms. The purpose of the introductory screen is to establish the identity of both the technician and the SP and to establish examinations required of the SP for each MEC room. After the technician enters the SP ID number, identification data for the SP will be sent to the body measurement screen by the scheduling system.

Only procedures required for the SP will be displayed on the introductory screen. Although allergy and body measures will be done in the same room, only SP's ages 6-19 and SP's ages 20-59 with an even NCHS number will receive an allergy examination. All SP's will receive a body measurement examination.

The Introductory Screen appears as follows:

Body Measurement Examination

Technician	Examinee
Tech# _____	NCHS# _____
Name _____	Name _____
	Age ____ Years/Months _
	Sex _

Procedures

■ Data Collection Screens

After selecting the appropriate procedure for an SP, the data collection screens will be displayed. If an SP is ages 12-16, the first data collection screen will be as follows:

Screen #1
Name _____ NCHS _____

Body Measures

How tall are you without shoes? ____ ft ____ in
(____ cm)

How much do you weigh without shoes? ____ . ____ lb
(____ kg)

The technician will ask the SP these two questions before obtaining any measurements. Again, this screen is only displayed and completed for SP's 12-16 years old.

These data collection screens will be displayed for SP's less than two years of age.

Name _____ NCHS _____

Description	Value	Comment
Weight	_____ XXX.XX kg	___
Recumbent Length	_____ XXX.X cm	___
Head Circumference	_____ XX.X cm	___
Upper Arm Length	_____ XX.X cm	___
Arm Circumference	_____ XX.X cm	___
Triceps Skinfold	_____ XX.X mm	___
Subscapular Skinfold	_____ XX.X mm	___

Technicians are required to enter a decimal point for each measurement entry.

The replicate skinfold screen follows the measurement screens. Only two skinfolds are repeated for SP's less than two years of age.

Name _____ NCHS _____

Replicate Skinfolds

Tech A# _____
 Tech B# _____

Description	Replicate Tech B	Replicate Tech A	Replicate Tech B
Triceps Skinfold	_____ *	_____	_____ XX.X mm
Subscapular Skinfold	_____ -	_____	_____ XX.X mm

The second technician (Tech B) will measure the skinfolds and record the values. Discrepancies between the skinfold measures of two technicians are allowed within certain tolerance levels. If the discrepancy exceeds these levels, the measurement will be flagged with a "*" and a message will be displayed at the bottom of the screen to measure and record the skinfold measurement again.

Name	NCHS		
Description	Value		Comment
Weight	_____	XXX.XX	kg
Standing Height	_____	XXX.X	cm
Sitting Height	_____	XXX.X	cm
Recumbent Length	_____	XXX.X	cm
Head Circumference	_____	XX.X	cm
Upper Leg Length	_____	XX.X	cm
Biiliac Breadth	_____	XXX.X	cm
Upper Arm Length	_____	XX.X	cm
Arm Circumference	_____	XX.X	cm
Waist Circumference	_____	XXX.X	cm
Buttocks Circumference	_____	XXX.X	cm
Thigh Circumference	_____	XXX.X	cm

These are screens for two year olds. Similar screens will be displayed for other ages. The cursor will move from measurement field to next measurement field. If the technician wants to enter a comment (i.e., tight skin) the "Insert Here" key will move the cursor to the comment field and then back to the measurement screen. A list of comments and codes will be placed near the terminal for reference and are also listed on the hardcopy exam form. If a code is not available, specific comments may be entered at the end of the exit screen.

Name	NCHS		
Description	Value		Comment
Thigh Skinfold	_____	XX.X	mm
Triceps Skinfold	_____	XX.X	mm
Subscapular Skinfold	_____	XX.X	mm
Suprailiac Skinfold	_____	XX.X	mm
Elbow Breadth	_____	XX.X	mm
Wrist Breadth	_____	XX.X	mm

After the measurement screens are completed, the height photo screen will be displayed for all SP's ages 2 years and older. This screen verifies that height photos were obtained and this information will also create a shipping record for the photos.

Name _____ Sample# _____

- Height Photo
1 = Obtained
2 = Not Obtained

■ Results Screens

The results of examination screen displays at the conclusion of every MEC examination.

Name _____

Results of Examination

- Test done
- Test incomplete
- Test not done

If "Test Done" is selected, the automated system will return to the introductory screen. If "Test Incomplete" or "Test Not Done" is selected, the "Reasons Test Incomplete or Not Done" screen will be displayed.

Name _____ NCHS _____

Reasons Test Incomplete or Not Done

- Software malfunction
- Hardware malfunction or lack of supplies
- Insufficient time available or room not available
- Examinee refused
- Examinee unable to understand test instructions due to language barrier

- Examinee unable to understand test instructions due to other reasons

- Examinee uncooperative
- Examinee pregnant
- Examinee wheelchair bound
- Amputee
- Artificial body parts
- Examinee uses walker, cane or braces
- Other

Comments _____

The technician will select the most appropriate reason for an incomplete or unattempted exam. If the reasons displayed do not apply, select "Other" and record reason in "Comments." The "Comments" field can always be utilized for any additional comments the technician thinks is applicable to the body measurement examination.

3.3.2.2 Hardcopy Data Form

When the automated system is not functioning, the body measurement data are recorded on hardcopy data forms (see Exhibit 3-13). The recorder enters the SP's identification number, or label at the top of the form. The examiner ID# is also recorded. The recorder must then verbally prompt

Exhibit 3-13. Body measurements (all ages)

BODY MEASUREMENTS				
ALL AGES				
STAFF NO. _____		NCHS ID No. _____		
How tall are you without shoes? 12-16 yrs		_____ ft _____ in	(_____ cm)	
How much do you weigh without shoes? 12-16 yrs.		_____ lb	(_____ kg)	
MEASUREMENT NAME	AGE	MEASUREMENT	CODE*	COMMENT
1. Weight	2 mo +	_____ kg	_____	
2. Standing Height	2 yr +	_____ cm	_____	
3. Sitting Height	2 yr +	_____ cm	_____	
4. Recumbent Length	2 mo-3yr	_____ cm	_____	
5. Head Circumference	2 mo-7 yr	_____ cm	_____	
6. Upper Leg Length	2 yr +	_____ cm	_____	
7. Knee Height	60 yr +	_____ cm	_____	
8. Biacromial Breadth	3 yr +	_____ cm	_____	
9. Biiliac Breadth	2 yr +	_____ cm	_____	
10. Upper Arm Length	2 mo +	_____ cm	_____	
11. Arm Circumference	2 mo +	_____ cm	_____	
12. Waist Circumference	2 yr +	_____ cm	_____	
13. Buttocks Circumference	2 yr +	_____ cm	_____	
14. Thigh Circumference	2 yr +	_____ cm	_____	
15. Thigh Skinfold	2 yr +	_____ mm	_____	
16. Triceps Skinfold	2 mo +	_____ mm	_____	
17. Subscapular Skinfold	2 mo +	_____ mm	_____	
18. Suprailiac Skinfold	2 yr +	_____ mm	_____	
19. Elbow Breadth	2 yr +	_____ cm	_____	
20. Wrist Breadth	2 yr +	_____ cm	_____	

Exhibit 3-13. Body measurements (all ages) (continued)

STAFF NO. _____ REPEAT MEASURES BY SECOND EXAMINER:

MEASUREMENT NAME	AGE	MEASUREMENT	CODE*	COMMENT
1. Triceps Skinfold	2 mo +	_____ mm		
2. Subscapular Skinfold	2 mo +	_____ mm		
3. Suprailiac Skinfold	2 yr +	_____ mm		
4. Mid-Thigh Skinfold	2 yr +	_____ mm		

RESULTS OF EXAMINATION:

1 Test done
 2 Test incomplete
 3 Test not done

REASONS TEST INCOMPLETE OR NOT DONE:

1 Software malfunction
 2 Hardware malfunction or lack of supplies
 3 Insufficient time available or room not available
 4 Examinee refused
 5 Examinee unable to understand test instructions due to language barrier
 6 Examinee unable to understand test instructions due to other reasons
 7 Examinee uncooperative
 8 Examinee pregnant
 9 Examinee wheelchair bound
 10 Amputee
 11 Artificial body parts
 12 Examinee uses walker, cane or braces
 13 Comments: _____

