

Protocol

Assessment of energy expenditure using indirect calorimetry

Methods

Equipment

Krogh's respirometer with 5 liters of oxygen, mouthpiece, examination bed, nose clip, Master's steps, metronome, PoweLab system.

Procedure

Actual energy expenditure in rest:

- Examined person lies down on the examination bed. Connect the examined person to the respirometer placing mouthpiece (with filter) into their mouth and prevent them breathing through the nose using a nose clip.
- Keep the side valve of the respirometer in the position „OPEN“, which means that the examined person breaths atmospheric air and not the oxygen from the respirometer. Let the person breathe for at least 5 minutes.
- Start the program BASAL METABOLISM by double-clicking the icon on the screen.
- Start the recording and ask the examined person to breathe out and hold their breath. Then, quickly turn the valve 180° degrees to the position „CLOSED“. The person is now breathing the oxygen from the respirometer.
- Make a 3-minute recording of breathing at rest. Then press STOP and the recording will be interrupted.

Actual energy expenditure in standing position:

- Ask the person to stand up. Start recording again and make a 3-minute recording of breathing in standing position. Stop the recording.

Actual energy expenditure after workload:

- Disconnect the examined person from the respirometer – don't forget to close the valve. Ask them to walk all the way up and down the Master's steps in the rhythm of the metronome set to the frequency of 80 beats/minute (one beat = one step)
- Meanwhile, ask the assistant of the practicals to refill in the oxygen into the tank of the respirometer. After having finished exercising, the examined person needs to lie down as fast as possible on the examination bed. Connect them to the respirometer by placing the mouthpiece into their mouth and turning the valve to the „OPEN“ position. Don't forget about the nose clip!
- Start the recording. Make a 3-minute recording of breathing after workload.
- At the end, insert the comments about each situation and save the record under the name „Basal metabolism XY“, whereby XY corresponds to the initials of the name of the examined person. File type is Data Chart File (*.adicht).

Name:

Numer:

Study group:

Evaluation

In each situation, select a block of the recording without artefacts. Average value of oxygen consumption in l/s will appear in the mini-window. Measured values need to be standardized in order to be able to compare them (with other values measured in different conditions that could be in the examination room). This can be done by correcting the measured values to eliminate the effect of barometric pressure, room temperature and water tension in the room. From the corrected values, you can further calculate actual energetic expenditure in each situation.

Correction of oxygen consumption (l/s) to 0 °C and 101,325 kPa (760 mmHg):

$$v_r = v_n \cdot \frac{273}{273 + t} \cdot \frac{B - e}{101.325} \quad [l/s]$$

* v_r - corrected value of oxygen consumption

v_n - measured value of oxygen consumption in l/s

t - room temperature in °C

B - barometric pressure in kPa (1 torr = 1 mmHg = 0,133 kPa)

e - water tension in kPa by room temperature – see the table

t (°C)	0	1	2	3	4	5	6	7	8	9
10	1,219	1,303	1,391	1,485	1,585	1,691	1,801	1,920	2,044	2,174
20	2,314	2,462	2,617	2,781	2,953	3,134	3,328	3,529	3,741	3,965
30	4,201	4,449	4,709	4,986	5,269	5,570	5,887	6,225	6,567	6,933

Calculation of **actual energy expenditure (AEE)** by indirect calorimetry can be performed based on the following relationships: if we know **the value of the consumed oxygen** in liters per minute (value v_r) we can multiply it by the energetic equivalent of the oxygen (EE = 20,19 kJ/liter O₂):

$$\text{AEE (kJ/s)} = 20,19 \cdot V_r \quad \text{the error of calculation is about 8 \%}$$

Name:

Numer:

Study group:

Results

Space for your calculations (do not hand in the protocol without them):

<i>REST</i>		<i>STANDING</i>		<i>WORKLOAD</i>	
V_n	V_r	V_n	V_r	V_n	V_r
.....l/s	.....l/s	.....l/s	.....l/s	.....l/s	.....l/s
AEE	AEE	AEE	AEE	AEE	AEE
.....kJ/s	.....kJ/day	.....kJ/s	.....kJ/day	.....kJ/s	.....kJ/day

Protocol

Assessment of energy expenditure by Harris-Benedict formula

Methods

Equipment

scales, height measuring device, table for calculation of AEE (look below)

Procedure

Assessment of AEE can be broken down to several steps:

a) Calculation of basal energy expenditure (BEE) in kcal/day:

Use Harris-Benedict formula to calculate BEE:

♂:	$BEE = 66 + (13,7 \cdot m + 5 \cdot h) - (6,8 \cdot r)$
♀:	$BEE = 66 + (13,7 \cdot m + 5 \cdot h) - (6,8 \cdot r) *$

* $m = weight\ in\ kg$, $h = height\ in\ cm$, $r = age$

Results should be transformed to kJ/day (1 kcal = 4,18 kJ).

b) Calculation of AEE:

$$AEE = BEE \times AF \times TF \times IF$$

Name:

Numer:

Study group:

The factors that we take into account:

activity– AF	lying patient	1,1	
	lying but mobile patient	1,2	
	mobile patient	1,3	
	healthy light working	1,55 ♀	1,60 ♂
	healthy middle working	1,64 ♀	1,78 ♂
	healthy hard working	1,82 ♀	2,10 ♂
body temperature-TF	37 °C	1,0	
	38 °C	1,1	
	39 °C	1,2	
	40 °C	1,3	
	41 °C	1,4	
injury– IF	uncomplicated patient	1,0	
	after surgery	1,1	
	fractures	1,2	
	sepsis	1,3	
	peritonitis	1,4	
	multiple injuries	1,5	
	multiple injuries + sepsis	1,6	
	burns 30–50 %	1,7	
	burns 50–70 %	1,8	
	burns 70–90 %	2,0	

Use in your calculations (based on the presumption that the examined person is healthy):
TF: 37°C and **AF:** lying but mobile patient (AEE at rest), mobile patient (AEE in standing position), healthy light working (AEE after workload). (This procedure is illustrative and serves only for didactical purposes of this practical)

Results

Space for your calculations: (do not hand in the protocol without them):

Name:

Numer:

Study group:

Calculated values of BEE and AEE for the same person: (fill in all the blank spaces)

BEE= KJ/dayKJ/s

AEE at rest=KJ/day.....KJ/s

AEE in standing position= KJ/day.....KJ/s

AEE after workload=

KJ/day.....KJ/s.....KJ/hour

Interpretation and conclusions

Why does the examined person need to breath for at least 5 minutes prior to our experiment?

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Which factors is the resting energy expenditure dependent on?

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.....

How did the energy expenditure change in standing position in contrast to the one at rest and why?

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How did the energy expenditure change after workload in contrast to standing position and resting state? Explain.

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Compare the measured (corrected) and calculated values. Provided that they are different, try to give a possible explanation of this.

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Name:

Numer:

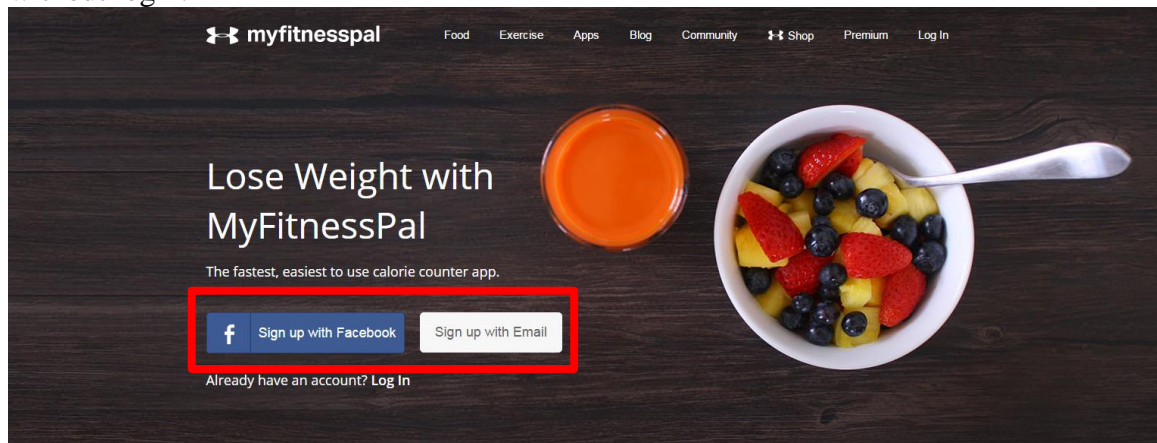
Study group:

Protocol

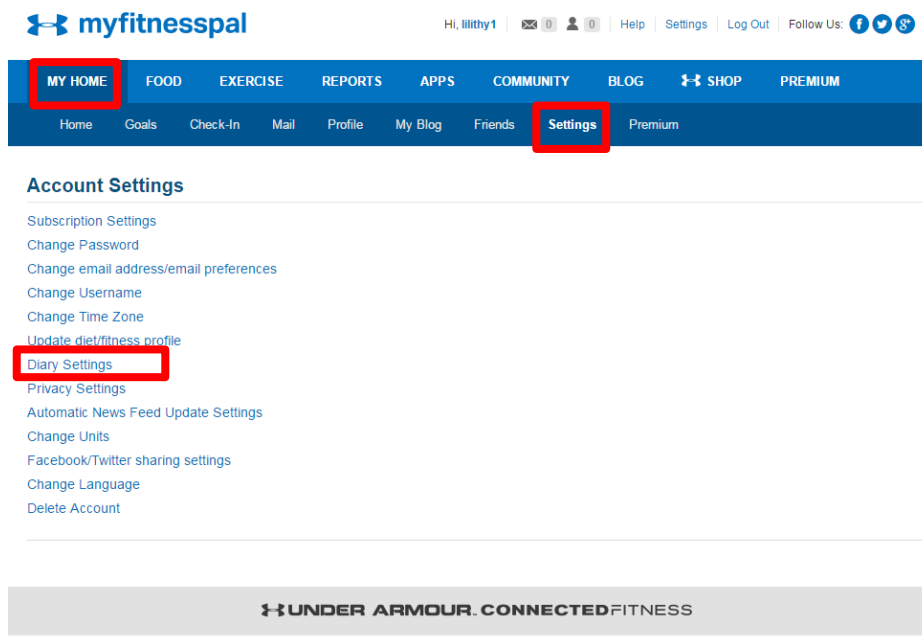
Compiling a daily diet: principles of proper nutrition

Go to **www.myfitnesspal.com**

Create your account or use your Facebook login for sign in. It is not possible to use the app without login.



After login go to „My Home-Settings“. From options, chose „Diary Settings“.
Use kilojoules (kJ) as an energy unit.



In option „Nutrients Tracked“ chose „Carbohydrates“, „Fat“, „Proteins“, „Calcium“, and „Vitamin C“. In option „Meal Names“ enter „Breakfast“, „Snack I“, „Lunch“, „Snack II“, and „Dinner“. Save by click on „Save Changes“.

Name:

Numer:

Study group:

Food and Exercise Diary Settings

Nutrients Tracked:
Kilojoules (Required)
Carbohydrates
Fat
Protein
Calcium
Vitamin C

Change Nutrients Tracked
If you'd like to change which nutrients you are tracking in your food diary, just use the controls to the left to choose which nutrients you'd like to track, then click "Save Changes".

Macronutrients In The Diary
Switch between grams and percentages

Default Add Food View:
Recent

Change Add Food Default View
By default we display your most recent entries when you add foods to your diary. If you would like to change this default, click on the drop-down box and select your preferred view.

Meal Names:
Breakfast
Snack
Lunch
Snack II
Dinner

Change Meal Names
You can change the names of the meals used in your food diary. For example, to track your eating habits by time, you could change your meal names to "9AM to 11AM", "11AM to 1PM", etc.
To delete a meal, just edit the meal name to be blank. Please note that previous food diary entries will also have their meal names changed.

For adding the foods go to „Food-Food Diary“. Click on „Add Food“, enter name or key words and find appropriate food. Estimate amount of the food and click on „Add Food to Diary“.

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Food Diary Database My Foods My Meals Recipes Settings

Your Food Diary For: Thursday, December 29, 2016

Breakfast
Add Food Quick Tools

Lunch
Add Food Quick Tools

Dinner
Add Food Quick Tools

Snacks
Add Food Quick Tools

	Kilojoules kJ	Carbs g	Fat g	Protein g	Sodium mg	Sugar g
Totals	0	0	0	0	0	0
Your Daily Goal	7,866	235	63	94	2,300	71
Remaining	7,866	235	63	94	2,300	71

When you're finished logging all foods and exercise for this day, click here:

Complete This Entry

After completion of the list for whole day, go to web myfitnesspal.com and open the food diary („Food-Food Diary“). Set the window size to fit the entire list including sums of the parameters on the screen. Use „Print Screen“ to take a copy of the screen, save it as a picture, crop it and fit it into A4 page format.

