

BODY COMPOSITION ASSESSMENT

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Abstract: Establishing realistic short and long-term goals for body composition are a challenge. The fitness classification chart can assist you in establishing realistic goals. To provide insight into the techniques and methodology used in assessment of body composition using the following steps:

- identify characteristics of basic body composition;
- identify methods of analyzing body composition;
- identify circumference sites and procedure for measuring body fat % of males and females;
- calculate lean body mass and target weight.

Keywords: body composition, percent body fat, fitness classification chart, long range body composition goal

PURPOSE: to provide insight into the muscle tissue on the other hand is usually located at anatomical locations such as the biceps, forearm and calf. The subject's weight, height, girth size and ratios of various site comparisons are utilized in the calculations of percent body fat, techniques and methodology used in assessment Naval Academy students of body composition

INTRODUCTION

The use of Anthropometric Measurement is a quick, easy and inexpensive method to estimate body composition. Using a standard calibrated cloth tape, girth and length measurements are taken from specific points on the body.

Body composition assessment provides valuable information about our structural make-up, which can help determine ideal body weight and identify certain health risks. Standard scales measure total weight but provide no reference to lean mass or fat mass. Over time in the absence of weight-bearing resistance exercise and sufficient protein intake, adults tend to lose healthy lean mass and gain unwanted body fat, even without an apparent change in weight. The methodology is based on the assumption that body fat is distributed at various sites on the body such as the waist, neck and thigh. Although the use of anthropometric measurements provides a reasonably reproducible value and gives a topographical assessment of an individual, the established accuracy for the prediction of body fat is at least $\pm 5\%$ compared to the hydrostatic tank.

TRAINING OBJECTIVES:

- identify characteristics of basic body types;
- identify methods of analyzing body composition;
- identify circumference sites and procedure for measuring body fat % of students males and females from Naval Academy students;
- calculate lean body mass and target weight.

Excesses body fat is associated with negative health consequences, including an increasing risk of blood pressure, diabetes, cardiovascular disease.

Excess body fat is also associated with the inability to maintain physical performance (especially in hot climates) and may be correlated with leak of fitness and stamina. Navy limits correspond to 22% fat for man and 33% for women's.

For the methodology used in assessment of body composition we must proceeding by the following steps.

The procedure for the measurement of height, weight, and the specific body circumference for the estimation of body fat are described in this appendix:

Although circumferences may be looked upon as easy measures, they can give erroneous results if proper precautions are not followed. The individual taking the measurements must have a through understanding of the appropriate anatomical landmarks and measurement techniques. Measurements will be made at least three times. If there is greater than 0.5 cm. difference between the measurements, continue measuring until there are three

measurements within 0.5 cm. of each other. All measurements are made in horizontal plane unless otherwise indicated

Complete each set of measurements in sequences. For male, complete one set of with the inability to maintain physical performance (especially in hot climates) and may be correlated with leak of fitness and stamina.

Compare the resulting current percentage body fat with the list percentage, witch we elaborate (after hundreds of measurements on Naval Academy students) according with age, gender and fitness classification. This chart allows the individual to determine his current fitness level in terms of the body composition component of fitness.

BODY TYPES

- ectomorf – linear build with thin face, chest, and extremities, delicate bone structure, little muscle and subcutaneous tissue.
- mesomorf – bone and muscle predominate with large head, broad shoulders and chest, muscular arms and legs.
- endomorph – predominate of abdominal mass and soft tissue.

METHODS OF BODY COMPOSITION ANALYSIS

a. Hydrostatic weighing is underwater weighing and is based on Archimedes Principle witch states that dense objects are heavier in water and sink, less dense objects are lighter and float. Fat is less dense than muscle thus persons with a high percent of body fat float and weight less in water. This method is the most reliable method and the standard for most other measurement methods.

b. circumference method – approximate 50% of fat tissue lies just below the skin. Formulas and tables to estimate body fat percent have been developed by comparing c. Skinfoid method – formulas developed comparing skinfoid measure estimates of fat tissue to hydrostatic weight measures.

d. Potassium Ion Measurement – lean body mass is estimated from potassium ion measured in the body. Fat content is then calculated as the difference between total body weight and lean body weight

e. Electrical Impedance Measurement – measures the resistance to the flow of an electrical current passed of two parts of the body (hand and foot), with subsequent conversion to body fat.

For the methodology used in assessment of body composition we must proceeding by the following steps:

- to find out the characteristic of body composition;
- principals methods of analyzing body composition

Circumference for the estimation of body fat is described in this appendix. Although circumferences may be looked upon as easy measures, they can give erroneous results if proper precautions are not followed.

