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Anthropometric Procedures Manual: Early parenteral nutrition vs. standard care in patients not expected to be fed within 24 h of ICU admission.

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The Early PN Trial

NHMRC Project Grant Number 402643

Australian and New Zealand Clinical Trials Registry Number [012605000704695](https://www.anzctr.org.au/Trial/Registration/Trial.jsp?ACTRN=12605000704695)

Endorsed by the Australian and New Zealand Intensive Care Society
Clinical Trials Group.

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DOI: [10.4451/EarlyPN_APM](https://doi.org/10.4451/EarlyPN_APM)

Title: **Anthropometric Procedures Manual: Early parenteral nutrition vs. standard care in patients not expected to be fed within 24 h of ICU admission.**

Edition: Version 1

Author/Contributor: Simpson, Fiona; Doig, Gordon S;

Date of Publication: 13 July 2011

Format: WEB

Size: 297x210

No. of Pages: 26

Publisher: EvidenceBased.net, Sydney, NSW, Australia.

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Use of this Manual

This reference manual was designed for use in the Early PN Trial. It was not intended to be used for any other purposes. This reference manual has been released on the web after trial close-out as a resource text.

General Comments

Timing of measurements and position of patient

- Body composition measurements must be taken as baseline measurements *on the day of randomisation and then every MONDAY and THURSDAY* for the length of ICU stay.
- If the measurements are missed for some reason please ensure they are taken *the very next ICU working day* and continue the Monday/Thursday pattern thereafter.
- Use the *right hand side* of the body to take all body composition measurements.
- If any one of the body composition measurements *have* to be taken on the left side of a patient's body (Ex. the patient has no right arm or they have severe strictures in their right arm preventing accurate measurements), all measures *for that patient* should be taken using the left side of the body.
- All patients will be lying on their backs in bed when measurements are taken. For consistency, please ensure measurements occur whilst the patient is in that position.
- This manual has been deliberately written in layman's terms and designed for use in unconscious/semiconscious ICU patients.

Equipment

You have been provided with 1) two sets of slim guide calipers, 2) one ball of non-stretch string, 3) one tape measure and 4) one makeup pencil for use in this trial. When using the non-stretch string on a patient please cut an appropriate length and discard after use.

Anatomical Landmarks

Skeletal points ("landmarks") are used to identify the exact location of the site to be measured. All landmarks are identifiable with the thumb or forefinger. The site should be marked *directly over the landmark* using a fine tipped felt pen/makeup pencil.

A makeup pencil is useful for landmarking as it is not influenced by body oils and is non-permanent.

CRF questions AD18, AD19, BC5 and BC6.

Preparation before measuring the Mid-Upper Arm Circumference and Triceps Skinfold Thickness.

Acromiale Landmark

(The acromion process of the scapula or “bump” on the upper shoulder)

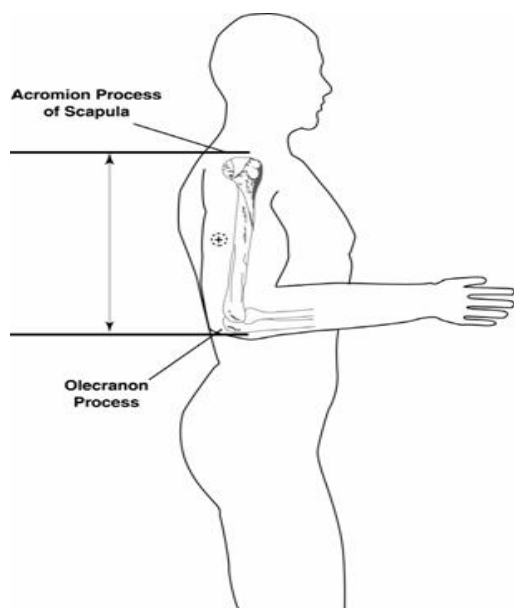
Finding the acromiale landmark is the first step in being able to measure the mid-upper arm circumference and triceps skinfold.

Patient: In bed, lying on their back, right arm as relaxed as possible and straight by their side.