***ITEM COMMENT CODES:**

1. SP refused to have measurement taken
 2. SP was crying/fighting/upset/uncooperative
 3. Not done because of a rash or other skin irritation/dermatosis
 4. "Tight skin" (i.e., could not separate subcutaneous fat from underlying muscle)
 5. Exam interrupted (e.g., to draw blood) -- reschedule
 6. SP visibly edematous
 7. Skinfold too large for calipers
 8. Too many folds or fat -- unable to reliably identify site
 9. Cast at site -- describe
 10. Equipment malfunction (e.g., camera jammed)
 11. Tech did not finish -- had to leave room
 12. SP unable to stand/sit straight (due to Dowager's hump, scoliosis, etc.)
 13. Exam aborted -- (e.g., SP too tired and hungry; SP had to leave exam center, etc.)

the examiner as to which measurements are applicable to the SP according to age. All of the possible exam components are listed on the hardcopy data form. It is the responsibility of the recorder to carefully monitor the form to make sure only the correct measurements are performed.

The "Results of Examination" code should be selected after the measurements are obtained. If "Test Incomplete" or "Test Not Done" is selected, a reason from the "Reasons Test Incomplete or Not Done" list must be selected.

Page two of the hardcopy data form also includes the list of codes that are used when a measurement is unable to be taken. These codes are the same comment codes that are entered into the automated system for unobtained measurements.

After the exam is completed, hardcopy data forms are placed in the SP chart with other completed data forms. If hardcopy data forms are used because the automated system is not functioning, the data from the hardcopy forms must be carefully entered into the computer when it returns to working order as per instructions from the MEC manager.

3.4 Postexamination Procedures

After completion of the body measurement examination, the technician should remove all cosmetic pencil marks off the SP with some alcohol or baby oil on a piece of gauze. Technicians should direct or accompany SP's to their next examination destination as per MEC procedures.

4. LOGS AND RECORDS

This section describes additional procedures for the Body Measurement component that are the responsibility of the health technicians. These procedures include completing records, logs, and transmittal forms for the recording and shipment of examination data. The accurate completion of these procedures help facilitate an organized data collection process.

4.1 Daily Appointment Schedule

The Daily Appointment Schedule will provide information for several uses. A copy of the schedule will be given by the coordinator to the health technicians for the next day. The form from the automated system will provide a copy with the name, age, and sample numbers for each SP scheduled for that day. This list can be used to verify the Daily Log Sheet and other forms. It also lists the number of SP's that are expected for the session.

4.2 Daily Log

The automated system serves as a daily log to record information about each SP. However, if the system is malfunctioning, hardcopy logs will be maintained.

Daily log sheets are to be completed in addition to the automated system until instructed otherwise by the MEC manager (see Exhibit 4-1). The daily log sheet is located on a clipboard in the body measurement room. One page is used every session that examinations are being conducted during a stand. The technician completes the date, the session time, the stand number, and location.

National Health and Nutrition Examination Survey III

Location _____
Stand No. _____

Date ____/____/____

BODY MEASUREMENT DAILY LOG SHEET

Session: AM PM EVE

SP ID #	Age	Sex	Examiner ID #	Time In/Time Out	Status Code	Comments
1.				____/____		
2.				____/____		
3.				____/____		
4.				____/____		
5.				____/____		
6.				____/____		
7.				____/____		
8.				____/____		
9.				____/____		
10.				____/____		

Exhibit 4-1. Body measurement daily log sheet

For each SP examined, the technician records the SP's ID number, age and sex, technician ID number and the time the exam started, the time it was completed and the assigned status code. Three status codes are used for the Status Code column. Code (C) indicates a "completed" exam, (PC) indicates a "partial complete" exam, and (NE) indicates "no exam." (PC) and (NE) both require reasons for the assigned codes. The comments sections is used to note reasons why the examination was not completed (PC or NE), or any unusual occurrences, etc. The pages of the log are kept in a file until the end of the stand. At that time, the log pages are sent to Westat with the other end of stand materials.

4.3 Equipment Calibration Log

Daily equipment checks and calibrations of the anthropometric equipment are recorded in the Calibration Log (see Exhibit 4-2). As indicated in Section 2, skinfold calipers, the infant measuring board, the Toledo weight scale, and the Stadiometer all require daily checks before the first examination session each day. Calibrations are performed at the times indicated in this manual.