Name:

Numer:

Study group:

MY HOME **FOOD** **EXERCISE** **REPORTS** **APPS** **COMMUNITY** **BLOG** **SHOP** **PREMIUM**

Food Diary Database My Foods My Meals Recipes Settings

Your Food Diary For: **Friday, December 30, 2016**

Breakfast

	Kilojoules kJ	Carbs g	Fat g	Protein g	Sodium mg	Sugar g
Bread, egg, 1 oz	340	14	2	3	108	1
Add Food | Quick Tools	340	14	2	3	108	1

Lunch

the - Lasagne, 1/4 cooked	1,937	33	21	34	651	5
Erin - Chicken Soup, 1 cup	209	0	2	2	690	2
Add Food | Quick Tools	2,146	33	23	36	1,341	7

Dinner

Yolida - Yogurt, 150 g	418	13	2	8	105	8
Cake - Chocolate, with chocolate frosting, 1 oz	435	15	5	1	95	0
Add Food | Quick Tools	853	28	7	9	200	8

Snacks

Panera Bread - French Baget, 1 baget	628	30	2	5	370	0
Add Food | Quick Tools	628	30	2	5	370	0

Totals	3,967	105	34	53	2,019	16
Your Daily Goal	14,309	428	114	171	2,300	129
Remaining	10,342	323	80	118	281	113

Kilojoules kJ **Carbs g** **Fat g** **Protein g** **Sodium mg** **Sugar g**

*You've earned 6,443 extra kilojoules from exercise today

Open the “Exercise” and “Exercise diary”. „Print Screen“ to take a copy of the screen, save it as a picture, crop it and fit it into A4 page format.

MY HOME **FOOD** **EXERCISE** **REPORTS** **APPS** **COMMUNITY** **BLOG** **SHOP** **PREMIUM**

Exercise Diary Database My Exercises Settings

Your Exercise Diary for: **Friday, December 30, 2016**

Cardiovascular

	Minutes	Kilojoules Burned
Running (jogging), 9.6 kph (6.2 min per km)	60	2,929
Walking, 7.5 mins per km	90	3,515
Add Exercise | Quick Tools		

Daily Total / Goal	150 / 60	6,444 / 1,423
Weekly Total / Goal	150 / 180	6,444 / 4,268

Strength Training

Sets	Reps/Set	Weight/Set
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Add Exercise | Quick Tools

Print the lists and bring them on practice.

Name:

Numer:

Study group:

Evaluation of energy balance (EB):

EB = Daily energy intake – Daily energy expenditure (DEE)

(+ = positive, - = negative EB)

DEE = BEE (basal energy expenditure) + SDE (specific dynamic effect of nutrients) + PA (physical activity)

BEE - we can calculate using Harrison-Benedict formula:

♂:	$BEE = 66.5 + (13.75 \cdot m + 5.003 \cdot h) - (6,775 \cdot r)$
♀:	$BEE = 655.1 + (9.563 \cdot m + 1.85 \cdot h) - (4.676 \cdot r) *$

* $m = weight\ in\ kg, h = height\ in\ cm, r = age$

SDE (specific dynamic effect of nutrients) – 10% of daily energy intake

Results

Fill in the information about the examined person:

Gender..... Age..... Height.....(m) Weight.....(kg)

BMI..... (kg/m²)

BEE.....(kJ/day)

SDE.....(kJ/day)

Physical activity.....(kJ/day)

EB.....(kJ/day)

allergens (food and other):.....

Smoking..... number of cigarettes per day.....

Alcohol..... amount of liters per day (including beer).....

Name:

Numer:

Study group:

Conclusion

Evaluate the daily diet of the examined person comparing the acquired and recommended values of nutrients, ions and vitamins.

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Quantitative aspect – Based on EB of the person, will they be prone to gain or lose weight?
Explain

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Qualitative aspect of nutrition

Give adequate recommendations as to how their life style and nutrition could be improved based on all the errors that you have observed during your examination:

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.....
.....
.....

Name:

Numer:

Study group:

Protocol

Evaluation of nutritional state

Indexes calculated from anthropometric parameters

Equipment

scales, device for height measurement, measuring tape, calculator

Results

1) Broca's index (ideal body mass):

♂: height in cm - 100 or $(\text{height in m})^2 \times 23$

♀: (height in cm - 100) - 10 % or $(\text{height in m})^2 \times 21$

Result:.....

% ideal body mass*:

$(\text{actual body mass/ideal body mass}) \times 100$

Results.....

Evaluation

Obesity degree	% ideal body mass
mild	115–129
moderate	130–149
severe	150–199
morbid	> 200

2) Quetelet's index or body mass index (BMI):

$$BMI = \frac{\text{body weight (kg)}}{\text{height (m)}^2}$$

BMI:.....

