

# 15

## Mission Nutrition for Combat Effectiveness

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# 15 Mission Nutrition for Combat Effectiveness

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## Key Points

- Inadequate energy intake and/or dehydration can result in fatigue and impaired performance during combat.
- Improper eating and sleeping due to all night and high op-tempo missions can be detrimental to overall health.
- Eating before night operations should be planned accordingly to prevent fatigue.
- Various environmental exposures (i.e. heat, cold, and altitude) can alter combat effectiveness if nutritional needs and hydration are not met appropriately.
- Energy and fluid requirements are typically higher than normal during combat and combat-simulated scenarios.

**T**he synergistic relationship between adequate fueling and operational performance on the battlefield cannot be underestimated when it comes to mission success. Operators of equipment like humvees, helicopters, and submarines require high performance fuels to operate effectively. In some instances fueling options are limited, but meeting energy and fluid requirements whenever possible is critical. This chapter describes various fueling options when exposed to various environmental and logistical extremes. As Napoleon Bonaparte stated, “An army marches on its stomach.”

## Nutritional Readiness Before Missions

Warfighters must be prepared for deployments at any time. Immediately before such events, they may find themselves in the field or under lock down on base. Regardless, the two main nutritional considerations for readiness before missions are:

- Maximizing glycogen stores.
- Being well-hydrated.



## Several Days Before a Mission

The average, lean, 175-pound man has approximately 1,800 calories of CHO stored as glycogen in liver and muscle, and 75,000 to 150,000 calories stored as fat or adipose tissue. Despite these large energy stores of fat, CHO is still the preferred fuels, and glycogen depletion will compromise physical and mental performance. Low glycogen stores = fatigue. A diet rich in CHO for several days before a mission will increase liver and muscle glycogen stores, and thereby ensure adequate fuels stores.

## Timing and Composition of Pre-Mission Meals

The purpose of the pre-mission meal is to ensure adequate glycogen stores and maintain blood sugar. Every Warfighter should know his own tolerance for timing of meals and what patterns are needed to sustain performance. In general, intense physical activities demand a longer time period after meal ingestion to allow for digestion and minimize gastrointestinal distress.

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Eat 2–4 grams of CHO per pound body weight, but no more than 400 grams, 3–4 hours before a sustained operation.

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A pre-mission meal should provide a minimum of fat, since it takes longer to digest than CHO. CHO beverages and CHO/protein drinks are excellent choices if taken four hours before the start of a mission. Liquids are digested and absorbed more rapidly than solids, but personal choice is important. Avoid a high protein meal because it is harder to digest than CHO, and is not a readily available source of energy.

## Sustained Night Operations

Night exercises require acute cognitive awareness and the ability to react quickly to sudden and potential compromised situations. Sustained Operations (SUSOPS) are work periods of 24 hours or more that usually result in physical and mental fatigue as well as sleep loss. In contrast, Continuous Operations (CONOPS) are periods of uninterrupted activity of “normal shift length” followed by sufficient sleep. Missions include both SUSOPS and CONOPS, which can frequently result in fatigue and sleep deprivation. Nutritional interventions can partially offset the detrimental effects of fatigue and sleep deprivation on physical and mental performance. The nutritional interventions most effective include:



- Carbohydrate intake
- Hydration status
- Caffeine intake

## CHO Intake

As noted earlier, a high CHO diet is needed to maintain muscle glycogen stores and blood glucose. A diet that provides 50 to 70% of energy from CHO, 10 to 20% from protein and 20 to 35% of calories from fat is important for SUSOPS. High CHO snacks and/or CHO-containing fluid replacement beverages providing 15–30 g of CHO/hour will also help to maintain blood glucose and delay fatigue during strenuous prolonged missions. When blood glucose levels fall, hypoglycemia results causing performance to drop rapidly, and you will be incapable to continue the workload you initially started at.

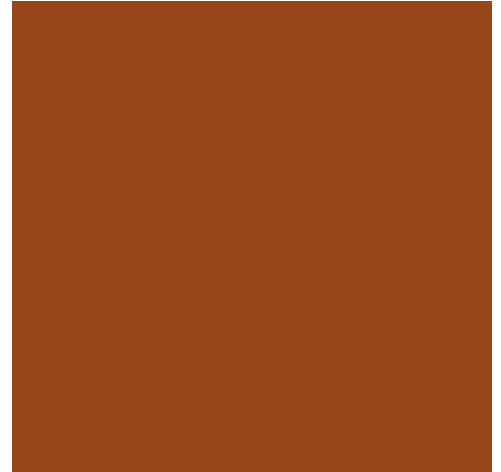
Table 15 1. Symptoms of Hypoglycemia

Headache	Weakness
Dizziness	Fatigue
Blurred vision	Sweating
Confusion	Unconsciousness

Portable foods that are easily accessible should always be included in a Warfighter “kit.” Quick eating foods that can fit conveniently in uniform pockets were presented in Chapter 8, Healthy Snacking. Additional foods include vacuum packed tuna or chicken with crackers and pocket sandwiches. Avoid foods that are high in the amino acid, tryptophan, since tryptophan promotes sleep.

