

**OBJECTIVE:** To assess and evaluate protein status using anthropometric measures and analysis of protein intake.

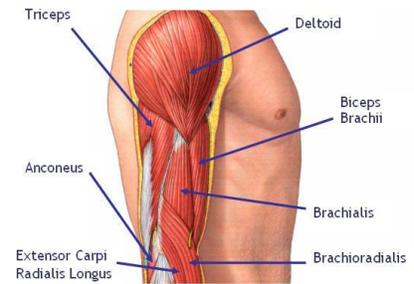
There are many ways to assess someone’s protein status. Today we will do this by assessing your **mid upper arm circumference (MUAC)** and **triceps skinfold thickness (TSF)** and using both of these values to determine your mid upper **arm muscle area**.

**Measurement of Mid Upper Arm Circumference:** MUAC is the circumference of the left upper arm, measured at the mid-point between the tip of the shoulder and the tip of the elbow. In children, MUAC is useful for the assessment of nutritional status. It is good at predicting mortality and in some studies, MUAC alone or MUAC for age, predicted death in children better than any other anthropometric indicator.

This measurement is also used to check for athletic fitness and weight gain. It is also used in anthropometric measures of skeletal muscle mass, as well as an *estimate* of the amount of muscle protein in your body. Almost 60 percent of the total body protein is found in your skeletal muscle. Hence, this muscle circumference can help determine nutritional intake.

Directions for measuring MUAC:

1. Hold the subject’s left arm away from their body but do not contract the muscle, as flexing the biceps will make the circumference larger.
2. Find the mid upper arm by finding the bony tip of shoulder and the back of the elbow. Measure this length and divide by two to find the half way mark, place a small dot there with a marker.



3. Circle the tape around the mid upper arm to determine the circumference (in millimeters) of the upper arm muscle. The muscles in this area include the biceps brachii on the upper side of the humerus arm bone and the triceps brachii on the posterior or lower side.

4. Note the circumference measurement and write it down in your raw data table (included at the very end of this lab handout). Measure three times and record in the raw data table, use average measurement when completing calculations.

Determine your Mid Upper Arm Circumference in millimeters (mm) by taking the average of your 3 measurements.

Use the following table to assess if your Mid Upper Arm Circumference is in the normal range.

<i>Category for Mid Upper Arm Circumference</i>	
	<i>(mm)</i>
Normal	> 185
Moderate Malnutrition	≤ 185
Severe Malnutrition	< 160

Calculation of **Mid Upper Arm Muscle Area** is used to estimate lean body mass. A change in mid upper arm muscle area is greater than the change in mid upper arm circumference. Consequently, changes in upper-arm musculature are not as easily detected by measurement of mid upper arm circumference as by Mid Upper Arm Area; therefore this is the preferred nutritional index.

To calculate the mid upper arm muscle area you need to measure the triceps skinfold thickness (TSF) using calipers.

1. Use the same landmark you used for the MUAC.
2. With your left thumb and index finger, pinch the skin-fold so it's 1 cm above the site.
3. Position the caliper perpendicular to the fold about 1 cm beneath the thumb and index finger.
4. Read the dial to the closest 1/2 mm one or two seconds after you release the trigger. Write this measurement in the raw data table.
5. Take at **least three readings** at each site and record in the raw data table. Pause a minimum of 15 seconds between measurements. If they differ by more than 1 mm, take more measurements until you get two readings less than 1 mm apart.
6. Use the measurements from the TSF and the MUAC to complete the calculation for Mid Upper Arm Muscle Area.

Calculate the mid upper arm area in mm<sup>2</sup> by using the equation:

$$\frac{(\text{Mid upper arm circumference in mm} - (\pi * \text{TSF mm}))^2}{4\pi}$$

$\pi = 3.14$

Use the tables attached to find your percentile for mid upper arm muscle area (data from Frisancho et al.)

**Men**

Age group	Arm muscle area percentiles (mm <sup>2</sup> )						
	5	10	25	50	75	90	95
1-1.9	956	1014	1133	1278	1447	1644	1720
2-2.9	973	1040	1190	1345	1557	1690	1787
3-3.9	1095	1201	1357	1484	1618	1750	1853
4-4.9	1207	1264	1408	1579	1747	1926	2008
5-5.9	1298	1411	1550	1720	1884	2089	2285
6-6.9	1360	1447	1605	1815	2056	2297	2493
7-7.9	1497	1548	1808	2027	2246	2494	2886
8-8.9	1550	1664	1895	2089	2296	2628	2788
9-9.9	1811	1884	2067	2288	2657	3053	3257
10-10.9	1930	2027	2182	2575	2903	3486	3882
11-11.9	2016	2156	2382	2670	3022	3359	4226
12-12.9	2216	2339	2649	3022	3496	3968	4640
13-13.9	2363	2546	3044	3553	4081	4502	4794
14-14.9	2830	3147	3586	3963	4575	5368	5530
15-15.9	3138	3317	3788	4481	5134	5631	5900
16-16.9	3625	4044	4352	4951	5753	6576	6980
17-17.9	3998	4252	4777	5286	5950	6886	7726
18-18.9	4070	4481	5066	5552	6374	7067	8355
19-24.9	4508	4777	5274	5913	6660	7606	8200
25-34.9	4694	4963	5541	6214	7067	7847	8436
35-44.9	4844	5181	5740	6490	7265	8034	8488
45-54.9	4546	4946	5589	6297	7142	7918	8458
55-64.9	4422	4783	5381	6144	6919	7670	8149
65-74.9	3973	4411	5031	5716	6432	7074	7453

