Altitude Training Fact Sheet

Background

Much of the original anecdotal evidence in support of altitude training originates from the successes of the East African athletes at the Mexico City Olympics in 1968. Coming from altitude, these athletes were better able to cope with the difficult conditions for endurance performance in Mexico City (2,300m above sea level). While training at altitude improves beyond doubt competitive performance at altitude, it is less clear whether or not living and training at altitude provides an advantage for competitions held at sea level. While there is much anecdotal reports of the advantages of altitude training, well-controlled studies have found mixed results.

How it Works

The lower atmospheric pressure at altitude results in lower partial pressure of inspired and arterial oxygen making it more difficult to inspire oxygen. The reduced arterial oxygen levels stimulates the synthesis release of erythropoietin (EPO), which subsequently leads to an increase in red blood cell mass and haemoglobin concentration. These haematological changes may significantly improve an athlete's VO2 by enhancing the blood's ability to deliver oxygen to the exercising muscles. Altitude training ***may*** also result in favourable changes within skeletal muscle including increased concentrations of myoglobin, increased mitrochondrial number (the part of the cell where energy is produced aerobically) and increased mitrochondrial oxidative enzyme activity, all of which serve to enhance the rate of oxygen utilization and aerobic energy production. Increased hydrogen-buffering capacity of both the muscles and the blood, and subsequent improvements in performance, have been reported following altitude training. Thus both the aerobic and anaerobic energy systems are improved with athletic performance.

Disadvantages of Training at Altitude

Because of the reduced oxygen content of the air at altitude, training at the same intensity as at sea level is not possible. Reduced intensity and volume have the potential to reduce the fitness of the athlete, though with cleaver planning, a balance between the intensity of training and the exposure to altitude can be struck. There is a higher risk of infection and over-training at altitude, and close monitoring should take place. Additionally, the humidity at altitude is lower than at sea-level, and any athlete training to compete in endurance events in high-humidity environments should not carry out the last stages of their preparation at altitude. At least 10 days will be required to reacclimatise to humidity.

Current Practices

It is now believed that many of the benefits of altitude can be attained just by living or sleeping at altitude, and thus a method known as Live High-Train Low (LHTL), whereby athletes travel to lower altitudes to carry out all or some of their training. This procedure can also be stimulated by use of altitude tents or altitude houses. Other methods of altitude training include Live High-Train High, Live Low-Train High (e.g. use of altitude masks), and Live High-Train Higher.

Training at altitude

- It is likely to take up to 14 days to acclimatise to altitude on the first visit. Subsequent trips may take less time. Adjust training accordingly.
- Overall training volume should be reduced by 10-20% during the first week and increased gradually over 3 to 4 weeks.
- Intensity level of interval work should be reduced by approximately 5-7% initially, and again, increased gradually. Interval work in week 1 will be difficult and should be confined to 100m-200m efforts. These distances can be doubled in week 2 (i.e. 200m-400m) and doubled again in week 3. Use heat rate to determine recovery (eg return to 120 BPM).
- You'll need longer recovery between sessions. Take resting HR and reduce the intensity or duration of any planned exercise if this is more elevated than normal. Some of the benefits of altitude will be gained purely from living there, so don't fret if you have to miss a session.
- Exposure to an altitude of 2,100-2,500m, for at least 4 weeks is advised for maximal haematological response to altitude.
- Remember that there are huge individual variations in response to altitude. Listen to your body and don't measure yourself against others.

Staying Fit and Healthy at Altitude

The sun's UV rays are much stronger at altitude than at sea level even though the temperatures may be cooler. Always use sunscreen, wear sunglasses and avoid prolonged exposure to the sun.

The reduced effect of gravity at altitude may cause muscle wastage, though this is minimal at altitudes below 3,000m. Maintain resistance training at altitude to minimise muscle mass loss and ensure adequate energy intake.

Diet is very important when training at altitude. Since more oxygen is required to break down fat than carbohydrates, 80% of calories should be derived from low glycaemic carbohydrates. Meals should be taken every 4 hours. Increased carbohydrate utilization may result in glycogen store depletion, so a conscious effort should be made to replace carbohydrates during and after training. Carbohydrate-rich drinks and snacks are very important.

Some individuals may also experience reduced appetite. Small but regular meals, and eating a variety of fresh products may help. Apples and grapes in particular have natural chemicals which increase appetite.

Iron levels are also very, very important. Get you haemoglobin and haematocrit levels checked 4-6 weeks before you travel, and ensure that you take iron supplements with you if you think you might not have access to adequate red meat in your diet, or have issues with absorbing iron naturally.

Because of increased ventilation, increased urinary water loss, and low humidity at altitude, there is a high potential for dehydration. Caffeine-free fluids intake should be increased by as much as 4 litres per day. Morning urine colour should also be monitored to ensure that fluid needs are being met, and caffeinated products should be drank sparingly.

There is risk of immunosuppression, and a subsequent increased risk of upper respiratory tract infections (UTIs), at altitude. It is important that you listen to your body, ensure that you have adequate vitamins (A, foliate, B6, B12, C and E) and minerals (copper, selenium and zinc) in your diet, and replace carbohydrates quickly after exercise.

Some individuals may experience other side-effects to living and training at altitude. Stomach cramps and digestive system discomfort, difficulty sleeping, intense dreams and disrupted sleep are among the side effects of altitude, though they usually reduce with acclimatisation. Afternoon naps may help replace lost sleep at night.

Exposure to more extreme altitude (>3,000m) can induce acute mountain sickness. Extreme headaches, blunted appetite, nausea and vomiting, tiredness and dizziness are among the symptoms. Symptomatic athletes should omit or reduce training until recovered.

Interested in finding out more?

Wilber, R. L. *Altitude Training and Athletic Performance*, 2004, published by Human Kinetics