Table 15 2. Foods High in Tryptophan

Dairy products and Eggs	Soy products
Seafood	Whole grains
Poultry	Rice
Meats	Hazelnuts, Peanuts
Beans and Lentils	Sesame seeds, sunflower seeds



## Hydration Status

Since water is critical for maintaining optimal operational performance as well as maintaining good general health, proper daily water intake is one of the most important factors for Warfighters. In 2004, the Institute of Medicine updated the adequate intake (AI) for water to 3.7 liters, or nearly one gallon of water, per day for men over the age of 19. Individuals typically need 1 milliliter of water for every kcal consumed. Warfighters usually have fluid needs greater than the recommended guidelines because of intense training, working in high humidity, extreme temperatures, and austere environments.




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When possible, select fluids that contribute not only fluids, but also vitamins and minerals.

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Fluid balance can be maintained with beverages containing water, such as juice, milk, coffee, tea, soda, and foods. Fruits and vegetables contain an upwards of 70%–90% water, whereas meats, dairy products and grain products consist of 30%–50%.

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Beverages consumed in the heat should be no more than 8% CHO—or less than 19 grams/8 oz.

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The need for electrolyte replacement in the field may be very great under warm and hot weather conditions, and during military exercises involving high mobility and strenuous physical work lasting 60 minutes or longer. When water is the only fluid available, the electrolyte SportStrips, a new product on the market, may be very useful. The SportStrips, which provide sodium and potassium, are inserted into the mouth between the gums and cheek and should be absorbed very quickly. The gastrointestinal tract is not required for absorption and as such, may be important for other conditions, such as dehydration from diarrhea. The effectiveness of this product is under review, but appears promising for military applications because of its simplicity and ease of transporting.

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Dehydration can result in a loss of appetite.

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Fluid replacement beverages with CHO are suggested during extended missions; however, the amount of CHO should be lower than usual so that the fluid/water is rapidly absorbed.

## Caffeine Intake

It is well-recognized that caffeine increases alertness and may delay fatigue during extended operations. However, the effective dose may vary, depending on habitual caffeine intake and sensitivity to caffeine. Caffeine is less effective for those who routinely consume large amounts. For caffeine to be effective, it should be consumed on an irregular basis.

A common dose shown to be effective for maintaining performance and vigilance is 200 mg. Although less may also be effective, the military has prepared “Stay Alert” gum, which contains 100 mg per chicklet. The current recommendation is to take 200 mg every two hours, for up to eight hours straight to help with alertness during operations. A regular dosing is needed because the effects of caffeine typically wear off within six hours.

Caffeine-rich beverages and foods are among the most popular forms of nutrition to help Warfighters maintain alertness at night. However, most products containing caffeine do not list amounts of caffeine on Nutrition Facts Labels. Manufacturers are not required to list caffeine amounts on labels, so the consumer can only determine the caffeine content by recognizing caffeine effects.

[Click here for caffeine content of various foods, beverages, and other products.](#)

## Nutritional Readiness During Missions

Four major nutrition-related issues encountered in the field are:

- Inadequate ration consumption.
- Inadequate energy intake.
- Dehydration.
- Gastrointestinal complaints.

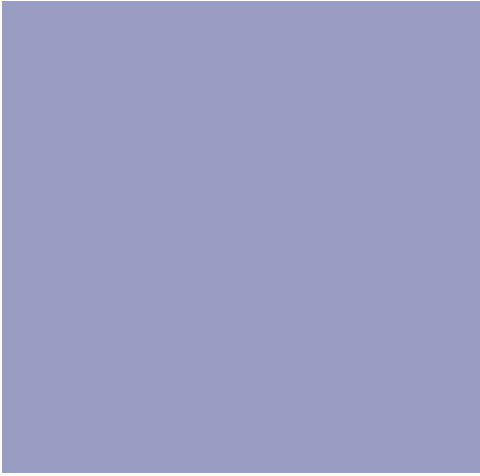
## Rations

One of the biggest problems with eating rations is that it gets boring! Monotony and lack of time to eat contribute to decreased ration intake and weight loss. Therefore, it is important to consume as much of the field ration as possible to maintain performance and health.

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Eat part of each ration item to obtain  
all the essential nutrients.

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Weight loss in the field is common, but may impair mental and physical performance.



Limit use of non-issue food items as meal/ration substitutes since they may be lacking in several important nutrients. Use these items as snacks to supplement daily rations. Also pack high CHO items, such as crackers, dried fruits, trail mixes, sports bars, and like (see Chapter 8 for snack ideas). Experiment beforehand to see what suits you best. When planning to use high CHO bars, check the fat content, because if the fat content is greater than 3 g/100 calories it may slow down absorption and can cause cramps.

The new First Strike Ration, which provides an average of 2,900 kcal per day, is great for missions, except that additional CHO must be provided to meet CHO needs. Table 3 provides the content of the three menus. This new ration takes up less space and weighs approximately 50% less than three MREs.

Table 15 3. Menus for First Strike Ration

Menu 1	Menu 2	Menu 3
Filled French toast pocket	Brown sugar cinnamon toaster pastry	Lemon poppyseed pound cake
Bacon cheddar pocket sandwich	Italian pocket sandwich	Honey BBQ beef pocket sandwich
Pepperoni pocket sandwich	Chunk chicken	Albacore tuna
Jalapeno cheese spread	Tortillas	Tortillas
Wheat snack bread	Peanut butter	Cheese spread, plain
ERGO drink	Cracker, plain	Cracker, plain
ERGO drink	ERGO drink	ERGO drink
First Strike!™ mocha	ERGO drink	ERGO drink
First Strike!™ chocolate	First Strike!™ apple cinnamon	First Strike!™ mocha
Peanut butter dessert bar	First Strike!™ cranraspberry	First Strike!™ cranraspberry
Beef snack, sweet BBQ	Dessert bar, mocha	Dessert bar, chocolate banana nut
Beef snack, teriyaki	Beef snack, sweet BBQ	Beef snack, sweet BBQ

