



THE UNITED STATES OLYMPIC COMMITTEE

Altitude and the Body

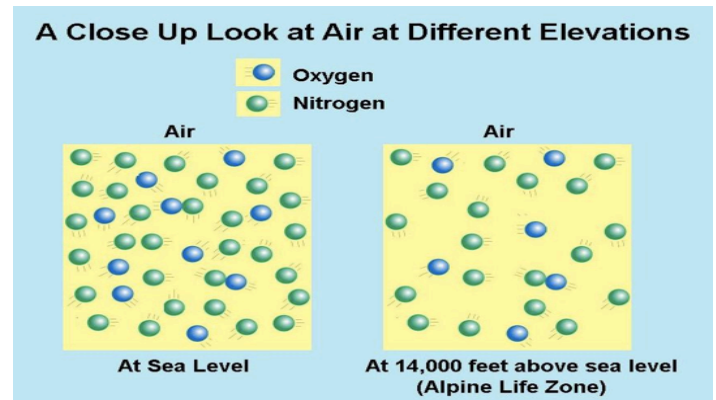
At higher elevations (defined as >5,000 feet), oxygen molecules are more spread out than they are at sea level. As a result, you inhale and deliver less oxygen to working tissues per breath of air. This causes a cascade of events and takes time for the body to adapt to the new conditions. It decreases performance significantly at first, but over time altitude training can be beneficial for athletes if they are competing in areas of high elevation or striving for specific training adaptations.

Over a period of time (depending on the person and the elevation), the body adapts to lower levels of oxygen by using less oxygen for the same amount of work. Altitude training also improves performance at sea level. This can be especially beneficial for endurance sports, high intensity team sports, and anaerobic sports like track sprinting or mogul skiing, especially if they compete at altitude.

Effects of Altitude Exposure

Initial Effects (within the first 72 hours)

- ↑ Iron needs
- ↓ Restful sleep (breathing pattern changes)
- ↑ Risk of dehydration (frequent urination)
- ↑ Headaches
- ↑ Reliance on stored carbohydrate (glycogen)
- ↑ Resting metabolism and ↓ appetite (weight loss)
- ↑ Adaptive pro- and anti-inflammatory responses



Key Points

Be prepared for the additional stress altitude can place on the body before traveling to or competing at altitude. Make sure to:

1. Be well rested and healthy (no cold or flu).
2. Know iron status and treat if iron deficient.
3. Eat enough calories and carbohydrates to support the additional stress of altitude.
4. Effectively manage training load by minimizing high intensity training in the first few days at altitude.

Effects of Acclimatization

Following 2-3 weeks training at altitude

- ↑ Oxygen-carrying capacity of blood
- ↑ Efficiency of oxygen utilization in muscles
- ↑ Formation of new blood vessels
- ↑ pH regulation = ↑ exercise tolerance
- ↓ Heart rate
- ↑ Red blood cell volume for 10-14 days after leaving altitude



“Sleep High, Train Low”

This method of altitude training can be done by:

1. Living at lower elevations and sleeping in an altitude-simulating chamber or tent
2. Living at a high elevation, but traveling to sea level to train
3. Living at a high elevation, but using supplemental oxygen when training

Training at altitude limits the ability to perform high-intensity exercise, even when acclimated, which is why athletes tend to “sleep high” (to adapt to lower a oxygen concentration) but “train low” (to perform at a higher intensity).

Adapting to Altitude

The higher the altitude, the longer it will take to adapt. Evidence suggests that 97.5% of athletes are likely to benefit after 2 to 3 weeks of altitude exposure **if they are healthy, not overly tired, and not iron deficient before arriving**. Since energy needs increase, eat slightly more calories and carbohydrate to avoid weight loss (e.g. an extra snack or a little extra food at main meals). Using altitude training to deliberately lose weight is not recommended since it will interfere with the body’s ability to adapt effectively, and can compromise health. When acclimatizing, increase the training stimulus progressively. The last few days should be the hardest workouts!

Preparation Strategies for Travel to Altitude

1. Hydration

- Drink regularly throughout the day, in training, and in competition. Don’t wait until thirsty.
- Check morning urine color and body weight as well as bathroom frequency to monitor status.

2. Iron status

- Increase intake of lean beef, eggs, oysters, lean pork, tuna, lentils, beans, tofu, and fortified cereal.
- Get a blood test at least 6 weeks before leaving for altitude training to allow time to correct any existing deficiency. Particularly important for vegetarians and those with a history of iron deficiency.

3. Immune health

- Eat a variety of colorful fruits and vegetables (red, orange, yellow, green, purple, blue, white).

4. Metabolism

- Focus on eating 3 balanced meals and 2-3 protein-containing snacks per day.
- Consider adding a few extra servings of carbohydrate to your usual dietary intake.

5. Sleep

- Have a plan in place to prevent sleepless nights. For ideas, see a sport psychologist.
- Foods that may enhance sleep: tart cherry juice, herbal teas, lean meats, whole grains, nuts.
- Foods that negatively affect sleep: caffeine, alcohol, fried food, high-calorie meals close to bedtime.

Athlete Recommendations: