

Guide to High Altitude Acclimatization, Illnesses, and First Aid Kits

High Altitude Trekking and Climbing

The pleasures of trekking in the world's highest mountain ranges cannot be overstated. Neither can the dangers. Altitude sickness can occur in some people as low as 8,000 feet, but serious symptoms do not usually occur until over 12,000 feet. Even then it is not the height that is important, rather the speed in which you ascended to that altitude.

Acute mountain sickness (AMS) is actually more common in fit young men because they are more likely to attempt a rapid ascent by racing up the mountain like some indestructible super hero! As a general rule, it is far safer (and more enjoyable) to avoid altitude sickness by planning a sensible itinerary that allows for gradual acclimatization to altitude as you ascend, (you can race back down as fast as you like!)

What is High Altitude?

High	2,500 to 4,000 meters	8,000 to 13,000 feet
Very High	4,000 to 5,500 meters	13,000 to 18,000 feet
Extremely High	Over 5,500 meters	Over 18,000 feet

It is difficult to determine who may be affected by altitude sickness since there are no specific factors such as age, sex, or physical condition that correlate with susceptibility. Some people get it and some people don't because some people are more susceptible than others.

Most people can ascend to 2,500 meters (8,000 feet) with little or no effect. If you have been at that altitude before with no problem, you can probably return to that altitude without problems as long as you are properly acclimatized. If you haven't been to high altitude before, you should exercise caution when doing so.

The Causes of Altitude Sickness

The percentage of oxygen in the atmosphere at sea level is about 21% and the barometric pressure is around 760 mmHg. As altitude increases, the percentage remains the same but the number of oxygen molecules per breath is reduced. At 3,600 meters (12,000 feet) the barometric pressure is only about 480 mmHg, so there are roughly 40% fewer oxygen molecules per breath so the body must adjust to having less oxygen. In addition, high altitude and lower air pressure causes fluid to leak from the capillaries in both the lungs and the brain, which can lead to fluid build-up. Continuing on to higher altitude without proper acclimatization can lead to the potentially serious, even life-threatening altitude sickness.

Acclimatization

The main cause of altitude sickness is going too high too quickly. Given enough time, your body will adapt to the decrease in oxygen at a specific altitude. This process is known as acclimatization and generally takes one to three days at any given altitude, e.g. if you climb to 3,000 meters and spend several days at that altitude, your body will acclimatize to 3,000 meters. If you then climb to 5,000 meters your body has to acclimatize once again.

Several changes take place in the body, which enables it to cope with decreased oxygen:

- The depth of respiration increases.
- The body produces more red blood cells to carry oxygen.
- Pressure in pulmonary capillaries is increased, "forcing" blood into parts of the lung, which are not normally used when breathing at sea level.
- The body produces more of a particular enzyme that causes the release of oxygen from hemoglobin to the body tissues.

Cheyne-Stokes Respirations

Above 3,000 meters (10,000 feet) most people experience a periodic breathing during sleep known as Cheyne-Stokes Respirations. The pattern begins with a few shallow breaths and increases to deep sighing respirations then falls off rapidly even ceasing entirely for a few seconds and then the shallow breaths begin again. During the period when breathing stops the person often becomes restless and may wake with a sudden feeling of suffocation. This can disturb sleeping patterns, exhausting the climber. This type of breathing is not considered abnormal at high altitudes. Acetazolamide is helpful in relieving this periodic breathing.

Acute Mountain Sickness (AMS)

AMS is very common at high altitude. At over 3,000 meters (10,000 feet) 75% of people will have mild symptoms. The occurrence of AMS is dependent upon the elevation, the rate of ascent, and individual susceptibility. Many people will experience mild AMS during the acclimatization process. The symptoms usually start 12 to 24 hours after arrival at altitude and begin to decrease in severity around the third day.

The symptoms of Mild AMS include:

- Headache
- Nausea & Dizziness
- Loss of appetite
- Fatigue
- Shortness of breath
- Disturbed sleep
- General feeling of malaise

Symptoms tend to be worse at night and when respiratory drive is decreased. Mild AMS does not interfere with normal activity and symptoms generally subside within two to four days as the body acclimatizes. As long as symptoms are mild, and only a nuisance, ascent can continue at a moderate rate. When hiking, it is essential that you communicate any symptoms of illness immediately to others on your trip.