Table 15 3. Menus for First Strike Ration

Menu 1	Menu 2	Menu 3
CHO enhanced applesauce	Beef snack, teriyaki	Beef snack, teriyaki
Nut fruit mix	CHO enhanced applesauce	CHO enhanced applesauce
Caffeinated gum	Nut fruit mix	Nut fruit mix
	Caffeinated gum	Caffeinated gum
	Mayonnaise, fat-free	Mayonnaise, fat-free
	Hot sauce	Hot sauce
<b>Access C</b>	<b>Access B</b>	<b>Access A</b>
Apple cider	Lemon tea	Coffee
Towelette	Towelette	Cream substitute
Salt	Salt	Sugar
Matches	Matches	Towelette
Tissue	Tissue	Salt
Each menu comes with a zip-lock pouch, 2 towelettes, and a spoon.		
If possible, drink 25 to 60 grams of CHO/hour to maintain blood glucose.		

## Dehydration

Dehydration occurs when sweat and urine losses are not replaced by drinking water and other fluid replacement products. It can occur at altitude, in the cold, in the heat, during diving, and even under conditions of low physical activity. Mild dehydration can decrease appetite and cause lethargy. It should be avoided at all costs.

Water and other fluids should be consumed when thirsty. At least 4 L should be consumed each day—more when the environment is hot.

## Gastrointestinal Complaints

Changes in diet, dehydration, too much fiber, poor sanitary conditions, contaminated food, unfamiliar bacteria, and/or stress may result in diarrhea or constipation in the field. Ensure adequate hydration at all times,



and avoid new non-issue foods whenever possible. Chapter 14, Eating Locally discusses approaches to mitigating gastrointestinal distress.

## Missions in the Heat

Repetitive movement along difficult terrain with heavy gear, such as during land warfare operations, is strenuous under any environmental condition, but particularly arduous with extreme heat and humidity. Land warfare scenarios where Warfighters carry heavy loads or injured comrades increase overall effort and energy expenditure, as well as fluid and electrolyte needs. The major concerns during operations in a warm/ hot environment are fluid and electrolyte balance. Working or exercising in the heat exacerbates water and electrolyte loss through sweating. The amount of sweat and fluid lost depends on:

- Environmental temperature and humidity.
- Work rate.
- Fitness level and acclimatization.
- Volume and rate of fluid replacement.

When the same task carried out in thermoneutral environment is performed in a hot environment, energy requirements are slightly increased due to the increased work of maintaining thermal balance. When living/ working in temperatures ranging from 86 to 104° F (30 to 40° C), energy intakes typically increase by 10%, unless activity level decreases accordingly.

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If 4,000 kcal/day are required, a 10% increase in energy would =  $4,000 \times 0.10$  or +400 kcal/day.

Goal: Consume 4,400 kcal/day.

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**Tip:** If activity levels decrease, no extra energy is needed!

High work rates in hot, humid surroundings can significantly increase fluid and electrolyte losses. Losses of one to two quarts per hour or even more are likely when special clothing, such as chemical protective gear, and/or body armor is worn. The highest sweat rates reported are over five quarts per hour. That is a lot of fluid.

## Fluids—Drink Early and Drink Often

Starting any operation without being adequately hydrated may increase the risk of performance mishaps. Some believe that relying on thirst is adequate for sustaining hydration, whereas others believe that thirst itself is



More information  
on fluid needs during  
heat stress.

an indicator of dehydration. For certain, failure to replace lost fluids from sweating will result in dehydration and possibly heat injury. Always drink when thirsty.

Although forced drinking is recommended throughout training in a warm environment to ensure adequate fluid replacement and performance, this is not always wise. Too much water can result in hyponatremia. A pre-determined drinking schedule is recommended to ensure enough fluids are being consumed: some type of beverage should be consumed with all meals and snacks.

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Drink 1–2 cups of fluid every 30 minutes.

Drinking more than 4 cups per 60 minutes may be *too much* to absorb!

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In the field when it is difficult, if not impossible, to obtain a body weight, urine color should be used to gauge hydration status.

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One pound of weight lost requires 2.25 cups or 0.5 quarts of fluid to restore fluid balance.

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A fluid loss of 2% body weight can impair physical performance and mood, decrease appetite, and increase the risk of heat injuries. A 5% loss of body weight can decrease work performance by 30%. This amount of water loss is a serious threat to overall health.

## Monitoring Hydration in the Field

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Monitor hydration status by inspecting urine color.

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Dark yellow or smelly urine suggests some degree of dehydration; fluid consumption should be increased until urine becomes pale yellow. If taking B vitamins, urine may be bright yellow, not pale, regardless of hydration status.

[Click here to view a urine color chart.](#)

### Example:

A WF weighs 175 pounds.

A 4% weight loss would be  
 $175 \times 0.04 = 7.0$  lbs.

Goal: Stay above 168 lbs.

[Click here to calculate your lower weight for fluid loss.](#)

## Electrolyte Balance

Excessive loss of electrolytes (i.e., sodium, potassium) from sweating can lead to muscle cramping or severe medical problems. Being in excellent physical condition will help minimize electrolyte losses, but athletes given free access to water when exercising in the heat replace only one half to two thirds of their fluid losses. Also, camelbacks are routinely used to stay hydrated, but since they provide water alone, electrolyte balance may be compromised. To maintain electrolyte snacks that contain sodium and potassium, fluids with electrolytes, electrolyte SportStrips or electrolytes in the form of gels and blocks may be needed during and after missions. Electrolytes should offset hyponatremia.

