12 Deployment and Altered Climates

In this chapter you will learn about:

- Acclimation.
- General guidelines for altered environments.
- Maintaining performance in the heat, cold, and at altitude.

Adapting to a new environment, such as extreme changes in climate or altitude, imposes considerable demands on the body. This adaptation, or **acclimation**, occurs gradually, allowing the individual to better tolerate and perform in that new environment. Thus, acclimation is the gradual change the body undergoes in order to function more efficiently in a new environment.

Acclimating to New Environments

Adapting to a new environment can take one to three weeks. During this time, endurance activities become more difficult and onset of fatigue occurs sooner. If environmental conditions permit, gradually increase the intensity of exercise until you reach your desired training intensity. Having a good aerobic fitness base will accelerate your acclimation to new environments. Factors that negatively affect acclimation include:

- Dehydration.
- Drinking alcohol.
- Cessation of physical activity.
- Electrolyte depletion.
- Inadequate energy intake.
- Illness.
- Infection.
- Injury.
- Loss of sleep.

General Nutrition Issues

Maintaining or improving health and fitness is more challenging in adverse conditions such as extreme heat, cold, or altitudes. Even highly, physically fit individuals can be quickly overcome by "environmental exposure" if proper preparation is overlooked or if symptoms of impending illness are ignored. The adaptation of the body to adverse environments increases energy expenditure and water losses. Furthermore, dehydration results in a loss of appetite. If energy and fluid needs are not met, then performance will be impaired. General suggestions for meeting increased energy and fluid requirements are provided below. Issues relevant to a particular environment are provided later.

Maintaining Energy Balance

- Eat a high-CHO diet to meet increased kcal needs, as CHO are more readily absorbed and better tolerated than fats or proteins.
- Avoid fatty foods which may not be well tolerated.
- Avoid high-protein intakes which will increase water loss and can lead to dehydration. (See Chapter 2 page 9.)
- Eat small frequent meals.
- When eating field rations, eat the entrees as well as the other food and beverage items provided in the pack.
- Drink a high-CHO beverage to increase your kcal intake if you are having difficulty eating enough solid foods to meet your energy needs.

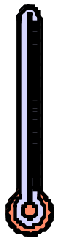
Maintaining Fluid Balance

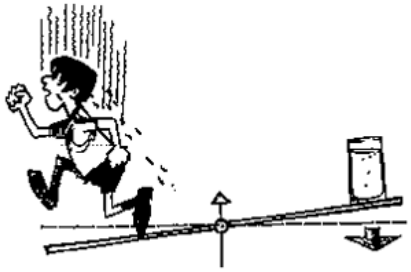
Maintaining fluid balance is crucial to avoid dehydration, as stated in Chapter 2 on page 17. Dehydration can limit performance and severe dehydration can be life-threatening. Tips for maintaining fluid balance include:

- Monitor hydration status by the frequency and color of your urine. Infrequent and dark yellow urine suggests dehydration.
- When possible, monitor fluid status by weighing yourself prior to and after prolonged physical activities. For every pound of weight lost due to water losses, drink 2 cups (0.45 L or 16 oz.) of water.

- Thirst is not a good indicator of fluid status. Drink fluids regularly throughout the day. When working in the heat, do not drink more than 6 cups of fluid an hour.
- Avoid alcoholic beverages as alcohol increases fluid losses.
- Reduce caffeine consumption as caffeine increases fluid losses.
- Avoid salty foods as salt increases fluid needs.
- Drink CHO/electrolytes beverages during prolonged physical activity or on extended missions (Chapter 11, page 90).

Hot Environments





How hot is too hot? Heat advisories are announced when a wet bulb-globe temperature (WB-GT) is over 87° F (30.5° C) or when temperature and humidity are over 85° F and 60%, respectively. Under these conditions exercise should be performed indoors or undertaken with caution. Any time you perform physical activities in the heat, you will lose a lot of water and electrolytes through sweat. Only the sweat that evaporates effectively cools the body; sweat that "drips" provides little cooling effect. As you adapt to the heat, you will start producing more dilute sweat (less salty) to conserve electrolytes. Factors that can limit "effective cooling" include high humidity, impermeable clothing, and skin conditions, such as sunburns or rashes.