Measurer: Stand on the right-hand side of the patient so you can clearly see the patient’s shoulder area.

Equipment Required: Fine felt tipped pen or a makeup pencil.

Figure 1 Skeletal image showing the Acromion process, Olecranon Process and Mid-point of arm. Right side standing view. From Phenxtoolkit, www.phenxtoolkit.org

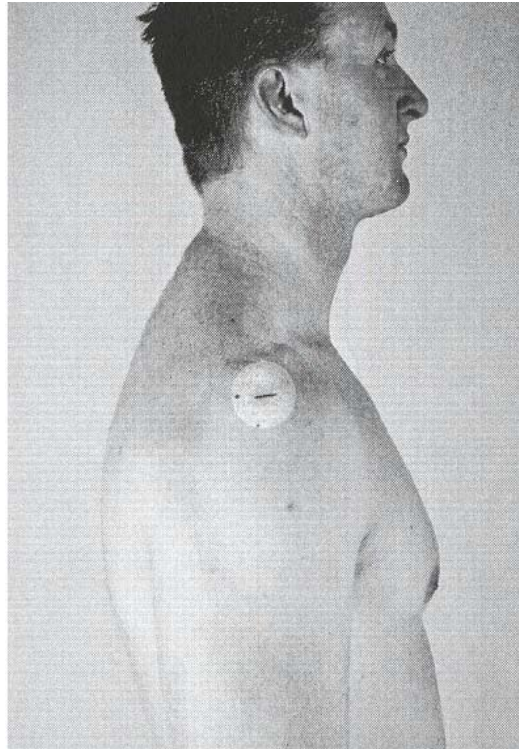


- Find the spine of the scapula. This is located at the top of the patients’ back. Run your fingers horizontally along the spine of the scapula, towards the back of the shoulder, moving away from the middle of the body.
- Once you run out of bone (scapula), move your fingers forward along the bone known as the acromion of scapula (i.e. towards the front of the patients’ shoulder).
- Find the bony protrusion (bump) on the acromion. *This should be roughly in the middle of the patients’ arm when looking from the side of the body. See figure 2 and 3*
- Mark the very edge of the acromion process (bump), at the site which is furthest away from the patient’s head, on the side of the right arm. Mark the landmark with a horizontal line.
- ❖ This is the acromiale landmark.

Figure 2 Acromiale Landmark, supine patient.



Figure 3 Acromiale Landmark, Standing View. ISAK 2001 page 24.



Radiale Landmark

(Head of radius)

Finding the radiale landmark is the second step in being able to measure the mid-upper arm circumference and triceps skinfold.

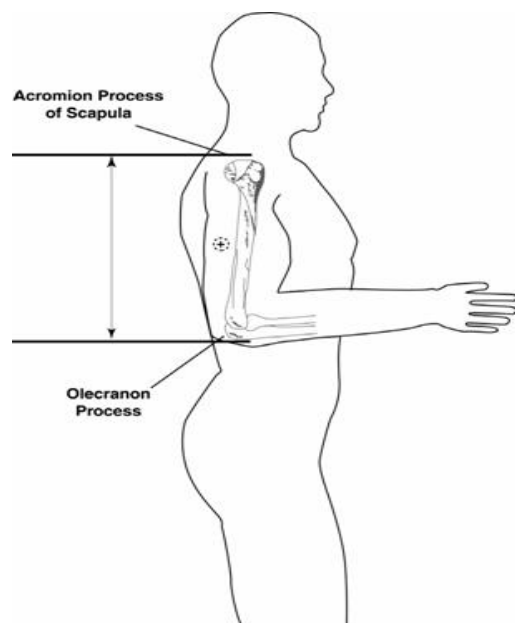
Patient: In bed, lying on their backs, right arm relaxed, straight and slightly extended from the patient's side.

Measurer: Stand on the right hand side of the patient so to clearly see the patients elbow area.

Equipment Required: Fine felt tipped pen or a makeup pencil.

- Slightly raise the patient's right arm (approx. 30 degrees) and move it away from the patient's body.
- Find the bony tip of the elbow (olecranon process). See figure 4.
- Move your hand from the olecranon process to the "dimple" of the elbow. The "dimple" will be located slightly higher than the olecranon process, towards the patient's shoulder.
- Feel for the "space" between the humerus and the head (top) of the radius.
- Move your hand onto the head of the radius (of the two bones, the radius is the bone closer to the patients wrist). See figure 5.

Figure 4 Skeletal image showing the Acromion process, Olecranon Process and Mid-point of arm. Right side standing view. From Phenxtoolkit, www.phenxtoolkit.org.



NOTE: To check if you have the correct landmark, keep your finger on the head of the radius and rotate the patient's wrist. You should be able to feel the radius rotating - if you can you have the correct landmark!

- Mark the site on the head of the radius at the point furthest away from the middle of the patient's body.
- ❖ This is the radiale landmark.

Figure 5 Radiale Landmark, Supine Patient.



Figure 6 Supine Patient showing Radiale, Acromiale and Midpoint landmarks.



Mid-acromiale-radiale Landmark

(The point exactly halfway between the Acromiale and Radiale landmarks).

Finding the Mid-acromiale-radiale landmark allows measurement of the Mid-upper arm circumference and triceps skinfold.

Patient: Lying on their back in bed. Right arm relaxed, straight and slightly extended from the patient's side.

Measurer: Stand on the right hand side of the patient so to clearly see the patient's upper right arm.

Equipment Required: Fine felt tipped pen or a makeup pencil, non-stretch string or Lufkin metal tape measure.

- Using either non-stretch string or a metal tape measure, measure the linear distance between the Acromiale and Radiale landmarks.
- The tape/non-stretch string should follow the patients arm in a straight line, and not be twisted or at an angle. See figure 7.
- Divide the linear distance from the Acromiale and Radiale by two if using a tape measure. See figure 7.
- If using non-stretch string measure the distance between the Acromiale and Radiale landmarks, and then fold the string measurement in half. Put the halved string measure again on the Acromiale landmark and mark the skin where the string ends. See figure 8.
- Mark the mid-point on the patient with a horizontal mark.
- ❖ This is the Mid-Acromiale-Radiale landmark.

Figure 7 Measurement of Mid-acromiale-radiale landmark. Supine patient.

(Note: tape measure is at zero at Acromiale landmark)



Figure 8 Measurement of Mid-acromiale-radiale landmark using string. Supine patient.



CRF questions AD18 and BC5. Mid-upper arm circumference

Mid Upper Arm Circumference Measurement (MUAC)

Patient: In bed, lying on back, right arm relaxed, straight and slightly extended from the patient's side

Measurer: Stand on the right hand side of the patient so to clearly see the patient's upper right arm.

Equipment Required: Lufkin W606PM 2m flexible steel tape measure or non-stretch string and fine felt tipped pen or an eyeliner (makeup) pencil.

If using a tape measure to measure Mid Upper Arm Circumference:

- Hold the tape measure case in the right hand and the stub in the left.
- Ask the attending nurse to raise the patient's right arm slightly so you can pass the tape measure stub around the back of the arm.
- Put the patients arm back on the bed so it is "relaxed".
- Line up the tape measure with the Mid-Acromiale-Radiale landmark, so that the (horizontal) line is underneath but in the middle of the overlapped tape. See figure 9.
- Apply constant tension to the tape so to minimise gaps between the skin and tape, but avoiding skin compression
- Secure both pieces of tape with the right hand, allowing the left hand to manipulate the tape so that zero can be read. Read with eyes level to the tape.
- Record to the nearest 0.1cm on case report form.

Figure 9 Lining up tape measure with Mid-acromiale-radiale landmark



Figure 10 Measurement of Mid-upper-arm-circumference using tape measure. Supine patient

(Note: Arm relaxed and as straight as possible)



If using string to measure Mid Upper Arm Circumference:

- Cut a piece of non-stretch string more than large enough to go around the patient's arm. If you have already used string to measure the mid-acromiale-radiale landmark (mid-point of the arm) you could use the same piece.
- Ask the attending nurse to raise the patient's right arm slightly so you can pass the string around the back of the arm.
- Put the patients arm back on the bed so it is "relaxed".
- Line up the string with the Mid-Acromiale-Radiale landmark, so that the (horizontal) line is underneath but in the middle of the overlapped string (see figure 11).
- Apply constant tension to the string so to minimise gaps between the skin and string, but avoiding skin compression
- Secure both pieces of string with the right hand, allowing the left hand to manipulate the string. Find where the end of the string meets and mark that point.
- Measure the marked string against a tape measure and record on the case report form *to the nearest 0.1cm*.

❖ This is the Mid Upper Arm Circumference Measurement.

NOTE: Whilst you still have the tape measure/string on the arm, mark the triceps skinfold site (see triceps skinfold landmark).

Figure 11: Measuring Mid-upper arm circumference using string.

(Note: string lining up with Mid-acromiale-radiale landmark)



CRF questions AD19 and BC6.

Preparation before measuring the triceps skinfold thickness

Triceps Skinfold Landmark

Finding the Triceps skinfold landmark allows measurement of the Triceps skinfold thickness.

Patient: In bed, lying on their back.

Attending nurse: Holding the right arm as straight up as possible (90 degrees to the floor, straight up in the air). Ensure that the attending nurse is taking all the weight of the arm (I suggest one hand holding the patients wrist and the other hand close to the patient's armpit to fully support the patients arm).

Measurer: The measurer will need to be able to clearly see the back of the arm. When the arm is held at 180 degrees the measurer should stand on the side of the arm which is closer to the patient's toes and the attending nurse closer to the patients head.

The measurer should still have the tape measure/string positioned at the Mid Upper Arm Circumference.

Equipment Required: Lufkin W606PM 2m flexible steel tape or non-stretch string. Fine felt tipped pen or a makeup pencil.

- After completing the measurement of the Mid-Upper Arm Circumference, keep the tape measure/string positioned at that landmark (Mid-acromiale-radiale landmark). Ask the attending nurse to hold up the patient's arm at 90 degrees to the floor. See figure 12.

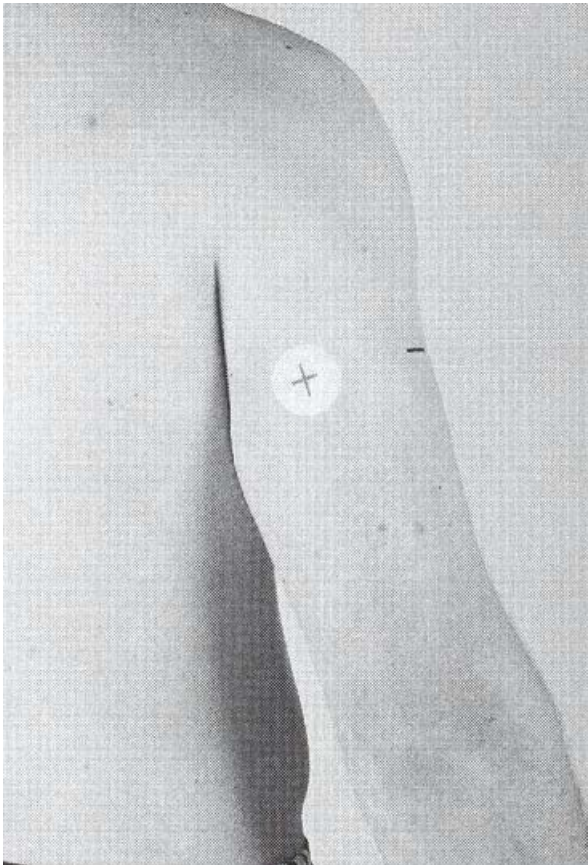
Figure 12 Marking the triceps skinfold landmark. Supine patient. Attending nurse holding arm.



- Using the tape measure/string as a template, make a horizontal mark in the middle of the *back* of the arm (triceps), between the two pieces of tape. The line should be at the same level as the Mid-acromiale-radiale landmark (midpoint of the front of the arm).
- ❖ This is the Triceps skinfold landmark site.

Figure 13 Marked triceps skinfold site. Standing patient. ISAK PAGE 27.

(Note: The Triceps skinfold landmark is at the same *level* as the Mid-acromiale-radiale landmark as shown in this photo)



NOTE: To save time, whilst the attending nurse is holding the arm up, remove the tape measure and take the triceps skinfold thickness measurement (see triceps skinfold thickness measurement section).

CRF questions AD19 and BC6. Triceps skinfold thickness

Triceps Skinfold Measurement

Patient: Lying on their back in bed.

Attending Nurse: Holding up the right arm straight up (90 degrees to the floor, straight up in the air). Ensure that the attending nurse is taking all the weight of the arm (I suggest one hand holding the patients wrist and the other hand close to the patient's armpit to fully support the patients arm).

Measurer: The measurer will need to be able to clearly see the back of the arm. When the arm is held at 90 degrees the measurer should stand on the side of the arm which is closer to the patient's toes and the attending nurse closer to the patients head.

Equipment Required: Slim Guide skinfold caliper.

- Hold calipers in your right hand, making sure the needle on the caliper is on zero.
- With your left hand, grasp and lift a fold of skin and underlying subcutaneous fat tissue at the marked Triceps skinfold site. The edge of the thumb and index finger should be in line with the marked site, palm facing away from you (see figure 14 and 15).
- The depth of the skinfold should allow the skin surface of the fold to be *parallel*.
- To ensure you don't include any underlying muscle tissue, roll the finger and thumb slightly before taking the triceps skinfold measurement. Remember subcutaneous fat has less tone and bulk than muscle tissue.
- The caliper should be held at 90 degrees to the surface of the skinfold site and applied 1cm below the thumb and finger at a depth equal to mid fingernail.
- The measurement is taken *2 seconds after* full pressure of the caliper is applied. *Continue to grip the skinfold throughout the measurement.* See figure 14 and 15.
- In the case of large skinfolds, the needle may still be moving when taking the measure. This is acceptable.
- Remove the caliper from the patients' arm. Don't forget to open the "contact faces" of the caliper otherwise you will pull the patients' skin!
- Record on the case report form to the nearest *millimeter*.

NOTE: After taking the Triceps Skinfold Measurement, remove the calipers and look at whether there has been any loss of subcutaneous fat at the triceps skinfold site (see "Subjective Global Assessment, Loss of Subcutaneous Fat" section for more details).

Figure 14 Triceps Skinfold Measurement. Standing patient.

(Note: skinfold grasped at marked triceps skinfold landmark).



Figure 15 Triceps Skinfold Measurement, Supine Patient.

(Note: attending nurse fully supporting weight of arm throughout measurement).



Height (Demi Armspan)

Height should be directly measured using Demi Armspan. This accurate measure of the patients' height is vital to determine the patients' body mass index. Height (Demi Armspan) needs to be measured only once during the hospital admission. The right arm is preferred but if it is not possible to use the right arm, use the left arm. Record the arm used on the case report form. If Demi Armspan measurement is *impossible* other acceptable measures of height are listed below, after the instructions for Demi Armspan.

CRF question AD17. Demi Armspan

Patient: Lying on their back in bed.

Attending nurse: Extending the patients' *right* arm until it is horizontal with the shoulder. Ensure the wrist is straight. The patients' arm may need to be supported.

Measurer: Standing on the right side of the patient.

Equipment Required: Lufkin W606PM 2m flexible steel tape or non-stretch string.

- Locate and mark the middle of the sternal notch (V at the base of the patient's neck). See figure 16.
- Place the metal tape measure between the middle and ring finger of the patients' right hand. The tape measure should be at zero at the base of the fingers (finger "web"). If using non-stretch string, the end of the string should be at the base of the finger "web". The tape/string should follow the patients arm in a straight line, and not be twisted or at an angle when measuring the distance.
- Extend the tape measure along the arm to the mid-point of the sternal notch.
- Record the measure to the nearest 0.5cm.
- Measures of the patients' height are taken *only once* during the trial.