Fluids alone may not be adequate for restoring or maintaining electrolyte balance, because there is an upper limit to how much sodium and potassium should be provided in a beverage.

Table 15 4. Upper Limits for Sodium and Potassium in Fluid Replacement Beverages During Heat Stress

Units	Sodium	Potassium
mg/8 oz	165	46
mg/L	690	195
mEq/8 oz	7.2	1.2

Check labels to ensure that beverages provide no more than indicated in the chart above. The National Academy of Sciences recommends that chloride be the only “anion” (negatively charged electrolyte) accompanying sodium and potassium, and no other electrolytes are recommended. Typically, magnesium and calcium are included, but the amounts are well below recommended upper limits.

In addition, foods that naturally provide sodium and potassium should be selected. Dried fruits are optimal food choices for potassium. For example, a small box of raisins provides 322 mg of potassium. Even if heat acclimatization has occurred, it is important to understand the importance of salt: 200–400 milligrams of sodium can be lost per pound of sweat, along with sodium excreted in urine. Adding salt to foods (1/2 teaspoon provides 1,200 milligrams) or including sodium-rich foods in the diet will help retain water and avoid a sodium deficit. Sodium is the most critical electrolyte for maintaining fluid balance.



Table 15 5. Sodium Content of Foods

Food	Serving Size	Sodium (mg)
Bacon	3 oz	621
Canned chicken soup	1 cup	850
Cheese, American	1 oz	304
Cornflakes	1 cup	298
Cottage cheese	½ cup	459
Deli ham	1 oz	341
Deli turkey breast	1 oz	335
Olives, black	5 large	192
Peanut butter smooth, salted	2 Tbsp	147
Peanuts, dry roasted, salted	3 oz	691
Pickles, dill	1 large	1,731
Potato chips	1 oz	183
Pretzels	1 oz	486
Sardines	3 oz	429
Sauerkraut	½ cup	780
Soy sauce	1 tsp	304
Table salt	1 tsp	2,358
Tortilla chips	3 oz	669

Table 15 6. Potassium Content of Foods

Food	Serving Size	Potassium (mg)
Apricots, dried	10 halves	407
Avocados, raw	1 oz	180
Bananas, raw	1 cup	594



Table 15 6. Potassium Content of Foods

Food	Serving Size	Potassium (mg)
Cantaloupe	1 cup	494
Dates, dry	5 dates	271
Figs, dry	2 figs	271
Kiwi fruit, raw	1 medium	252
Lima beans	1 cup	955
Melons, honeydew	1 cup	461
Milk, fat-free or skim	1 cup	407
Nectarines	1 medium	288
Orange juice	1 cup	496
Oranges	1 orange	237
Pears, fresh	1 pear	208
Peanuts, dry roasted, without salt	1 ounce	187
Potato, baked, with skin	1 potato	1,081
Prune juice	1 cup	707
Prunes, dried	1 cup	828
Raisins	1 cup	1,089
Spinach, cooked	1 cup	839
Tomato sauce	1 cup	909
Winter squash	1 cup	896
Yogurt, plain, skim milk	8 oz	579

Nutrition advice for operations in a cold weather environment.

More information on cold weather training.

## Missions in the Cold

Exposure to a cold environment seriously challenges the human body. Blood vessels tighten to conserve heat and shivering is initiated to gener-

ate heat and guard against hypothermia (a dangerously low core body temperature). Side effects of these responses are: an increase in urine output and an increase in energy metabolism. Therefore, the most important nutritional considerations for a cold environment are:

- Energy intake.
- Glycogen stores.
- Fluid status.
- Vitamin and mineral needs.

## Energy Intake

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Energy requirements can increase 25–50% during cold weather operations as compared to warm weather operations.

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Cold weather increases energy requirements significantly. Factors that increase caloric intake include:

- Added exertion due to wearing heavy gear.
- Shivering, which can increase resting metabolic rate by two to four times the normal level.
- Increased activity associated with traveling over snow and icy terrain.
- Increased activity to keep warm.

Many studies have shown that Warfighters tend to progressively lose weight when conducting two to three week field exercises in the cold. Because significant weight loss can result in fatigue and performance decrements, energy intake should meet the increased energy demands.

Energy expenditure for Warfighters during periods of physical exertion in the cold may range between 4,200 and 5,000 kcal/day. Although CHO is critical, a diet that provides 35% of the energy as fat may be necessary to match energy needs. It is important to remember that both fat and CHO are important energy sources in a cold environment.

Ideally, during cold weather operations, 50–60% of energy should come from CHO, 30–35% from fat, and 10–20% from protein: high CHO snacks should be eaten between meals. A high protein diet is not advised as it may increase fluid requirements.

Missions in cold weather require foods that produce heat. Foods high in CHO produce more heat through digestion than either fat or protein. Hot beverages, such as cocoa, provide CHO and other warm beverages, to in-



clude coffee, teas and broth, increase body temperature, enhance mental awareness and provide comfort.

### Example:

WF require ~4,000 kcal/day

A 25% increase in energy would  
=  $4,000 \times 0.25$  or +1,000 kcal

Goal: Consume 5,000 kcal/day

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Eat high CHO snacks frequently.

