Balancing the Energy Tank

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- Units of Energy
- Sensitivity of Energy Balance
- Components of Energy Expenditure
- Body Size and Body Mass Index

Key Points

- Balancing energy intake and expenditure can be difficult when activity levels are very high and also when activity levels are very low, such as during isolation.
- Typically, body weight remains constant when energy intake equals expenditure.
- To lose or gain one pound of weight, 3,500 calories must be expended or consumed.
- Calculating Resting Energy Expenditure (REE) and the intensity of daily activities gives an accurate estimate of how much energy a War-fighter might expend in one day.
- The Body Mass Index (BMI) is a clinical tool for assessing body fat composition and classifies individuals into underweight, normal, overweight, and obese categories.

Energy balance is one very important aspect of nutrition. Knowing how much energy is going to be expended allows one to calculate how much fuel the “tank” requires to function and how much fuel to take on missions. Energy expenditure must be balanced by energy intake to maintain body weight or “energy balance.” To determine how much fuel your tank needs, basic information about metabolic rate and activity level is needed. This chapter will address those issues.

Units of Energy

The unit most commonly used to describe energy intake and energy expenditure is the calorie. The terms kilocalorie (kcal) and kilojoule are also used when referring to energy intake and expenditure. For simplicity:

- $1 \text{ kcal} = 1 \text{ calorie}$.

Throughout this book we will use the terms kcal and calorie interchangeably.
Resting Energy Expenditure (REE):
The amount of energy required to maintain life.

Table 2–1. Determining Resting Energy Expenditure (REE) of Men From Body Weight (in pounds)

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Equation to Derive REE (kcal/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18–30</td>
<td>6.95 x Weight + 679</td>
</tr>
<tr>
<td>31–60</td>
<td>5.27 x Weight + 879</td>
</tr>
</tbody>
</table>

Sensitivity of Energy Balance

The energy balance equation can be “unbalanced” by changing energy intake, energy expenditure, or both. To gain or lose 1 pound, approximately 3,500 extra kcal must be consumed or expended. Believe it or not, the energy balance equation is very sensitive.

1 lb = 3,500 kcal.

Example 1:
- One 32 oz Gatorade® has 4 servings of 8 fl oz. If you consumed the whole bottle, you would drink 200 kcal (8 oz = 50 kcal).
- If you drank one 32 oz Gatorade® per day every day of the year without increasing your activity level, you would add 73,000 kcal (200 x 365 days/yr), which is 20.8 lbs in one year.

Example 2:
- Eating one PowerBar® Protein Plus per day would provide 258 kcal of energy.
- Eating one PowerBar® Protein Plus per day for an entire year without increasing your activity level, would add 94,170 kcal (258 x 365 days/yr), which is 26.9 lbs per year.

Example 3:
- Drinking one extra beer per day would provide an additional 145 kcal of energy.
- Drinking one beer per day for an entire year without increasing your activity level, would add 52,925 kcal (145 x 365 days/year), which is 15.1 lbs per year.

Components of Energy Expenditure

The three major contributors to energy expenditure are:
- Resting energy expenditure.
- Physical activity.
- Energy for digesting foods (TEF or thermic effect of food).

The first two are of interest here and will be discussed in detail.
Resting Energy Expenditure

Resting Energy Expenditure (REE) is the amount of energy required to maintain life—such as breathing, beating of the heart, maintaining body temperature, and other life processes. Measurements are made in the morning after waking with the body at complete rest. REE can be estimated by a formula to predict your daily energy requirements. The only information needed is your body weight in pounds.

Physical Activity Energy Expenditure

The amount of energy you expend during physical activity is different each day, depending on your training. Some days are very strenuous and involve running, swimming, calisthenics, cold water exposure, sleep deprivation, and carrying heavy loads. Some days you are in the classroom sitting a good portion of the day. Thus, determining your actual energy expended during activity is more difficult, but there are ways to estimate it. You would usually take your REE and multiply it by a number (or factor) based on your expected physical activity, as shown in Table 2–2. Multiplying your REE by this physical activity factor provides a rough estimate of your total energy/calorie needs.

Example:
You are 21, weigh 175 lbs, and activity is moderate.
REE = 6.95 x Weight + 679 = 6.95 x 175 + 679 = 1,895 kcal/day.
Total Energy Needs = 1,895 x 1.7 = 3,222 kcal/day.

Note: Formula for REE came from Table 2–1; 1.7 is the Activity Factor for “Moderate Activity.”

Click here to calculate your REE.

How to Calculate Energy Expenditure

You will need a calculator to complete this exercise.

Over a 24-hour period, different amounts of energy will be expended in each activity you engage in, be it watching TV, eating, running in boots, humping, or listening to teammates. The objective of this activity is to increase awareness of the energy actually expended.

Click here to record your physical activity.
• Record your name and date on the Energy Expenditure Activity Form.
• List all the activities participated in over the last 12 hours and the

Table 2–1. Physical Activity Factor for Various Levels of Activity

<table>
<thead>
<tr>
<th>General Activity</th>
<th>Activity Factor (x REE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Light: Seated and standing activities, driving, playing cards.</td>
<td>1.3</td>
</tr>
<tr>
<td>Light: Walking, carpentry, sailing, playing ping-pong or pool, golf.</td>
<td>1.6</td>
</tr>
<tr>
<td>Moderate: Carrying a load, jogging, light swimming, biking, calisthenics, scuba diving.</td>
<td>1.7</td>
</tr>
<tr>
<td>Heavy: Walking with a load uphill, rowing, digging, climbing, soccer, basketball, running, obstacle course.</td>
<td>2.1</td>
</tr>
<tr>
<td>Exceptional: Running/swimming races, cycling uphill, carrying very heavy loads, hard rowing.</td>
<td>2.4</td>
</tr>
</tbody>
</table>
approximate length of time (in minutes) spent on each activity.

- Go through the alphabetical list of activities, and find the activity that most closely approximates the ones you listed on the form.

- Write down on the form the kcal/minute (not per hour!) value in the appropriate column (Energy Value).

- Multiply the energy value by the total time in minutes. For example, if you ran in boots for 25 minutes, then your energy expenditure for that activity would be 12 (energy value) x 25 (time) = 300 kcals.

Do this for five activities, or preferably all events in 12 hours. Then add up the numbers to get an actual energy expenditure estimate. How did you fare? Keep track of your weight if you are in doubt—it is the most accurate way to monitor energy balance.

### Body Size and Body Mass Index

Body Mass Index, or BMI, is a measure commonly used to rapidly assess body composition and classify individuals as underweight, normal, overweight or obese. BMI is the ratio of (weight in kg)/(height in m)², or [(weight in lb) x 704.5]/(height in inches)². Reference standards have been developed for the United States population by race and gender, so that individuals at risk for obesity can be easily identified. However, the reference values for the U.S. population do not always apply to special populations, such as Warfighters. As a result, unique populations often develop their own standards and references based on individuals within that population. A reference range based on a survey of over 800 SEAL Warfighters was developed. The average BMI was 25, and the average body fat was 13%. For more information on BMI, [click here](#).

BMI is a screening tool, and you can use it to keep track of changes in your body composition. If your BMI is high, have your body fat checked, and if your body fat is more than 20%, you should take action to lower your weight.