NOTE: If neither the right or left arm can be used to measure Demi Armspan see details below for alternate measures of height.

Figure 16 Measurement of Demi Armspan. BAPEN 2003 page 14.

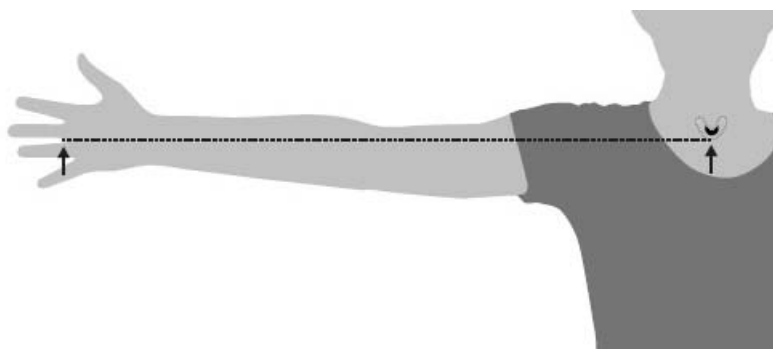


Figure 17 Measurement of Demi Armspan. Supine Patient.

(Note: Straight tape measure, following the patients arm. Wrist will need to be supported in an unconscious patient)



CRF question AD17a. Height

Total Height Measurement (only if Demi Armspan cannot be measured)

Demi Armspan should be used to measure height *if at all possible*. In the very small number of cases where Demi Armspan cannot be measured (e.g. when the patient has no arms) patient height can be measured directly (see below). Patient height is used to calculate body mass index (BMI).

Patient: Lying in bed on their back as flat and straight as possible.

Attending nurse: Standing at the patients' head.

Measurer: Standing at the lowest extremity of the patients' lower body. The measurer and the attending nurse should be standing at opposite extremes of the patient.

Equipment Required: Lufkin W606PM 2m flexible steel tape or non-stretch string. Clipboard or similar flat surface.

- Together with the attending nurse, use a clipboard or similar flat surface to each extend the perpendicular lines from the top of the head to lowest extremity of the patient. In many cases the lowest extremity will be the heel of the patients' foot.
- In cases such as where the patient has had an amputation please measure to the level of the lowest extremity

For example, a patient has had a double amputation with one leg amputated above the knee and the other leg amputated below the knee. Please measure to the lowest extremity. In this case this would be the leg amputated *below* the knee.

- Pull the tape measure/non flexible string out *in a straight line* until it is level with the lowest extremity of the patient.
- Please indicate on the case report form that the height was *measured* if using this technique.
- Measures of the patients' height are taken *only once* during the trial.
- Record to the nearest 0.5cm.

Estimating Height (Visual inspection)

If Demi Armspan and a full height measure cannot be undertaken please estimate the patient height.

- Visually inspect the patient in bed. It often helps if you know the length of your ICU's bed.
- Reports from family members may not be accurate so visual inspection is preferred. Check your visual inspection agrees with their report.
- Estimated heights should be as accurate as possible.
- Please indicate on the case report form that the height was *estimated* if using this technique.
- Estimates of the patients' height are taken *only once* during the trial.
- Please record to the nearest 0.5cm.

CRF questions AD16. Weight

We have asked for an estimate or direct measure of the patient's weight. This is vital to determine the patient's body mass index. Weight needs to be measured *only once* during the trial.

Weight Measure

Current body weight should be estimated from *direct observation or measured directly* (for example using bed scales or sling scales etc).

- If it is current ICU policy to weigh the patient, please continue with this policy and indicate on the case report form that weight was *measured*.
- Direct observation of weight is known to be accurate and is preferred to any historical weights or reports from family members.
- If an estimation of weight is made within a range of upper and lower limits, please record the upper limit of that range. Please also document on the case report form that the weight was *estimated*.
- Please record the patient's weight (in kilograms) to the nearest 0.1kg.