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## Glycogen Stores

Prior to deploying to a cold environment, the pre-mission diet should ensure that glycogen stores are optimized. Likewise, a high CHO diet is preferred during cold exposure, as CHO are needed to replenish glycogen being used to maintain core temperature. Thus, regular meals and snacks providing CHO should be eaten to maintain CHO intake. Including a liquid or solid CHO supplement may be critical for maintaining energy balance and performance.

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A minimum of 400 grams of CHO  
is necessary in the cold.

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## Fluid Status

Becoming dehydrated in cold environments is easy because of the cold-induced increase in urine output, increased fluid losses through breathing, involuntary reduction in fluid intake, and sweating. Because dehydration decreases performance and potentially may lead to various medical problems, maintaining fluid status by drinking plenty of fluids and monitoring hydration is absolutely critical.

Table 15 7. Tips for Maintaining Fluid Status

Force yourself to drink 2–4 cups of warm fluid at hourly intervals.

Avoid alcoholic beverages: alcohol tends to increase heat and urine losses.

Drink beverages with CHO to increase energy intake.

Don't eat snow without first melting and purifying it.

Moderate caffeine consumption.

Beverages containing 5–8% CHO and some electrolytes are best.

Drinking 1 to 2 cups per 30 minutes is recommended.

## Vitamin and Mineral Needs

The requirements for some vitamins and minerals increase when working in the cold due to increases in energy metabolism (example: thiamin) or urinary losses (example: magnesium, zinc). The amount by which daily vitamin and mineral needs may increase above the DRI during cold weather operations are shown in Table 8. These amounts are based on intake data from field studies, urinary excretion of nutrients and other measures of “nutrient status.” In most cases, energy requirements and vitamin and mineral needs can be met by eating all ration components.

Table 15 8. Vitamins and Mineral Supplements for Cold Weather and Altitude Operations

Nutrient	Suggested Amount	% DRI
Vitamin B1, Thiamin	3 mg	200
Vitamin B2, Riboflavin	2 mg	118
Vitamin C	250 mg	417
Vitamin E	400 mg $\alpha$ -TE	1,990
Zinc	15–20 mg	133

## Missions at Altitude

Ascent to altitude and flying can cause a variety of disturbances, and adequate nutrition is crucial for maintaining performance. The major nutritional concerns at altitude are:

- Weight loss.
- CHO intake.
- Dehydration.
- Oxidative stress.





Nutrition advice for military operations in high-altitude environments.

A Soldier's Guide to Staying Healthy at High Elevations.

#### Example:

A WF requires 4,000 kcal/day.

A 50% increase in energy would be  
 $= 4,000 \times 0.50$  or +2,000 kcal

Goal: Eat 5,000 kcal/day

Dehydration in a plane is different from on a mountain.

## Weight Loss

Virtually all people who go to high altitudes experience weight loss and loss of lean body mass. At altitudes below 5,000 m weight loss can be prevented by being vigilant about eating on a regular basis. Above 5,000 m, a 5–10% weight loss is inevitable. Energy intakes should range from 3,500–6,000 kcal per day, which is equivalent to eating at least four MREs or two First Strike Rations daily. Some reasons for weight loss at altitude include:

- Increased energy requirements to 115–150% of sea level requirements.
- Decreased sense of taste, which causes a reduction in food intake.
- Changes in the metabolism of fat and CHO.
- Loss of body water from increased breathing rate and dry air.
- Impaired absorption of nutrients.
- Acute Mountain Sickness (AMS), which can cause nausea, vomiting, headache and decreased appetite.

The only way to minimize weight loss is by being vigilant about maintaining energy intake.

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Energy requirements may increase  
 15–50% above requirements at sea level.

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## CHO Intake

High CHO foods are the preferred energy source at altitude and in flight because they:

- Replete glycogen stores.
- Require less oxygen to produce energy than fat.
- Are the most efficient energy source.
- Can blunt and delay the progression or severity of AMS symptoms (nausea, vomiting, and headache).
- Maintain blood glucose.

Diets should provide at least 400 grams of CHO and CHO should contribute 50–70% of the total energy. This can be accomplished by eating high CHO snacks between meals and drinking CHO-containing beverages during strenuous activity, long flights, and recovery.

## Dehydration

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Dehydration in a plane is different from on a mountain.

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Exposure to high altitude is associated with significant levels of dehydration because water losses are increased. If these losses are not replaced, dehydration will result. Some studies suggest that vigorous hydration may decrease the incidence and severity of AMS. Dehydration will increase the risk of cold injury. The reasons dehydration occurs at altitude include:

- Increased respiratory losses due to increased ventilation.
- Increased urine output due to altitude and cold temperatures.
- Possible diarrheal fluid losses.
- Failure to drink water.
- Poor access to water.

Pilots need to have regular access to a bottle of water or an electrolyte beverage, but on a limited basis. Drinking beverages with sugar is not recommended. Also, coffee, sodas, and teas should be avoided.

Importantly, do not over-exercise before a flight, since strenuous exercise can deplete body water, which may be difficult to replace quickly. Recent illness, fever, diarrhea, or vomiting will also greatly affect the degree of dehydration.

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Fluid requirements may be > 4 quarts per day at high altitude.

Maintain a drinking schedule and monitor hydration status daily to avoid AMS.

