HIGH ALTITUDE and ATHLETIC TRAINING

The underlying problem with high altitude (>2000 m) is that there is less oxygen and while this may not be that threatening to individuals at rest it does pose a challenge to athletes. Of course for the pure anaerobic events no adaptation is required so this discussion is necessarily focused on endurance training and competition. In general the higher the altitude the longer it takes to adapt. Understanding the adaptation process and the things that you can do to aidit will make for a less taxing transition. A number of physiologic changes occur to allow for acclimatisation at high altitude. These can be divided into immediate, which take place over several days, and long term, which requires weeks to a few months.

The first thing that happens is your respiratory rate and heart rates speed up. This occurs both at rest and during sub-max. exercise. This helps offset the lower partial pressure of oxygen. You will not be able to reach your max. VO2 so don't get frustrated. The faster breathing rate changes your acid-base balance and this takes a little longer to correct.
The longer term changes are:

- a decrease in maximum cardiac output a decreased maximum heart rate
- an increased number of red blood cells
- excretion of base via the kidneys to restore acid-base balance. (Unfortunately, the net result is that you have less tolerance for lactic acid.)
- a chemical change within red blood cells that makes them more efficient at unloading oxygen to the tissues.
- an increase in the number of mitochondria and oxidative enzymes.

PRACTICAL IMPLICATIONS FOR ATHLETES

DIET

A high carbohydrate, low salt diet allows for better adaptation and less risk of "mountain sickness". Some people experience significant decline in appetite and the resulting loss of muscle mass may hinder performance. Iron is used to make haemoglobin and the demand for making more red blood cells may require iron supplementation -- especially in women and vegetarians. Mega-doses of vitamins are not helpful and are potentially dangerous.
Fluids - Because mountain air is cool and dry you can lose a lot of water so be sure to maintain adequate hydration.
Alcohol - It is best to avoid alcohol consumption during the acclimatisation period since it appears to increase the risk of "mountain sickness".

WORKOUT INTENSITY

This will necessarily be lower until adaptation can occur. Pushing your workouts too hard may increase your risk of over training or injury. Additionally some people just do not adapt as well as others. There is not one workout program that is appropriate for everyone-- just like at sea
level. It is best to keep a log in which you rate fatigue during workout and at rest, morning resting heart rate, weight, and mood. Correlate this with the intensity of your workouts and this will help mould a flexible routine that is right for you.

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PERFORMANCE

The body's adaptation to high altitude helps significantly but doesn't fully compensate for the lack of oxygen. There is a drop in VO2 max. of 2% for every 300 m elevation above 1500 m even after allowing for full acclimatisation. I know that this is a difficult concept to believe because so many programs have touted the benefits of high altitude training .To fully appreciate this realise that there aren't any world record times at high altitudes. Think about this a moment. The air density is much lower, thus wind resistance is much lower. Wind resistance is the cyclists biggest barrier to speed. If all other factors were equal, then there must be faster times at higher altitudes. Because there aren't, means that something else must have decreased. That something is the engine -- the human engine.
Furthermore, while adaptation to high altitude makes you better at high altitude it hasn't proved useful for making you faster at sea level. There is a lot of mysticism that surrounds the belief of enhanced sea-level performance after altitude training, but the current scientific evidence is lacking. The reason is that some of the adaptive responses at high altitude are actually a hindrance at lower altitude. As more research is done then perhaps a
training regimen that shows definitive improvement will emerge. The best advice as of 1994 is that high-altitude training is like "magic shoes" -- If it works for you then wear them.
There is some more recent evidence to suggest that a "train-low, sleep high" approach may confer some advantages. In this scenario, training is carried out at low altitude -- to push anaerobic threshold, and VO2 max. --but sleeping is done at high altitude so that the hypoxic stress increases red cell mass. Certainly a creative approach and one which might yield excellent results, because it may give the athlete the "best of both worlds". In a practical sense it may be difficult to construct, but if you are lucky enough to live in a situation that allows this type of training, it is worthy of consideration.

WHAT IS MOUNTAIN SICKNESS?

Mountain sickness is the name given to a cluster of symptoms that occurs in some people after rapid ascent to high altitude. Mild forms of the illness may affect up to 50% of people travelling to altitudes above 14,000 ft. Severe forms of the illness may be life threatening.

Symptoms of headache, malaise, and decreased appetite are fairly common amongst people travelling to altitudes greater than 8,000 ft -- although this can occur at lower altitudes.

The mild forms of mountain sickness can usually be treated with rest, hydration, analgesics (eg. ibuprofen), and alcohol avoidance.
If you are already experiencing these symptoms do not go to higher altitudes. There is a medication that can help prevent this illness.
People who have already experienced an episode of mountain sickness are at risk for future trips and should seek medical advice.

Severe forms are characterised by severe shortness of breath, cough, severe headache, confusion, or hallucinations. This may progress to coma and death. This is a medical emergency. Immediate descent to lower altitude, administration of oxygen, and medical attention are required.