Energy Needs

Although appetites may be suppressed in the hot weather, especially during the first few days after arriving, adequate caloric intake is very important. Inadequate food intake will lead to weight loss which can impair both physical and mental performance. When you do the same task in a hot environment, energy requirements are increased due to the increased work of maintaining a normal body temperature. When living and working in temperatures ranging from 86° to 104°F (30° to 40°C), kcal intakes should be increased by 10%, unless your activity level decreases accordingly.

If your activity level decreases,
you do not need extra kcals!

Worksheet 12-1. Calculate Your Energy Requirements for a Hot Environment

Your Estimated Energy Requirement (EER) = _____kcal/day.
(from Worksheet 1-2)

A 10% increase in energy requirements equals:

_____ EER x 0.10 = _____ kcal/day.

Your total energy requirement equals:

_____ EER + _____ 10% increase= _____ kcal/day.

Tips for Maintaining Performance in a Hot Environment

- Prepare by maximizing aerobic fitness before your exposure.
- Plan your workouts to avoid the heat of the day.
- Plan for decreased physical performance the first two weeks.
- Drink plenty of fluids and eat enough kcals.
- Be aware of any symptoms that may predispose you to dehydration (diarrhea, vomiting, fever).
- Be aware of the warning signs of heat illness. Stop if signs or symptoms of heat injury become apparent (See Chapter 13).
- Avoid substances that can lead to dehydration or heat injuries.

Table 12-1. Substances that Can Cause Dehydration

Caffeine	Alcohol	Decongestants
Antihistamines	Atropine and other anticholenergics	

Check with the medical department for other substances that may affect fluid balance.

Cold Environments

What is a cold environment? It is considered cold if the air temperature is below 15° F and the wind speed is greater than 25 m.p.h, or the water temperature is below 64°F. Cold wind and cold water accelerate heat loss by replacing the warm layer of air or water surrounding the body with colder air or water.

The body responds to cold by constricting (tightening) blood vessels to conserve heat and by shivering to generate heat and guard against hypothermia. There is increased urination and increased energy metabolism in cold environments, both on land and in water.

Energy Needs

Many studies have shown that soldiers tend to progressively lose weight when conducting field exercises in the cold for two to three weeks. Because significant weight loss can result in fatigue and performance decrements, energy intake must increase to meet the increased energy demands. Energy requirements can increase by 25 to 50% because of the increased work associated with performing physical tasks in the cold and the kcal expenditure due to shivering. Factors that increase energy requirements in the cold include:

- Increased basal metabolic rate (BMR, see page 3).
- Shivering.
- Working in cold weather gear.

To meet energy needs consume a diet that is high in CHO (roughly 60% of your total daily kcals). This will replace glycogen stores (page 7) that are being used to maintain body temperature. Eat frequent high-CHO snacks to help meet your kcal requirements. Keep fat intakes under 30% of your total daily kcals since high-fat diets may cause stomach upset. Keep protein intakes at 10% of your total daily kcals and avoid protein and amino acid supplements because high-protein intakes increase water losses.

Worksheet 12-2. Calculate Your Energy Requirements for a Cold Environment

Your Estimated Energy Requirement (EER) = _____kcal/day.
(from Worksheet 1-2)

A 25% increase in energy requirements equals:

_____ EER x 0.25 = _____ kcal/day.

Your total energy requirement equals:

_____ EER + _____ 25% increase= _____ kcal/day.

e.g., If your EER is 3,000 kcals/day then in a cold environment your energy needs would increase by 3,000 kcals x 0.25 = 750 kcals/day. Your total daily energy requirement would be 3,000 kcals + 750 kcals = 3,750 kcals/day.

Vitamin and Mineral Needs

In addition to increased energy requirements, increased intakes of many of the vitamins and minerals may be useful for maintaining performance when working for prolonged periods in the cold. Vitamin and mineral recommendations have been developed to account for possible increased requirements based on intake data from field studies, urinary excretion of nutrients, and other measures of "nutrient status". Table 12-2 presents the suggested additional amount of some nutrients that may be needed when working in the cold. See Chapter 2, Table 2-2 and Table 2-3 for a list of food sources for these nutrients. In most cases, if you meet your energy requirements by eating all ration components, you should be meeting your vitamin and mineral needs.

Table 12-2. Suggested Additional Intakes of Micronutrients During Cold Weather Training

Nutrient	Suggested Increase*	Nutrient	Suggested Increase
Vitamin B_1 (Thiamin)	3 mg	Folic Acid	200 μg
Vitamin B_2 (Riboflavin)	2 mg	Vitamin B_{12}	1 μg
Vitamin B_3 (Niacin)	5 mg	Magnesium	200 mg
Pantothenic Acid	5 mg	Zinc	5 mg

Adapted from Reynolds RD. (1995) Effects of Cold and Altitude on Vitamin and Mineral Requirements. In: Marriot BM (Ed). *Nutrient Requirements for Work in Cold and High Altitude Environments*. Washington, DC: National Academy Press. *Amounts in addition to the RDA (see Chapter 2).

Tips for Maintaining Performance in a Cold Environment

- Check weather conditions, dress appropriately, and avoid profuse sweating.
- Allow for a longer warm-up.
- Replenish CHO and electrolyte losses.
- Drink plenty of fluids and try to avoid substances that cause dehydration (see page 93 and Table 12-1).
- Be aware of the signs of cold injury (see Chapter 13).
- Eat snow only after melting and purifying it.

Altitude

Ascent to altitude can cause a variety of physiologic disturbances due to the drops in temperature and humidity, and the lack of oxygen. Some major concerns are weight loss, disturbances in digestion, and vitamin, mineral and fluid needs.

Physical performance can suffer dramatically with changes in altitude. The lower oxygen concentrations at altitude can reduce aerobic capacity by 1-2% every 100 meters (328 feet) above 1,500 meters (4,918 feet). Many adaptations occur during extended exposure to high altitudes including:

- Increased number of oxygen-carrying proteins in the blood (hemoglobin) and muscle.
- Increased density of blood vessels to and within the muscle.
- Increased rate of respiration.

Adequate nutrition can play a crucial role in maintaining performance.

Energy Needs

Energy requirements are 15-50% greater than at sea level

Virtually all persons who go to altitude experience weight loss and loss of lean body mass. At altitudes below 5,000 m weight loss can be prevented by increased caloric intake; whereas above 5,000 m, a 5-10% weight loss is inevitable. Some reasons for weight loss at high-altitude are:

- Energy requirements are 15-50% greater than at sea level.
- Decreased appetite and sense of taste.
- Loss of body water from increased breathing rate and dry air.
- Impaired absorption of nutrients.
- Acute Mountain Sickness (AMS) - symptoms include headache, nausea, vomiting, fatigue and poor appetite.

Worksheet 12-3. Calculate Your Energy Requirements at Altitude

Your Estimated Energy Requirement (EER) = _____kcal/day
(see Chapter 1)

A 50% increase in energy requirements equals:

_____ EER x 0.50 = _____ kcal/day

Your total energy requirement equals:

_____ EER + _____ 50% increase= _____ kcal/day

A high-CHO diet (60% of total daily kcals) is preferred at altitude because it restores glycogen, requires less oxygen to metabolize than a high-fat diet, and can blunt or delay the severity of AMS symptoms.

Vitamin and Mineral Needs

Vitamin and mineral needs are likely to increase at altitude. In particular, the increased metabolic rate and the lack of oxygen can increase the production of harmful free radicals. These free radicals can slow blood circulation and impair physical performance. Preliminary findings in men indicate that taking 400 IU per day of vitamin E, an antioxidant, at high altitude reduces free radical production and maintains aerobic energy production. Increased amounts of many other nutrients should be considered, especially since food intake usually decreases (see Table 12-2).

Tips for Maintaining Performance at Altitudes

- Plan on decreased physical performance the first few weeks.
- Drink plenty of fluids. Fluid requirements may be as high as 4.25 quarts, or more, each day.
- Listen to your body, be aware of any warning signs of illness or symptoms of AMS and seek medical attention.
- Try to avoid substances that cause dehydration (Table 12-1).

As noted throughout this chapter, meeting energy and fluid requirements are vital for maintaining physical performance in adverse environmental conditions. Being physically fit and eating a healthy diet prior to deployment will greatly improve your acclimation and adaptation to the new environment.