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## Oxidative Stress


One consequence of altitude exposure is the production of an excessive load of reactive oxygen species. In particular, increased metabolic rate and hypoxic conditions at altitude can increase the production of harmful free radicals. Collective free radicals cause oxidative stress, which may slow blood circulation and impair physical performance. Polyunsaturated fatty acids (PUFAs) are the nutrients most susceptible to oxidative stress. Studies have shown that symptoms of altitude sickness correlate



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Taking regular sips of cool, 40°F water before feeling thirsty may help prevent dehydration.

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with markers of oxidative stress. Thus, antioxidants have been used to minimize oxidative stress.

Several studies indicate that taking Vitamin E (400 IU/day) may reduce free radical production at altitude, and help maintain blood flow and aerobic energy metabolism in men. Also, a combination of 1,000 mg of Vitamin C, 400 IU of d- $\alpha$ -tocopherol acetate (400 mg  $\alpha$ -TE) and 600 mg of alpha-lipoic acid taken in divided doses in the morning and evening was shown to minimize symptoms of altitude sickness and improve energy intake in men. However, the protective benefits of antioxidants against acute mountain sickness are inconsistent.

Although studies are showing benefits of antioxidants, too much may be harmful. Exposure to altitude produces natural adaptations and it is possible that too much of any antioxidant could compromise nature's response to lower oxygen levels. Refer to Table 15-8 for a complete recommendation of vitamin and mineral supplements for cold weather and altitude recommendations.

## Missions in Water and at Depth

Like exposure to altitude and cold environments, water operations, especially cold water operations, are associated with increased energy expenditure and marked fluid losses. Thus nutritional concerns for diving are maintaining:

- Energy intake.
- Fluid intake.
- Mineral balance.
- Antioxidant balance.

### Energy Intake

When working at the same rate in water as on land, the energy expenditure to accomplish the same task is greater in water. The reasons for this increased energy expenditure during water operations include:

- Greater resistance offered by water.
- Decreased efficiency of movement when thermal protective clothing are worn.

Glycogen stores are rapidly used when performing hard work in cold water. These stores must be replaced between operations to prevent performance decrements. Increasing CHO intake before an anticipated dive has been shown to improve and extend exercise performance during prolonged dives.

### Fluid Intake

Immersion in water increases urinary excretion by 2–10 times above normal. Without adequate hydration a diver can quickly become dehydrat-

ed and suffer performance decrements. For example, immersion during a single dive for 3 to 6 hours can result in a 2–8 pound loss in body weight by urination; this is equivalent to losing 1–3 quarts of fluid. Importantly, drink fluids with CHO whenever possible to maintain blood glucose. A decline in blood glucose is known to adversely affect performance.

## Mineral Balance

Immersion in water, especially cold water, increases urinary losses of magnesium, calcium, zinc, and chromium. It is important to consume foods high in these important minerals to restore immersion-induced losses. See Chapter 4 for foods high in these minerals.

## Antioxidant Balance

Like altitude, diving results in greater oxidative stress than working at sea level. This makes sense because with increased depth comes increases in oxygen tension. Oxidative stress is even greater when oxygen is the air breathed at depth. As noted with altitude, some adaptation takes place and natural antioxidant defense systems are “up-regulated” to minimize cell damage from oxidative stress. Despite this, antioxidants have been used to combat potential deleterious effects of oxidative stress. Although no definitive recommendations can be made, some benefits have been noted by taking 1 gram of vitamin C and 400 IU of vitamin E two hours before extended dives. However, a diet high in natural antioxidants should confer protection as well.

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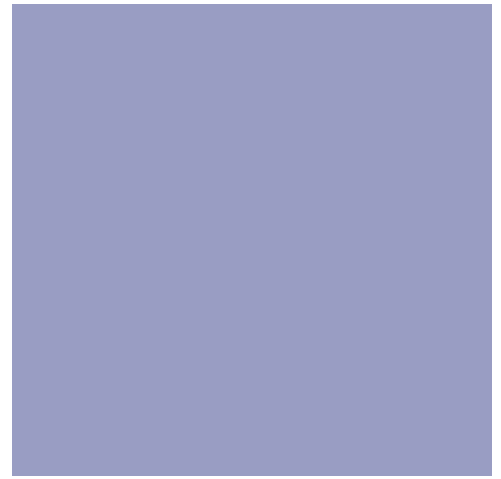
Diving at depth, especially when breathing oxygen-rich gas, facilitates the formation of “reactive” oxygen species.

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## Mission Scenarios

Nutrition challenges are expected during deployments where harsh environmental conditions, austere living quarters, and lack of food services are the rule. Although nutritional inadequacies can compromise performance, if energy intake can be maintained above 2,000 kcal/day with at least 300 gram of CHO and 60 gram of protein, and fluid status maintained, performance should be sustained over a period of weeks. However, developing sound nutritional plans for training and mission scenarios should help sustain performance. Sample nutrition plans are provided for the following training scenarios:

- Typical Training Day.
- SDV Operation.



- Unconventional Warfare.
- Special Reconnaissance.
- Nighttime Air Mission.

For most scenarios, the macronutrient recommendations assume an energy requirement of 4,000 kcal/day. If energy requirements are lower or higher, the amounts of CHO, protein, and fat should be altered accordingly. **The timing and/or amount of any particular nutrient can be modified to suit individual needs based on the scenario and personal experiences.** Snacks refer to food and beverages that can be carried and consumed while on the mission/operation. Specific foods are not identified, but a list of good field foods, both from rations and commercial off-the-shelf products is included. Each person has individual tastes and it is most important that all food components taken for deployment be tested. The caveat is for extended missions when eating on the economy is the rule, rather than the exception.