The technician performing the checks completes the top of the log sheet entering the stand number and location. The technician's ID number is recorded and the date of the check or calibrations should be recorded in the appropriate boxes. Calibration Log sheets are kept until the end of the stand. At that time, they are mailed with other required materials.

4.4 Shipment of Forms and Logs

At the end of each stand and at designated times during the stand, all materials are mailed to either Westat or NCHS. A standard transmittal form is to accompany any mailing of these materials. Transmittal forms are generated from the automated system.

Always make a copy of the transmittal form to keep for your records as well as recording any pertinent information about the mailing procedure (e.g., time of mailing, post office from which you mailed). If the packet with completed forms is lost in the mail, this information will enable the packet to be traced and you will have a record of everything that was contained in the packet.

For the body measurement procedure, you will be mailing the following forms, logs, and data material:

- Body measurement daily log sheets,
- Equipment calibration log,
- Stadiometer calibration pictures,
- Toledo scale readings,
- Quality control for body measurements form,
- SP standing height and sitting height pictures, and
- Hardcopy exam forms (if used).

Detailed procedures for shipment of materials is discussed in the Standardized Procedures section.

5. 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.

5.1 Examination Forms

5.1.1 Automated System

The automated system is designed to function as a quality control measure by minimizing possible measuring and recording errors. Tolerance levels or ranges have been set for each measurement. If a measurement does not fall within these ranges, the system displays an "out of range" message and the examiner can recheck the measurement and enter 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 would verify the original measurement value.

Measuring skinfolds often produces variability amongst examiners. 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, all skinfold measurements are to be repeated on each SP. The automated system is programmed to restrict major discrepancies between technician skinfold measurements. Again, tolerance levels allow for some inter-observer differences, but discrepant measures which exceed the levels must be resolved.

The system also edits the data for placement of decimal points and length of the entry. For instance, if the number of positions entered for a measurement exceeds the number of positions allowed

for a measurement, a message will be displayed and the cursor will not advance until the problem is resolved.

5.1.2 Hardcopy Exam Form

Hardcopy exam forms when used must be carefully edited for complete, accurate and legible data.

5.2 Examination Data Items

5.2.1 Tracking of Data Items

Standing height and sitting height photographs should be checked for clarity immediately after they developed. Unfocused or fuzzy photos should be retaken at that time. Photos should be stored in an orderly manner by date until the end of the stand. The automated system will have recorded the number of photos taken for each SP during the measurement procedure.

5.2.2 Shipping Data Items

The photos will be shipped at the end of the stand to NCHS. Each shipment must include a transmittal sheet generated from the automated system.

5.3 Equipment Calibrations

Routine calibrations and checks of the body measurement equipment ensures that the equipment is standardized and producing accurate measures. Documentation of calibration activities is transmitted to NCHS at the end of the stand.

5.4 Review, Observations and Replication

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

Replication

Different types of replicates will be utilized in NHANES III as quality control measures:

- Partial Replicates - Replicates who will be selected on the same day of their examination to evaluate interexaminer variation. For example, body measurements performed the same day by different technicians.
- Complete Replicates - Replicates who will be scheduled from the pool of volunteers for a complete reexamination at the MEC.
- Home Replicates - Replicates who were examined at the MEC and will be reexamined at their home, scheduled from the pool of volunteers.
- "Expert" Replicates - These are the replications performed by experts, i.e., the body measurement consultant.
- Laboratory Replicates - These are the split duplicates produced in the MEC laboratory from "Dry runs" and "guest" specimens.
- Bench Replicates - These are the blind controls and split duplicates of the specimens created at the CDC laboratory.

5.5 Refresher Sessions

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

6. SAFETY PROCEDURES

6.1 Equipment Precautions

All equipment in the body measurement 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.

6.2 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.

Body measurements which involve having the SP sit on the measurement table may require the assistance of the technicians. It is also recommended that the SP hold onto the edge of the counter for measurements which require them to maintain their balance on one leg.

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. Again, it is the technician's responsibility to carefully explain and monitor the body measurement procedures to adequately protect the SP's from any physical injury.

6.3 Emergency Procedures

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