Moderate AMS

The signs and symptoms of Moderate AMS include:

- Severe headache that is not relieved by medication
- Nausea and vomiting, increasing weakness and fatigue
- Shortness of breath
- Decreased co-ordination (ataxia)

Normal activity is difficult, although the person may still be able to walk on his or her own. At this stage, only advanced medications or descent can reverse the problem. Descending only 300 meters (1,000 feet) will result in some improvement, and twenty-four hours at the lower altitude will result in a significant improvement. The person should remain at lower altitude until all the symptoms have subsided (up to 3 days). At this point, the person has become acclimatized to that altitude and can begin ascending again.

The best test for moderate AMS is to have the person walk a straight line heel to toe just like a sobriety test. A person with ataxia would be unable to walk a straight line. This is a clear indication that an immediate descent is required. It is important to get the person to descend before the ataxia reaches the point where they cannot walk on his or her own (which would necessitate a stretcher evacuation).

Severe AMS

Severe AMS results in an increase in the severity of the aforementioned symptoms including: shortness of breath at rest, inability to walk, decreasing mental status, fluid build-up in the lungs. Severe AMS requires immediate descent of around 600 meters (2,000 feet) to a lower altitude.

There are two serious conditions associated with severe altitude sickness; High Altitude Cerebral Oedema (HACO) and High Altitude Pulmonary Oedema (HAPO). Both of these happen less frequently, especially to those who are properly acclimatized. But, when they do occur, it is usually in people going too high too fast or going very high and staying there. In both cases the lack of oxygen results in leakage of fluid through the capillary walls into either the lungs or the brain.

High Altitude Pulmonary Oedema (HAPO)

HAPO results from fluid build-up in the lungs. This fluid prevents effective oxygen exchange. As the condition becomes more severe, the level of oxygen in the bloodstream decreases, which leads to cyanosis, impaired cerebral function, and death.

Symptoms of HAPO include:

- Shortness of breath at rest
- Tightness in the chest, and a persistent cough bringing up white, watery, or frothy fluid
- Marked fatigue and weakness
- A feeling of impending suffocation at night
- Confusion, and irrational behavior

Confusion and irrational behavior are signs that insufficient oxygen is reaching the brain. In cases of HAPO, immediate descent of around 600 meters (2,000 feet) is a necessary life-saving measure. Anyone suffering from HAPO must be evacuated to a medical facility for proper follow-up treatment.

High Altitude Cerebral Oedema (HACO)

HACO is the result of the swelling of brain tissue from fluid leakage.

Symptoms of HACO include:

- Headache
- Weakness
- Disorientation
- Loss of co-ordination
- Decreasing levels of consciousness
- Loss of memory
- Hallucinations & Psychotic behavior
- Coma.

It generally occurs after a week or more at high altitude. Severe instances can lead to death if not treated quickly. Immediate descent of around 600 meters (2,000 feet) is a necessary lifesaving measure. There are some medications that may be used for treatment in the field, but these require proper training in their use. Anyone suffering from HACO must be evacuated to a medical facility for follow-up treatment.

Prevention of Altitude Sickness

This involves proper acclimatization and the possible use of medications.