[Click for the nutrient content of First Strike Ration Menu Items.](#)

[Click for the nutrient content of various COTS useful for deployments.](#)

## Typical Training Day



- OPORDER:** Get in shape.
- Duration:** 12 hours.
- Chow Availability:** COTS.
- Terrain:** Command Dependent.

### Nutrition Recommendations:

- Plan a healthy recovery meal after morning PT.
- Maintain a high intake of CHO.
- Drink fluids and eat CHO during long training events.
- Choose plenty of fresh fruits and vegetables, and a variety of whole grains while still on home territory.

Table 15 9. Typical Training Day

Time	Activity	CHO (g)	Protein (g)	Fat (g)
0530	Wake-Up — Juice	50	0	0

Table 15 9. Typical Training Day

Time	Activity	CHO (g)	Protein (g)	Fat (g)
0630–0830	PT			
0830	Breakfast	100	20	15
0830–1000	Classroom/briefing			
1000–1200	Work on gear/other			
1100	Snack	40	10	6
1300–1330	Break for lunch	120	30	30
1400–1630	10 mile march 2 mile swim 3 hr dive	60	0	0
1630–1730	Clean Gear—snack	40	0	0
1730	End of work day— go home			
1730–1900	Dinner	120	60	40
1900–0530	Personal time and sleep			
2200	Snack	40	10	6
	<b>Total g</b>	570	130	97
	<b>Total kcal</b>	2,280	520	873
	<b>Total Daily kcal</b>	3,673		

### Food Suggestions:

- Yogurt and bagel.
- Whole-wheat crackers.
- Fruit and vegetables.
- Chicken and fish.
- Fruit juices.
- Rice and baked potatoes.



## SDV Operation

<b>OPORDER:</b>	Long range insertion.
<b>Duration:</b>	12–14 hours at night.
<b>Chow Availability:</b>	COTS/Rations.
<b>Terrain:</b>	Nautical Environment—Surface water temperature 55–60°.

### Nutrition Recommendations:

- Eat a high CHO meal or snack two hours before mission.
- Increase fluids to offset urinary losses.
- Consume CHO rich beverages to maintain blood glucose.
- Consume foods high in magnesium, calcium, zinc and chromium (trail mix, beef jerky).
- Consume a hot CHO beverage upon mission completion, if possible.
- Eat CHO rich foods between sorties.

Table 15 10. SDV Operation

Time	Activity	CHO (g)	Protein (g)	Fat (g)
1700	Pre-Mission Meal Water 16 oz	100	25	25
1800	Descent 1			
2400	Snack CHO drink, 16 oz	60	10	5
0100	CHO Drink, 32 oz	50	0	0
0200	Descent 2			
0800	CHO Snack Water, 16 oz	60	10	5
0900	CHO drink, 32 oz	40	0	0
1200	Meal Water, 16 oz	100	20	25
1400	Snack Water, 16 oz	60	10	0

Table 15 10. SDV Operation

Time	Activity	CHO (g)	Protein (g)	Fat (g)
1600–1730	Dinner	100	25	25
	<b>Total g</b>	570	100	85
	<b>Total kcal</b>	2,280	400	765
	<b>Total Daily kcal</b>	3,445		

### Food Suggestions (CHO, protein, fat in grams):

- Chunked Chicken and tortilla, 1 serving each—(32, 35, 9).
- Whole-wheat crackers, 10 each—(27, 4, 6).
- Turkey Jerky, 2 oz—(12, 24, 1).
- Soldier Fuel Bar, 1—(40, 10, 9).
- Poppyseed pound cake, 1 piece—(37, 4, 13).
- Fruit nut mix, 0.3 cup—(18, 12, 26).
- Coconut-Almond bar, 1—(56, 16, 12).
- Strawberry-Honey granola, 1 serving—(43, 18, 12).
- Dried cranberries, 0.5 cup—(45, 0, 1).
- Gels, 1 pack—(27, 0, 0).
- CHO Beverage, 8 oz—(15, 0, 0).

## Unconventional Warfare

### OPORDER:

Train indigenous guerilla force.

### Duration:

Multi-year until completion of mission.

### Chow Availability:

Limited resupply; be prepared to exist on indigenous, local food sources. Resupplies should include sport bars, CHO-electrolyte packets, and other snacks.

### Terrain:

Tropical to sub-artic, with some heavy forested areas.





### Nutrition Suggestions:

- Purify water.
- Refer to Chapter 14 on Combat Rations and Chapter 13 on Eating Globally.
- Try to maintain 2,000 kcal per day with as much CHO as possible.
- Eat a sport bar every two hours to maintain blood sugar.
- Protein and CHO may come from local sources (animal, legumes, grains, dairy).
- Majority of energy may come from rations (MRE /First Strike Ration) and COTS.
- See section above on hot/cold weather.