The individual taking the measurements must have a through understanding of the appropriate anatomical landmarks and measurement techniques. Measurements will be made at least three times. If there is greater than 0.5 cm. difference between

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the measurements, continue measuring until there are three measurements within 0.5 cm. of each other. All measurements are made in horizontal plane unless otherwise indicated Complete each set of measurements in sequences. For male, complete one set of abdomen and neck (not three abdomens

and then three necks) circumferences. Continue the process by measuring the abdomen and neck in that orders until you have three sets of measurements. For females, complete one set of hip, forearm, neck and wrist measurement.

MEASUREMENT FOR NAVAL ACADEMY STUDENTS (male)

Nr.	Abdomen and Neck Factor (difference)cm.	Height	Weight	Age
1	19-20	170	83	20
2	21-22	174	78	25
3	23-24	160	91	22
4	25-26	186	79	21
5	27-28	164	83	22
6	29-30	174	81	23
7	31-32	168	87	23
8	33-34	170	96	24
9	35-36	172	86	22
10	37-38	174	84	22
11	21-22	176	79	24
12	41-42	178	73	23
13	25-26	180	92	25
14	45-46	182	84	23
15	27-28	164	78	22
16	49-50	174	89	23
17	35-36	190	88	24
18	27-28	180	96	22
19	31-32	194	75	23

How to calculated Percentage Body Fat (male)

	step	first	second	third	average
1	Measures abdomen to the nearest 0.5 cm.	92.0	92.7	92.0	92.23
2	Measures neck to the nearest 0.5 cm.	41.27	41.27	41.91	41.48
3	Subtract 2 step from 1 step				50.75
4	Find the result (The difference between neck and abdomen on Table A1, the row we marked)				100
5	Find the height on Table A2 (height factor, the row we marked)				79.8
6	Subtract step 5 from step 4. This is Subject's Percentage Body Fat				20.2

MEASUREMENT FOR NAVAL ACADEMY STUDENTS (female)

Nr	Height	Weight	Hip	Forearm	Weight	Neck	Wrist	Age
1	146	44	77	27	23	15	17	20
2	148	46	80	17	19	21	17	25
3	150	48	83	19	19	19	19	22
4	152	50	86	21	21	21	21	21
5	154	52	89	31	17	23	27	22
6	156	54	92	25	25	25	25	23
7	158	56	95	27	27	27	27	23
8	160	58	98	29	29	29	29	24
9	162	60	101	31	21	27	31	22
10	164	62	104	33	33	33	33	22
11	178	64	107	17	17	19	25	24
12	160	66	110	23	18	29	23	23
13	170	68	113	19	19	25	21	25
14	162	70	116	25	29	17	19	23
15	150	72	119	23	25	18	29	22
16	168	74	121	21	23	25	17	23
17	174	62	124	19	27	23	18	24
18	176	64	127	29	29	27	27	22
19	178	57	130	31	23	29	29	23
20	180	64	133	17	25	23	23	22
21	180	61	136	18	23	25	25	22

How to calculated Percentage Body Fat (female)

	step	first	second	third	average
1	Measures hips to the nearest 0.5 cm.	116.8	112.2	120.6	116.5
2	Measures forearm to the nearest 0.5 cm.	20.9	21.5	22.2	21.5
3	Measures neck to the nearest 0.5 cm	33.6	34.2	34.9	34.2
4	Measures wrist to the nearest 0.5 cm	14.6	15.2	15.8	15.2
5	Calculations				
6	Weight Factor				156.2
7	Hip Factor				20.4
8	Total weight plus hip				176.6
9	Forearm Factor				40.9
10	Neck Factor				13.5
11	Wrist Factor				5.2
12	Total 9+10+11				145.9
13	The subject's percent body fat. 8 - 12				30.7

**Body composition fitness classification chart
Male - % body fat**

age	20-25	25-30	30-35	35-40	40-45
Excellent	5.4-13	7.8-16	9.9-18.1	12.3-19.3	11.4-18.1
Good	13.8-17	16.8-21	18.2-22.7	19.4-23.2	18.2-22.1
Fair	17.4-22	21.2-24.5	22.8-25.7	23.4-26.4	22.2-26.2
Poor	22.2-27.9	26.6-29.4	25.8-30.3	26.5-31.1	26.3-30.2
Very poor	28.0-40.7	29.5-41	30.4-41.4	31.2-41.6	30.3-43.5