- Get at least two 8-hour nights of sleep, and make sure you're well hydrated before you start.
- If possible, don't fly or drive to high altitude. Start below 3,000 meters (10,000 feet) and walk up.
- If you do fly or drive, do not overexert yourself or move higher for the first 24 hours. You can help yourself acclimatize by camping at the trailhead.
- Climb slower than your normal walking pace. If you need to rest after ascending only 20 meters, you're flirting with exhaustion and need to slow down.
- If you go above 3,000 meters (10,000 feet), only increase your altitude by 300 meters (1,000 feet) per day, and for every 900 meters (3,000 feet) of elevation gained; take a rest day to acclimatize.
- Climb high and sleep low! You can climb more than 300 meters (1,000 feet) in a day as long as you come back down and sleep at a lower altitude.
- When your legs turn to stone or you feel nauseous, use pressure breathing. This is done by taking a deep breath and then forcing air out through pursed lips, like you're blowing out a candle, 3 or 4 times a minute. Vigorous respiration pushes more oxygen from the lungs into the bloodstream.
- If you begin to show symptoms of moderate altitude sickness, don't go higher until symptoms decrease.
- If symptoms increase, go down, down, down!
- Keep in mind that different people will acclimatize at different rates. Make sure everyone in your party is properly acclimatized before going any higher.
- Stay properly hydrated. Double your normal water intake. Acclimatization is often accompanied by fluid loss, so you need to drink lots of fluids to remain properly hydrated (at least four to six liters per day). Urine output should be copious and clear to pale yellow.
- Take it easy and don't overexert yourself when you first get up to altitude. But, light activity during the day is better than sleeping because respiration decreases during sleep, exacerbating the symptoms.
- Avoid tobacco, alcohol and other depressant drugs including, barbiturates, tranquilizers, sleeping pills and opiates such as dihydrocodeine. These further decrease the respiratory drive during sleep resulting in a worsening of symptoms.
- Eat a high calorie diet of primarily easily digestible carbohydrates in frequent, small amounts while at altitude. Carbohydrates help your body transport oxygen through your bloodstream. Limit your fat and salt, because these impede your already compromised ability to supply your body with proper amounts of oxygen.
- Remember: Acclimatization is inhibited by overexertion, dehydration, and alcohol.

Preventative Medications:

Acetazolamide (Diamox): This is the most tried and tested drug for altitude sickness prevention and treatment. It seems to work by increasing the amount of alkali (bicarbonate) excreted in the urine, making the blood more acidic. Acidifying the blood drives the ventilation, which is the cornerstone of acclimatization. For prevention, 125 to 250mg twice daily starting one or two days before and continuing for three days once the highest altitude is reached is effective. Blood concentrations of acetazolamide peak between one to four hours after administration of the tablets.

Studies have shown that administration of acetazolamide at a dose of 250mg every eight to twelve hours before and during rapid ascent to altitude results in fewer and/or less severe symptoms (such as headache, nausea, shortness of breath, dizziness, drowsiness, and fatigue) of acute mountain sickness (AMS). Pulmonary function is greater both in subjects with mild AMS and asymptomatic subjects. The treated climbers also had less difficulty in sleeping.

Gradual ascent is always desirable to try to avoid acute mountain sickness but if rapid ascent is undertaken and acetazolamide is used, it should be noted that such use does not obviate the need for a prompt descent if severe forms of high altitude sickness occur, i.e. pulmonary or cerebral oedema.

Side effects of acetazolamide include: an uncomfortable tingling of the fingers, toes, and face; carbonated drinks tasting flat; excessive urination; and rarely, blurring of vision.

On most treks, gradual ascent is possible and administration of acetazolamide tends to be discouraged. Certainly if trekkers do develop headache and nausea or the other symptoms of AMS, then treatment with acetazolamide is fine. The treatment dosage is 250 mg twice a day for about three days. A trial course is recommended before going to a remote location where a severe allergic reaction could prove difficult to treat if it occurred.

Other treatments/medicines used for prevention of altitude sickness include:

Ibuprofen: Ibuprofen can be effective in relieving altitude-induced headache. (600mg three times a day).

Ginkgo Biloba: Some studies show that the herbal remedy ginkgo biloba helps increase oxygen uptake. In a recent double-blind, placebo-controlled study, 40 volunteers who lived at 1400m (4,597 ft) were taken rapidly to 4300m (14,110 ft) and spent the night. Compared to those taking placebo, subjects taking ginkgo had half the incidence of AMS symptoms, and those on ginkgo who did become ill had far milder symptoms. The recommended dosage of ginkgo biloba is 120 mg orally twice a day, starting 5 days prior to the ascent, and continuing at altitude.

Antioxidant vitamins: Taking antioxidant vitamins (A, C, and E) also helps reduce the effects of high altitudes.

Conditioning: Working out before you go is another great preventative measure. While this doesn't guarantee an easier time when up high, it can enhance your lungs' ability to cope with the challenges of high elevations

Antacids: Some believe that the use of an antacid tablet would be beneficial, though this is open to debate, since antacid tablets are designed to alter the acid/base balance in the stomach, not necessarily in the bloodstream. According to the Merck Manual, antacids are useless for prevention of altitude sickness.