Table 15 11. Unconventional Warfare

Time	Activity	CHO (g)	Protein (g)	Fat (g)
0530	Pre-Mission Meal CHO/PRO beverage	120	10	20
0730	Snack Water, 8–16 oz	40	10	5
0930	Snack Water, 8–16 oz	40	0	0
1130	Lunch Water, 8–16 oz	120	20	20
1430	Snack Water, 8–16 oz	40	10	10
1630	Snack Water, 8–16 oz	120	30	30
1830	Snack CHO/PRO beverage, 8–16 oz	75	10	15
2130	Snack Water, 8–16 oz	40	0	0
	<b>Total g</b>	595	90	100
	<b>Total kcal</b>	2,380	360	900
	<b>Total Daily kcal</b>	3,640		

### Food Suggestions (CHO, protein, fat in grams):

- Mountain House Beef Stroganoff, 1 serving—(62, 21, 21).
- Alpine Aire Freeze-Dried Pineapple Chunks, 1 serving—(20, 10, 0).
- Powerbar Endurance sport powder drink, 16 oz—(40, 0, 0).
- Gookinaid ERG drink powder, 8 oz—(40, 0, 0).
- Odwalla Super Protein bars, 1 bar—(31, 16, 5).
- Zapplesauce, 2 serving—(64, 0, 0).
- Carb-BOOM! Gel, 1 pack—(27, 0, 0).
- FSR tortillas, 1 serving—(32, 4, 5).

### Special Reconnaissance

- OPORDER:** Conduct recon and gain awareness of enemy ground activity.
- Duration:** Four cycles of night.
- Chow Availability:** Rations/Rations.
- Terrain:** Altitude—be prepared to work between 7,000–9,800 feet.

### Nutrition Suggestions:

- Pre-mission meal should be high in CHO, protein, and fluids.
- Purify water—hydration critical to minimizing AMS.
- Meals must be easy to prepare, and high in CHO.
- Vitamin E (400 IU) and C (1 gram) may be helpful.
- Moderate caffeine intake may be needed for alertness and cognitive function.
- Easily portable and accessible foods are requisite.
- Minimize fiber intake.

Table 15 12. Special Reconnaissance (SR)

Time	Activity	CHO (g)	Protein (g)	Fat (g)
1700	Pre-Mission Meal Water, 16 oz	120	40	30
1900				



Table 15 12. Special Reconnaissance (SR)

Time	Activity	CHO (g)	Protein (g)	Fat (g)
2100	Snack Fluid, 16 oz	50	0	0
2300	Snack Fluid, 16 oz	40	10	6
0100	Snack Fluid, 16 oz	75	10	15
0300	Snack Fluid, 16 oz	40	10	6
0500	Snack Fluid, 16 oz	40	5	30
0700				
0900	Meal Fluid, 16 oz	100	30	25
1100				
1300	Snack Fluid, 16 oz	40	0	0
1500	Repeat 24 hours Cycle	40	0	0
	<b>Total g</b>	545	105	112
	<b>Total kcal</b>	2,180	420	1,008
	<b>Total Daily kcal</b>	3,608		

### Food Suggestions (CHO, protein, fat in grams):

- Beef BBQ pocket sandwich, 1 serving—(40, 9, 9).
- MRE cracker, plain, in FSR—(26, 4, 5).
- HooAH! Cran-Raspberry, 1 serving—(25, 2, 3).
- ERGO drink, 16 oz—(86, 0, 0).
- Zapplesauce, 1 serving—(32, 0, 0).
- French toast pocket, 1 serving—(60, 5, 10).
- Desert Bar, mocha, 1 serving—(21, 2, 15).

- Alpine Aire Freeze-Dried Strawberries, 1 serving—(24, 2, 0).

## Nighttime Air Mission

- OPORDER:** Infiltrate ground troops/bundle drops.
- Duration:** 10-14 hrs in length.
- Chow Availability:** COTS/Rations.
- Environment:** Too hot or too cold during flight, circadian rhythms are periodically switched.

### Nutrition Suggestions:

- Plan for a CHO rich pre-mission meal.
- Decrease fluid intake during the mission.
- Consume small, CHO rich snacks on a regular basis to maintain blood glucose.
- Eat a meal after the mission.
- Increase fluid intake after landing to restore fluid balance.

Time	Activity	CHO (g)	Protein (g)	Fat (g)
1600	Pre-Mission Meal, 8 oz	100	20	20
1900	Snack	40	10	5
2100	Snack	40	10	5
0100	Snack Water, 8 oz	40	0	0
0300	Snack	40	10	10
0500	Snack	40	10	10
0700	Meal Water, 16 oz	100	20	20
0900	<b>Rest</b>			
1100		60	5	10





Table 15 13. Nighttime Air Missions

Time	Activity	CHO (g)	Protein (g)	Fat (g)
1300	Snack Water, 8 oz	40	10	5
1500	Repeat Cycle			
	<b>Total g</b>	500	95	85
	<b>Total kcal</b>	8,000	1,520	6,885
	<b>Total Daily kcal</b>	3,145		

### Food Suggestions (CHO, protein, fat in grams):

- Mountain House Beef Stew, 1 serving—(54, 36, 16).
- Whole-wheat crackers, 6—(11, 1, 3).
- Beef jerky, teriyaki, 2 oz—(9, 11, 4).
- Soldier Fuel bar, 1—(40, 10, 9).
- Zapplesauce, 2—(64, 0, 0).
- Ergo drink, 1—(43, 0, 0).
- Trail mix, 5 oz—(18, 12, 26).
- Box raisins, 1.5 oz—(32, 1, 0).

## Summary

The three primary ways to be nutritionally prepared during missions are:

- Eating a high CHO diet to maintain and sustain glycogen stores.
- Being well hydrated—follow a forced fluid replacement schedule since thirst is not always a good indicator of fluid needs under extreme environmental conditions.
- Eating snacks every 2 hours to maintain blood glucose.