Name:

Numer:

Study group:

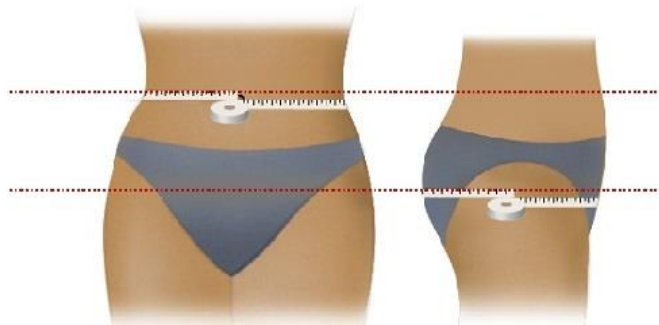
Evaluation of BMI

BMI (kg.m ⁻²)		
Category	Men	Women
Underweight	< 20	< 19
Healthy	20–24,9	19–23,9
Overweight	25–29,9	24–28,9
Obesity	30–39,9	29–38,9
Morbid obesity	> 40	> 39

3) Waist circumference

Waist circumference is measured in standing position in the narrowest part of the trunk (slightly above the belly button)

Hip is measured in the widest part of the upper part of the body (over gluteus area)



Evaluation

Waist circumference (cm)		
Category	Men	Women
Normal value	≤ 94	≤ 80
Necessity to decrease body mass	95–102	81–90
Medical assistance with decreasing of body mass necessary	> 102	> 90

4) Waist/Hip Ratio = WHR

WHR recommended for women < 0,80
for men < 1,00

Waist.....cm

Hipcm

Waist/Hip.....

Body fat measurement by caliper

Thickness of subcutaneous fat layer informs us about the energy balance of the organism. However, it does not reflect possible differences in distribution of subcutaneous and visceral fat. The simplest method widely used in the clinical practice to determine the skinfold thickness is the measurement with a caliper over the triceps brachii muscle. For the purposes of our practical we will determine the skinfold thickness over the triceps brachii muscle and also under the scapula. (positions 1 and 2 in the picture below)

Equipment

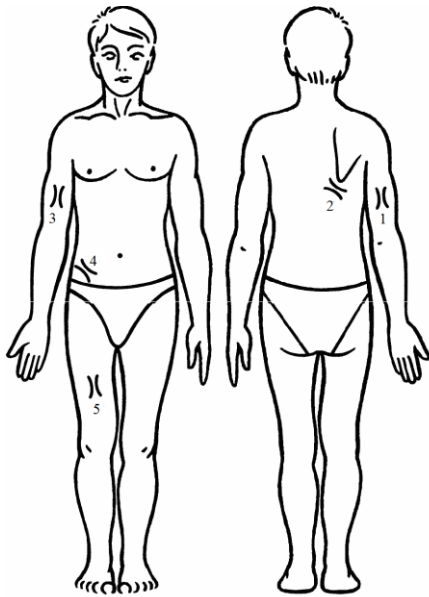
caliper

Name:

Numer:

Study group:

Procedure



The measurement is conducted in a sitting position (for the triceps skinfold) or standing (for scapular skinfold). Your hand should hang loose and stay relaxed. The measurement should be performed on the non-dominant upper extremity (right-handed people on the left and vice versa). When measuring with a caliper, the skinfold is grasped with the thumb and index finger and pulled up from the underlying muscle. Using the other hand put the measuring facets of the caliper about 1 cm from the top of the skinfold held by your fingers, and then release the caliper arms in order to apply a constant force to the skin. The skinfold thickness should be read within 2 seconds. At least 3 measurements should be performed, and the arithmetic mean calculated to make the measurement more exact.

From the values of the skinfold thickness, you are able to determine the portion of the fat mass in the organism by using **nomogram** (see below). Note that it is only an approximate value.

Other possible places where skinfold thickness can be measured (see also the picture above):

- 3 – over biceps brachii
- 4 – over crista iliaca
- 5 – on the thigh

Evaluation

Assessment of percentage of body fat (calculated from the two skinfolds, according to Slaughter)

♂: % fat = 0,735 * [under scapula (mm) + over triceps (mm)] + 1,0

♀: % fat = 0,610 * [under scapula (mm) + over triceps (mm)] + 5,1

Results

	1. measurement	2. measurement	3. measurement	the mean value
over triceps (mm)				
under scapula (mm)				

Nomogram: by matching the measured values of the skinfolds, you will get % of body fat.

