Nutritional Assessment
Biol 2402 Lab

Ziser, 2004

Food is used by the body for both the nutrients and the energy it contains. The nutrients are extracted and used by the body to build new molecules, cells, and tissues and to make repairs. Energy from the chemical bonds in the organic molecules we consume are broken and the energy is saved in the form of ATP which is used to power nerve impulses, muscle contractions, synthesis of organic molecules and other cellular activities. In animals, most excess nutrients that we eat are turned into fats for storage. Each pound of fat stores approximately 3500 excess Calories. Likewise, you lose a pound of fat (not just water) whenever you burn 3500 more Calories than you consume.

In this assignment you will assess your nutritional status and energy balance. Several factors are useful in determining your ideal weight and/or susceptibility to certain diet related diseases. Some of the most commonly used assessment parameters are: your Ideal Body Weight based on various Height and Weight Tables, Body Mass Index (BMI), Body Fat/Lean Mass Index,, and Body Fat Distribution Estimates. You will estimate each of these values for yourself to assess your health risks known to be related to weight, fat, and fat distribution. You will also record your Caloric intake and estimate your daily energy expenditures to assess your daily energy balance. The various tables and figures referenced in the exercises below will be available in binders in the lab room.

I. Background data for determining your nutritional status

Measure and record the following information on your data sheet. Since some of the tables you will be using will be based on metric measurements and others on English measurements, record the dimensional measurements in both metric and English units

A. **Gender, Height** (inches & centimeters), **Weight** (pounds & kilograms), **Age**
weights and heights assume without clothing

B. **Wrist Circumference**
use one of the metric tape measures provided in lab to measure your **wrist circumference** in cm and record it on your data sheet

C. **Frame Size**
There are several ways to estimate your frame size

1. Frame size estimated from height and elbow breadth.

a. use the skinfold calipers or the steel calipers and meter stick to measure the width of your elbow; from medial to lateral epicondyle (see “How to Determine Frame Size” in folder)

b. use the tables on “Frame Size” in the folder to estimate your frame size

2. Frame size estimated from height and wrist circumference.

a. have your lab partner use a metric tape measure to measure the circumference of your wrist in cm

b. calculate the height-wrist circumference ration, r:

$$r = \frac{\text{height (cm)}}{\text{wrist circ. (cm)}}$$

c. compare the r value to the table E-6; Frame Size for Height-Wrist Circumference Ratios in the folder

Record your frame size as determined from both methods on your data sheet, and indicate which you believe is a more accurate estimate of frame size

II. Ideal Body Weight

There are many methods that can be used to estimate a persons ideal body weight. Most take into account such things as age, gender, height; some also include wrist circumference or frame size

You will estimate your frame size in several ways and then you can decide which you think is the most accurate or useful in determining your nutritional status

1. **Traditional Height/Weight Charts**
   based on height, gender and frame size, but don't take muscle development or age into account
   now believed to underestimate desired or ideal body weight

2. **Metropolitan Height and Weight Tables**
   revised version of the traditional height/weight tables
   specified for height, gender and frame size but it makes no allowances for age

3. **Quick Estimate of Ideal Body Weight**
   Use the formulas in Table E-7; Quick Estimate of ideal body weight, in the folder to estimate your ideal body weight

4. **Calculated IBW**
   Women: IBW = a. begin with 119 lbs
   b. add 3 lbs for every inch in height over 60 inches
   c. if large frame – add 10%; if small frame - subtract 10%
   d. additional calculations from below if necessary
   e. the total is your Ideal Body Weight

   Men: IBW = a. begin with 135 lbs
   b. add 3 lbs for every inch in height over 63 inches
   c. if large frame – add 10%; if small frame - subtract 10%
   d. additional calculations from below if necessary
   e. the total is your Ideal Body Weight

   Additional Calculations: → add 10% of above value if over 50 yrs old
   → subtract 10% if paraplegic; 10-15% if quadriplegic

Record these 4 estimates in the table on your data sheet. Indicate which you believe to be the most accurate of IBW for you.

III. Nutritional Status Indices

Now that you have collected some of the basic information that is used in a nutritional analysis, the next step is to try to determine some index of your nutritional health by comparing your stats to tables of your Ideal Body Weight. These indices can be used to determine simply whether your weight is acceptable or if you are over or underweight or they can be used to generate various kinds of health risks to which you might be susceptible.