**Women**

1-1.9	885	973	1084	1221	1378	1535	1621
2-2.9	973	1029	1119	1269	1405	1595	1727
3-3.9	1014	1133	1227	1396	1563	1690	1846
4-4.9	1058	1171	1313	1475	1644	1832	1958
5-5.9	1238	1301	1423	1598	1825	2012	2159
6-6.9	1354	1414	1513	1683	1877	2182	2323
7-7.9	1330	1441	1602	1815	2045	2332	2469
8-8.9	1513	1566	1808	2034	2327	2657	2996
9-9.9	1723	1788	1976	2227	2571	2987	3112
10-10.9	1740	1784	2019	2296	2583	2873	3093
11-11.9	1784	1987	2316	2612	3071	3739	3953
12-12.9	2092	2182	2579	2904	3225	3655	3847
13-13.9	2269	2426	2657	3130	3529	4081	4568
14-14.9	2418	2562	2874	3220	3704	4294	4850
15-15.9	2426	2518	2847	3248	3689	4123	4756
16-16.9	2308	2567	2865	3248	3718	4353	4946
17-17.9	2442	2674	2996	3336	3883	4552	5251
18-18.9	2398	2538	2917	3243	3694	4461	4767
19-24.9	2538	2728	3026	3406	3877	4439	4940
25-34.9	2661	2826	3148	3573	4138	4806	5541
35-44.9	2750	2948	3359	3783	4428	5240	5877
45-54.9	2784	2956	3378	3858	4520	5375	5964
55-64.9	2784	3063	3477	4045	4750	5632	6247
65-74.9	2737	3018	3444	4019	4739	5566	6214

**Guidelines for interpreting percentile values for Mid Upper Arm Muscle Area**

<b>Percentile</b>	<b>Category</b>
<5 <sup>th</sup>	Wasted
5-15 <sup>th</sup>	Below average
15 <sup>th</sup> -85 <sup>th</sup>	Average
85 <sup>th</sup> -95 <sup>th</sup>	Above average
>95 <sup>th</sup>	High muscle

**Lab report (Please type the final report)**

**Introduction:**

Your introduction should include a short title for this lab.

You also need a discussion of why this lab is important, what you hope to learn from it, and what the information gathered can be used for.

**Materials and Procedures:**

This section should include a list of any materials or supplies you used to complete this lab.

You also need to include a Step by Step description of what you did during this lab.

**Results and Analysis:**

You will need to attach your raw data.

You will need to create a table that summarizes your findings for your mid arm circumference and mid upper arm muscle area. Be sure to include what category you fall into.

**Conclusions:**

You will need to summarize the main findings (for this lab a summary of your mid upper arm circumference and mid upper arm area, and an evaluation of your protein status based on these values).

Be sure to discuss whether or not your findings suggest you should change anything about your diet. Please describe the changes you would make.

Conclusions Part 2

Complete the protein calculator activity found at:  
<http://www.proteinsmart.kashi.com/#/calculator>

When completed, print your protein list and turn it in with your lab.

RAW DATA: Take at **least three readings** at each site and record in the raw data table. Pause a minimum of 15 seconds between measurements. If they differ by more than 1 mm, take more measurements until you get two readings less than 1 mm apart.

Variable	Value 1	Value 2	Vale 3	Average
Mid arm circumference (mm)				
Tricep skinfold (TSF) (mm)				

Calculate the mid upper arm area in mm<sup>2</sup> by using the equation:

$$\frac{(\text{Mid upper arm circumference in mm} - (\pi * \text{TSF mm}))^2}{4\pi}$$

Mid upper arm area \_\_\_\_\_

Instructor Signature \_\_\_\_\_

	Excellent (3 pts)	Good (2 pts)	Adequate (1 pts)	Needs Work (0.5 pt)	Not attempted (0)
<b>Introduction</b>	Includes the question or purpose to be answered by the lab, states the reason why this is important and has a short, relevant title.	One of the "excellent" conditions is not met, two conditions met	Two of the "excellent" conditions is not met, one is met	Introduction present, no exemplary conditions met	
<b>Materials and Procedures</b>	Description or step-by-step process is included, could be repeated by another scientist	Description included, some steps are vague or unclear	The description gives generalities, enough for reader to understand how the lab was conducted	Would be difficult to repeat, reader must guess at how the data was gathered or lab was conducted	
<b>Results and Analysis</b>	Results and data are clearly recorded, organized so it is easy for the reader to see trends. All appropriate labels are included	Results are clear and labeled, trends are not obvious or there are minor errors in organization	Results are unclear, missing labels, trends are not obvious, disorganized, there is enough data to show the experiment was conducted	Results are disorganized or poorly recorded, do not make sense; not enough data was taken	
<b>Conclusions</b>	1. Summarizes data used to draw conclusions 2. Conclusions follow data (not wild guesses or leaps of logic), 3. Discusses applications or real world connections	2 of 3 of the "excellent" conditions is met	1 of 3 of the "excellent" conditions is met	Conclusion section is present but no conditions are met	
<b>Conclusions part 2</b>	Answers all additional questions required correctly.	Answers 2 or 3 additional questions correctly.	Answers 1 of 3 additional questions correctly.	Attempts to answer questions but none are correct.	