% fat by Slaughter.....%

% fat from nomogram.....%

Name:

Numer:

Study group:

Body fat measurement by bioimpedance method

Equipment

Hand bioimpedance device and bioimpedance scales

Procedure

Device OMRON TBF-551:

1. Set the personal data of your experimental subject into the memory of the device: press the button SET and choose always one from the offered parameters that are being displayed in the bottom part of the screen as different figures: adult/child/sportsman, man/woman, height of the experimental subject
2. After setting 0 on the display, the experimental subject stands carefully **barefoot** on the scales. After a while the values the values of weight in kg and body fat in % appear. Write down the values and **use the cloth with disinfection to disinfect the device.**

Device OMRON BF300:

1. Turn the device on by pressing the button ON/OFF. For the first few seconds, display test is running and then zero values are shown. Proceed by pressing following buttons:
 - a. **HGT:** enter the height of the examined person **in cm** using numerical buttons (in case you make a mistake, press HGT again and repeat)
 - b. **WT:** enter the body weight **in kg**
 - c. **AGE:** enter the age (interval is 10 – 80)
 - d. **M/F:** press this button to set up the gender (You can press this button again if you make a mistake.)
2. After all values are entered, press SET. After a short while, the device will beep and READY will appear on the display.
3. Grab the device properly with both hands and your arms stretched out in front horizontally and press START using your right thumb. After the measurement is completed, the device emits a single beep and the results will be shown on the display.

Evaluation

Age (years)	< 30	> 30
Women	17–24 %	20–27 %
Men	14–20 %	17–23 %

Results

1) measurement by hand device

% fat

2) measurement by scales

% fat

Name:

Numer:

Study group:

Measurement of amount of muscle tissue

Equipment

measuring tape

Procedure

Circumference of arm muscles (CAM) is determined - measure the circumference (CA) of the non-dominant hanging and relaxed arm (where the muscle size is the greatest) using measuring tape. Be careful not to press the arm! Obtained value has to be **corrected to subcutaneous tissue**:

$$\text{CAM} = \text{CA} - 3,14 \times \text{skinfold over triceps} \quad \underline{\text{in cm}}$$

Evaluation

Muscle tissue loss	not present	moderate	severe
Women	> 23,2 cm	14–21 cm	< 14 cm
Men	> 25,3 cm	15–23 cm	< 15 cm

Corrected surface of arm muscles (c-SAM)

In addition, the value of CAM needs to be **corrected to the arm bone (humerus)**. From this reason, c-SAM value is calculated (in cm²):

$$\text{for women: } c - \text{SAM} = \frac{(\text{CAM} - \pi \cdot \text{skinfold over the arm})^2}{4 \cdot \pi} - 6.5$$

$$\text{for men: } c - \text{SAM} = \frac{(\text{CAM} - \pi \cdot \text{skinfold over the arm})^2}{4 \cdot \pi} - 10$$

Evaluation

Deficiency	not present	mild	moderate	severe
Women	> 36,3	29,1–36,3	25,5–29,0	< 25,4
Men	> 40,9	32,8–40,8	28,7–32,7	< 28,6

Name:

Numer:

Study group:

Results

Space for your calculations: (do not hand in the protocol without them):

CAM =

c-SAM =

Summary of results

- Gender: male/female
- Ageyears
- Height..... cm
- Weight.....kg
- Broca´s index.....
- % ideal body mass:..... (mild/moderate/severe/morbid)
- BMI:.....kg/m² (underweight/normal/overweight/obesity/morbid obesity)
- Waist :.....cm (normal value/necessity to decrease body mass/ medical assistance with decreasing of body mass necessary)
- Hip:..... cm
- WHR:..... (normal/increased)
- % fat by Slaughter.....% (decreased/normal/increased)
- % fat from nomogram.....% (decreased/normal/increased)
- % fat (measurement by hand device).....% (decreased/normal/increased)
- % fat (measurement by scales).....% (decreased/normal/increased)
- CAM..... (not present/moderate/severe)
- c-SAM..... (not present/mild/moderate/severe)

Name:

Numer:

Study group:

Discussion and conclusion

Evaluate the nutritional state of the examined person based on all examined parameters.

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.....
.....

Would you recommend them to lose or rather gain weight or gain more muscle mass or combination of these? Explain.

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.....
.....

Do your results differ based on the method/parameter that you have used? Try to explain why by filling in the table of advantages/disadvantages of the methods.

Type of method/index	Advantages	Disadvantages
Broca's index		
BMI		
WHR		
Caliper		
Bioimpedance method		