A. Percent Ideal Body Weight

One of the simplest indices compares your actual weight to your Ideal Body Weight. Select the IBW calculated from the methods above that you believe is most accurate. If a range is given, use the middle of the range in the calculation below:

$$\textbf{\%IBW} = \frac{\text{your actual weight}}{\text{your ideal body wt}} \times 100 = \underline{\hspace{4cm}}$$

Compare the value you get to the table below to determine your nutritional status based on %IBW. Record your %IBW and your nutritional status based on it on your data sheet:

%IBW	**Nutritional Status**

>200	morbidly obese
>120 or 130	obese
110-120	overweight
90-110	acceptable range
80-90	mildly undernourished
70-79	moderately undernourished
<70	severely undernourished

B. Body Mass Index

Some nutritionists prefer using the Body Mass Index; an index of a person's weight in relation to their height. Calculate your BMI using the formula below:

BMI = weight (kg)/height^2 (m) = ______________

Compare your value to the information below to determine your nutritional status based on BMI:

BMI men	**BMI women**		**Increasing Risk of Death due to obesity related factors**
< 20.7	<19.1	underweight	↓
20.7 – 27.8	19.1 – 27.3	acceptable weight	
≥ 27.8	≥ 27.3	overweight	
≥ 31.1	≥ 32.3	severely overweight	
≥ 45.4	≥ 44.8	morbidly obese	

C. Body Fat/Lean Mass Estimate

Indices based solely on weight are oversimplified because they assume that the amount of fat is directly proportional to height and weight. They don't take into account the proportion of your weight that is actually muscle mass versus the proportion that is fat. Someone who performs a lot of resistance training, for example, may show up on height weight tables as overweight when, in fact, they have a disproportionate amount of muscle mass, not fat, and therefore are probably much healthier than a person of the same weight who does not exercise.

1. Triceps Skinfold Measurement: Percent Body Fat

About half the fat in the body is located directly beneath the skin, and its thickness reflects total body fat. In some parts of the body this fat is loosely attached; a person can pull it up between the thumb and forefinger to obtain a measure of fatfold thickness. The most common (but least accurate) method of estimating body fat is by making multiple site skinfold measurements and plugging the values into a formula to estimate Percent Body Fat. If you are interested in this more thorough analysis the pamphlet that accompanies the skinfold calipers has instructions for doing this.

Most skinfold estimates require measuring skinfolds in at least 3 different body areas. A very rough but much simpler method of estimating body fat can be made by a single measurement, the Triceps Fatfold Measurement (Fig E-12):

a. Find the midpoint of the arm and ask the subject to bend their air at the elbow and lay the hand across the stomach (if they are right handed measure the left arm and vice versa)
b. Feel the shoulder to locate the acromial process (It helps to slide your fingers along the clavicle to find the acromial process).
c. Place a measuring tape from the acromial process to the tip of the elbow. Divide this measurement by 2 and mark the midpoint of the arm with a marker.
d. Ask the subject to let their arm hang loosely to the side.
e. Grasp a fold of skin and subcutaneous fat between the thumb and forefinger slightly above the midpoint mark. gently pull the skin away from the underlying muscle. (this step takes a lot of practice; if you want to be sure you don't have muscle as well as fat, ask the subject to contract and relax the muscle. You should be able to feel if you are pinching muscle.)
f. Place the calipers over the fatfold at the midpoint mark and read the measurement to

the nearest 1.0 mm in two to three seconds. Record this number below then repeat the process twice more

measurement #1:_____

measurement #2:_____

measurement #3:_____ average of 3:_____

g. compare your value to Table E-9; Triceps Fatfold Percentiles, to determine your percentile value. 50th percentile is the norm

h. convert your average triceps skin fold measurement to a rough estimate of body fat using Chart #3 or #4; % Fat for Measurement on Back of Upper Arm, from the folder

This same page also has charts based on other skinfold measurements; the most accurate method of estimating percent body fat using skinfold calipers is to measure the sum of 4 different skinfold values; the triceps (back of upper arm, front of upper arm, below shoulder blade, and waist; see pamphlet that accompanies skinfold calipers for more details

i. also calculate the % body fat from the simpler table below. record both on your data sheet

triceps skinfold measurement	Rough Estimate of % body fat men	women
5-10 mm	5-9%	8-13%
11-16 mm	9-13%	13-18%
17-22 mm	13-18%	18-23%
23-28 mm	18-22%	23-28%

Some typical average % Body Fat values for healthy people are also shown below:

Age	Men	Women
<30 yrs old	12-15%	22-29%
>30 yrs old	18-27%	35-34%

Unfortunately, appropriate fat levels are not well defined and nutritionists cannot yet reliably correlate any specific values to risk factors or longevity

2. Estimate of Lean Body Mass (Muscle Mass)

a. use a metric tape measure and measure the circumference (in cm) of your upper arm at the same location that you measured the skinfold thickness above
[see Fig E-14: How to Derive Midarm Muscle Circumference if needed]

the midarm circumference = muscle plus fat
the triceps skinfold measurement = two times the thickness of the fat layer beneath your skin

b. use the following formula to calculate the circumference of muscle which is an index to the body's lean mass

midarm muscle circumference =
midarm circumference (cm) – (0.314 x triceps skin fold (mm)

c. compare this number with Table E-11; Midarm Muscle circimference Percentiles to determine which percentile you are in. 50th percentile is the norm.