**Body composition fitness classification chart
Female- % body fat**

age	20-25	25-30	30-35	35-40	40-45
Excellent	5.4-13	7.8-16	9.9-18.1	12.3-19.3	11.4-18.1
Good	13.8-17	16.8-21	18.2-22.7	19.4-23.2	18.2-22.1
Fair	17.4-22	21.2-24.5	22.8-25.7	23.4-26.4	22.2-26.2
Poor	22.2-27.9	26.6-29.4	25.8-30.3	26.5-31.1	26.3-30.2
Very poor	28.0-40.7	29.5-41	30.4-41.4	31.2-41.6	30.3-43.5

The percent body fat is calculated using the formulas developed by Haddon and Beckett at the Naval Health Research Center in 1984. The formulas require the measurements to be in centimeters with an accuracy of 0.5 cm. Men and women require different methods for measuring because men accumulate fat mostly in the abdomen (the "apple" body shape or "beer belly"), while women accumulate fat in their abdomen and hips (the "pear" body shape).

The equations take this into consideration.

The formula for men is:

$$\%Fat = 495 / (1.0324 - 0.19077(\log(\text{waist-neck})) + 0.15456(\log(\text{height}))) - 450$$

The formula for women is:

$$\%Fat = 495 / (1.29579 - 0.35004(\log(\text{waist} + \text{hip-neck})) + 0.22100(\log(\text{height}))) - 450$$

These formulas are complicated.

However, we have made it easy for you to calculate body fat percentage with the simple body fat calculator. Now, instead of guessing at your body fat percentage, you can use your data to measure your progress and results to determine if you are burning fat during your weight loss efforts!

Lean Body Mass or Fat-Free Mass - This is derived by subtracting the calculated value of body fat from the total weight.

$$\text{Lean Body Mass} = \text{Weight} \times (100 - \%Body Fat)$$

The American Council on Exercise uses the following categories based on percentage of body fat:

	male	female
Essential fat	10-12%	2-4%
Athletes	14-20%	6-13%
Fitness	21-24%	14-17%

Acceptable 25-31% 18-25%
Obese 32% or more 26% or more

With this information establish a realistic goal for body fat and body weight utilizing the following steps:

- current percent body composition: 20%
- long range body composition goal :15%
- body fat measured x present body weight
- 0.20 x 90 kg. = 18
- present body weight – body fat = lean body mass
- 90 – 18 = 72
- 1 - % body fat standard written as a decimal
- 1- 0.2 = 0.8
- Target weight:
- 1- % body fat composition goal (15% in our case) = 0.85
- 72 : 0.85 = 84.70kg
- Weight loss determination:
- 90 – 84.70 = 5.30kg.

One kilogram of body fat contains 7000 calories of energy. To lose 1/2 kg. of fat per week subtract 500 calorie per day from your calorie maintenance level. It will take the subject approximately 3 month to reach his target weight of 84.70 if he consistently losses body fat at the rate of 0.5 kg. per week (90-84.70=5.3). The subject should maintain his active level and keep track of his daily caloric intake by listing and type and amount of food eaten daily. Then he should refer to a caloric chart and determine the number of calories consumed each day. Its goal is to meet, but not exceeded 2200 calories per day. (180 x 15 = 2700; 2700 – 500 = 2200). To estimate the number of calories you use in normal daily activity, multiply your body weight by 13 if you are sedentary, 14 if somewhat active, and 15 if moderately active.

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The result is a rough estimate of the number of calories you need to maintain your present body weight. You will need steel more calories if you are more than moderately active

CONCLUSIONS

For most sports, a high lean mass to fat mass body composition ratio is associated with superior performance, although too little fat can compromise body health and biological function, especially in female athletes. Excess fat is detrimental to athletic performance because it adds non-force-producing mass. You can't flex fat and excess fat is a liability. Based on the fact that force conforms to Einstein's equation of $E = mc^2$, we know that strength from power producing muscle is the key to athletic speed and therefore superior performance.

Medical doctors seldom measure the aerobic capacity or muscular strength of patients during an annual checkup. They might have you stand on a medical scale to determine your 'weight', but that information by itself is practically useless.

Body "weight" only reflects the influence of gravity on mass but composition of mass is by far more important to know for health and performance.

Establishing realistic short and long-term goals for body composition is a challenge. The fitness classification chart can assist you in establishing realistic goals

Why do we care where our excess fat is stored? The pattern of excess body fat. distribution is an important predictor of the health risks associated with obesity. Excess fat storage in the abdominal area is of most concern due to the increased risk of hypertension, type 2 diabetes, stroke, and coronary artery disease.

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