CRF questions AD20, AD21, BC 8 and BC9. Subjective Global Assessment of Nutritional Status: Physical Component.

CRF questions AD20 and BC7. Loss of Subcutaneous Fat stores.

The SGA is a validated and reliable instrument for detecting nutritional status *at a given point in time*. It is by very nature *subjective*. We are asking you to assess the patient at baseline *on the day of randomisation and on each Monday and Thursday thereafter* and decide *at that point in time* whether the patient shows evidence of subcutaneous fat loss. *Please do not try to remember all previous assessments when conducting a subsequent assessment*. These measures are part of the physical exam component of the SGA.

Physical Evidence of Loss of Subcutaneous Fat.

There are two areas to look at to assess whether there has been any loss of subcutaneous fat stores.

Fat Stored at the Triceps Skinfold Site

When grasping the skin at the triceps skinfold site, look to see the amount of subcutaneous fat stores. If your fingers *meet* when the triceps are grasped the loss of fat is *severe*; if the fingers *don't quite meet* the loss of stores would be regarded as *moderate*. If fingers don't touch there is ample subcutaneous fat tissue and the patient would be regarded as having *no obvious loss* of subcutaneous fat stores.

NOTE: Often determining the amount of subcutaneous fat present is easier when the skinfold is rolled between the fingers. This helps differentiate between fat and muscle. Subcutaneous fat stores lie directly under the skin. Muscle mass stores are deeper under the skin and have more tone and bulk than subcutaneous fat.

Figure 18 and Figure 19 No obvious Loss of Subcutaneous Fat Stores at Triceps Skinfold site.



Figure 20 Moderate Loss of Subcutaneous Fat Stores at Triceps Skinfold Site.

(Note: Fingers almost touching)



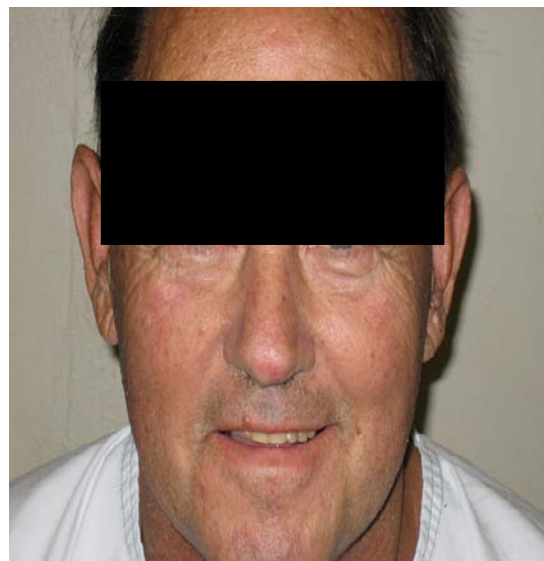
Loss of fat padding under the Eyes

- Look at the fat pads directly under the eyes. In normally nourished patients the fat pads appear as a slight bulge. In severely malnourished patients (severe loss of subcutaneous fat stores) *depressions or sometimes a darkened area* are seen under the eyes. Also look for *loose or hanging skin around the eyes and cheeks*.

Figure 21 Mild Loss of Subcutaneous Fat Stores



Figure 22 No Obvious Loss of Fat Stores



RANK THE PATIENT for physical evidence of loss of subcutaneous fat stores.

After examining the patients' subcutaneous fat stores (fat pads under the eyes, fat stores in the triceps area) please determine whether the patient shows any evidence of loss. If you are re-assessing the patient, *please do not try to remember previous assessments* and assess the patients' subcutaneous fat stores for only that calendar day.

Note: If the patient shows signs of subcutaneous fat loss in one area but not in the other, rank the patient in either the *mild or moderate category*, depending on the degree of subcutaneous fat loss in that ONE area

Please choose only ONE of the following categories to best represent *your overall* assessment of the patients' subcutaneous fat stores.

- **No obvious loss** (i.e. there is ample subcutaneous fat stores *in both areas*),
- **Mild loss** of subcutaneous fat stores (loss may vary between sites (see note above) OR loss is *slight in both areas*),
- **Moderate loss** of subcutaneous fat stores (loss may vary between sites (see note above) OR loss is moderate in *both areas*),
- **Severe loss** (the amount of subcutaneous fat store loss is severe *in each area*).

Please record your subjective assessment on the case report form.

CRF questions AD20, AD21, BC 8 and BC9. Subjective Global Assessment of Nutritional Status: Physical Component

CRF questions AD21 and BC8. Muscle Wasting

The SGA is a validated and reliable instrument for detecting nutritional status *at a given point in time*. It is by very nature *subjective*. We are asking you to assess the patient at baseline *on the day of randomisation and on each Monday and Thursday thereafter* and decide *at that point in time* whether the patient shows evidence of muscle wasting. *Please do not try to remember all previous assessments when conducting a subsequent assessment*. These measures are part of the physical exam component of the SGA.

Physical Evidence of Muscle Wasting

Muscles around the Clavicle

- Look along the line of the clavicle. *The smaller the muscle mass the more prominent the bone*. In the severely malnourished patient the bone can be quite prominent. Take note of the degree of muscle wasting in the clavicle area and inspect the shoulder area (see below).

NOTE: In well-nourished males the clavicle is usually not visible. In well-nourished females the clavicle *can* be visible so it is important to combine your findings with your assessment of the patients muscle mass around the shoulder area (see below).

Figure 23 Female. Normal (no muscle wasting). **Figure 24 Male. Clavicle visible, normal muscle around shoulders. Mild muscle wasting.**

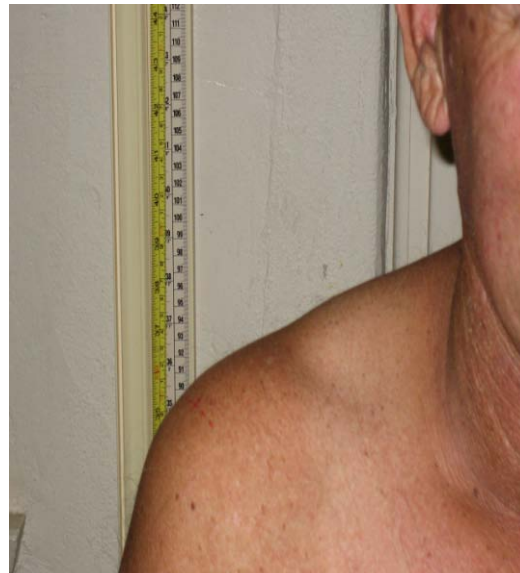


Figure 25: Male. Clavicle quite obvious. Acromion process visible. Shoulders slightly more square than above photo examples but still rounded. Good muscle bulk around biceps. Mild muscle wasting.



Muscles around the shoulder

- Position the patient's arm down at his/her side if possible. The shoulders of a *severely* malnourished patient (i.e. severe muscle wasting) are *square rather than rounded*. The acromion protrusion can be quite pronounced. Normal shoulders are curved, especially at the junction between the neck and the shoulder, and at the shoulder joint. You also should be able to *grasp muscle tissue at the shoulder joint*.

Mildly or moderately malnourished patients will show some signs of muscle wasting and whilst the shoulders will not be square the acromion protrusion can be evident.

RANK the patient for physical evidence of muscle wasting.

After examining the muscle around the shoulder and clavicle, subjectively rate the degree of muscle wasting.

Note: If the patient shows signs of muscle wasting in one area but not in the other rank the patient in either the *mild or moderate category* depending on the degree of muscle wasting.

Please choose only *ONE* of the following categories to best represent your overall subjective assessment of the degree of muscle wasting:

- Normal (i.e. there is no physical evidence of muscle wasting *in either area*),
- Mild muscle wasting (the loss of muscle may vary between sites (see note above) OR muscle wasting is *slight in both areas*),
- Moderate muscle wasting (the loss of muscle may vary between sites (see note above) OR muscle wasting is moderate *in both areas*),
- Severe (the loss of muscle is severe *in both areas*).

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