Transfer this information to your data sheet

D. Body Fat Distribution

Not just the total amount, but the distribution of fat in the body also affects one's health. Men typically have an android pattern of excess fat distribution; most fat is deposited around the waist as "upper body fat". Women more typically exhibit a gynoid fat distribution; excess fat tends to be deposited in the thighs and buttocks as "lower body fat. Body fat concentrated more around the waist (=android or apple body form) is associated with a greater risk from some chronic heath related diseases.

1. **Body Fat Distribution Estimates**: **Waist to Hip Ratio**

   a. use the metric tape measure to measure the circumference of your waist and your hips

      circumference at waist (cm):_____
      circumference at hips(cm): _____

   b. Now, divide the waist measurement by the hip measurement to get the **waist/hip ratio**.

      waist to hip ratio:_____

   c. Determine your risk for obesity related health problems by comparing your value to those given below:

$$\text{risk factor:} \quad \left.\begin{array}{l} \text{women} \geq 0.8 \\ \text{men} \quad \geq 0.95 \end{array}\right\} \begin{array}{l} \text{at high risk of} \\ \text{obesity relate} \\ \text{health problems} \end{array}$$

   d. record your data and assessment on your data sheet

IV. Assessment of Nutrient Intake

A. Calculating your Daily Nutrient and Energy Intake

1. **Three Day Food & Energy Record**
   Monitor your food intake over ***three consecutive days*** by writing down everything that you eat or drink each day on the table provided. Also record the number of **grams** of proteins, fats and carbohydrates as well as the number of **calories** contained in each. If your weight is fairly constant then the calories in the food you eat is equal to the amount of energy you burn each day.

   If you do not have the nutritional data for the foods that you eat, tables will be available in the lab that you can use as references. Also, the PIN LRS has software called "Nutrition Pro" that will calculate your daily Calorie intake for you. Also, the following websites help you calculate your food consumption and energy burned:

      http:/www.ag.uiuc.edu/~food-lab/nat
      http:/www.nat.uiuc.edu/energy/daily.html

   After collecting data over three days, calculate **average values** for each column and report your data on your data sheet

2. For **2 points extra credit**, you can also record your intake of vitamins in these foods and as supplements as well(you will need to create your own table for vitamins). Create a table that lists US RDA's and your actual average daily intake of these vitamins.

V. Assessment of Energy Balance

Maintaining a stable weight implies that food energy input is equal to your energy output. Energy is measured in Calories.

Note: **a kilocalorie (kcal) of energy is equivalent to the Nutritionists Calorie ("capital calorie");**

ie. it takes 1000 calories(little 'c') to make one kcal or one Cal.

Ideally, your daily **energy input** (food) should be the same as your daily **energy expenditure**. If input and output are balanced then your weight should be relatively stable. Energy Input is measured by keeping track of the calories in the foods that you eat. Energy Output is much more difficult to estimate. Energy output can be estimated in several ways: the calculations below can provide a quick estimate of your energy expenditure; if your weight is relatively stable, your daily energy expenditure will be equal to the calories in the food you eat. A third way to estimate energy output is to keep a record of all your daily activities and use a table to convert those activities to calories burned.

A. Energy Intake

1. Recommended Energy Intake

a. Calculate your energy needs from the table, "Mean Heights and Weights and Recommended Energy Intakes".

b. Record the actual needs (kcal = Calorie) and the range listed on your data sheet

2. Three Day Food and Energy Record

use your three day record to determine your average caloric intake per day and record this value on your data sheet

B. Energy Output

1. Quick Estimate of Energy Expenditure:

One way to estimate your daily energy needs involves making estimates of the 3 basic components of energy useage by the body:

The Basal Metabolic Rate
energy needed for maintenance of basic life functions such as breathing, circulation, posture, etc

Physical Activity
additional energy needed to perform additional activities over and above the basal metabolism

Thermic Effect of Food
the energy required to ingest, digest and absorb the food you eat

a. Basal Metabolic Rate (BMR):

i. Record your height, weight, age and gender on your data sheet.

ii. Use the Dubois Body Surface Chart to determine your **Body Surface Area (BSA)** in square meters on your data sheet.

iii. Find your **heat loss per square meter (HLPSM)** of body surface area per hour using Table 10-1 and record this value on your data sheet.

iv. Calculate your basal metabolic rate per hour:

BMR (as Cal/hr) = (HLPSM/hr) x (BSA) = ____________

BMR (as Cal/day) = BMR/hr x 24 hr = ____________

v. record the BMR/day on your data sheet

b. Physical Activity/Exercise:

The is the additional energy (over and above your BMR) that you expend during the day

i. Choose the level of activity in the box below that best describes your daily routine, or use some intermediate value if you think that is appropriate.

The following are taken as percent of Basal Metabolism to determine energy used in an activity	
• 20% Sedentary: sitting and standing quietly	= **.2**
• 30% Light Activity: clean house, office work, baseball, golf	= **.3**
• 40% Moderate Activity: walking, cycling, dance, basketball	= **.4**
• 50% Heavy Activity: running, racquetball, skiing	= **.5**

ii. Multiply your BMR (calculate above) by this value to calculate the amount of extra energy you burn each day in your various activities:

Additional energy expended = BMR x activity factor = ___________

iii. record this value also on your data sheet

c. Dietary Induced Thermogenesis:
DIT is the cost of digesting and absorbing food. This value typically varies from between 6 to 10% of the kcalories consumed.

i. Calculate DIT using the formula below:

DIT = [BMR (kcal/d) + Activity (kcal/d)] x .08 = ____________

ii. record this value also on your data sheet

d. Now add these three values together to estimate your **total energy expenditure/day**:

Total Energy Output = BMR + Physical Activity + DIT = ____________

record this value on your data sheet

2. Three Day Average Energy Expenditure
Another way to calculate the energy you burn each day is by keeping track of the amount of time (minutes) that you spend on specific kinds of physical activities and multiplying that by your weight and by the energy required for each activity per minute. In theory, this method should give you a more accurate estimate than the "Quick Estimate of Energy Expenditure" that you calculated above. At the same time that you are logging your food intake, monitor your activities over the ***same three days*** and the amount of time spent on each. Record your activities in the table provided. Then use the attached information on energy expenditures to estimate the amount of energy required for each of the activities. After three days of record keeping calculate an average energy output per day and report your data on your data sheet

3. Energy Balance:
Now use the the averages from your 3-day logs above to calculate your total energy balance. Your total energy balance is calculated by subtracting your **total energy expenditure** from your **total energy input**. Use the average values you determined from your 3 days of record keeping in section A for Energy Input, and either the quick estimate from section B or your 3 day estimate for Energy Output:

Total Energy Balance
=Average Energy Input/day (Calories) – Average Energy Output/day (Calories)

= _________________ (record this value also on your data sheet)

Name:_________________
Due Date:___________

Nutritional Assessment

Biol 2402 Lab
Data Sheet

Ziser, 2004

I. Background Data for Determining Your Nutritional Status

Gender:	____________	Body Surface Area(m^2):	____________
Age:	____________	Heat Loss/ sq m/hr:	____________
Height:	____________	Wrist Circumference:	____________
Weight:	____________	Frame Size:	____________

II. Ideal Body Weight

Ideal Body Weight:	IBW Based On
	1. Traditional Height/Weight Chart
	2. Metropolitan Ht/Wt Tables
	3. Quick Estimate of IBW
	4. Calculated IBW

Which IBW value do you believe is the most accurate? Why?

III. Nutritional Status Indices

Index of Nutritional Status	Your Value	Nutritional Status
A. Percent Ideal Body Weight		
B. Body Mass Index		
C. Body Fat/Lean Mass		
Cl. Triceps Fatfold average		
Triceps Fatfold Percentile		
Percent Body Fat		
C2. Midarm Muscle Circumference		
Midarm Mm Circ Percentile		
D. Body Fat distribution		
D1. Waist/Hip Ratio		

Summarize your nutritional status based on the above table.

IV. Assessment of Nutrient Intake

<u>Activity: Food Intake (3 day average)</u>

Food Intake	average gms per day	% of Total	RDA values	+/- difference from RDA
food intake **(gms)**		100		
proteins **(gms)**				
lipids **(gms)**				
carbohydrates **(gms)**				

What proportion or percent of your total food intake consisted of proteins, lipids, and carbohydrates?

How does your daily intake of total foods, proteins, lipids and carbohydrates compare with RDA's

V. Assessment of Energy Balance

Energy Input	**Energy (Calories/day)**
1. Recommended Energy Intake:	
2. Food Calories Consumed/day:	
Energy Output	
1. Quick Estimate of Energy Expenditure	
2. 3 Day Average Energy Expenditure	
Energy Balance	
3 day input – 3 day output	

1. Quick Estimate of Energy Expenditure

a. BMR (as Cal/day) = ____________

b. Physical Activities = ____________

c. Dietary Induced Thermogenesis: = ____________

d. **Total Energy Burned** = BMR + Physical Activity + DIT = ____________

How does your food energy consumption compare with your recommended energy intake?

Which estimate of energy expenditure do you believe is most accurate; the one based on three days of data or the quick estimate? Explain

Based on your records are you in "energy balance" or are you gaining or losing energy

If these are accurate measurements how long would it take you to gain (or lose) 5 lbs?

Summarize your nutritional status below in a concise paragraph based on the data you collected for this exercise.