

# **What Happens After Elite Athletes Come Back to Sea Level? The Time Course of the “Decay” of Altitude Training Adaptations and Timing for Major Competitions**

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## **Introduction / Purpose**

For most elite endurance athletes, properly executed altitude training holds the potential for significant performance enhancement. The primary mechanism behind the performance improvement appears to be a strong EPO response to altitude, followed by increased red blood cell production and increased oxygen delivery to working muscles.

A number of scientific studies have been completed in the last 15 years, designed to optimize how best to utilize altitude training. Excellent data is available suggesting / characterizing:

a) what altitude to live at, b) how long to stay at altitude, c) what altitude to train at, d) how best to control for ancillary factors, such as iron stores, e) the wide variation in strong or weak responders to altitude, and more. Yet, despite these great scientific efforts, data on what happens after the athlete returns to sea level is extremely thin. For the coach and athlete looking to appropriately utilize altitude and time an altitude camp prior to a major competition, the time course of the “decay” in the altitude acclimatization response is a very important variable.

## **Methodology**

This past spring, 7 members of our Indiana post-collegiate group completed a 28 day altitude training camp in Flagstaff, Arizona. For 4 weeks after return to sea level, the athletes were serially tested to determine the time course of changes in key physiological and mechanical variables related to race performance.

Below is a sample of physiological adaptations to altitude which change after return to sea level, which also have a strong potential effect on performance.

--Volume of red blood cells

Although a typical red blood cell has a life span of between approximately 90 and 120 days, the time frame of an augmented red blood cell count after altitude training is significantly shorter. Data will be presented on the time course of the decline in the volume of red blood cells after return to sea level, with a focus on the individual differences that exist on the time course of red cell “decay.”

--Ventilatory acclimatization

With altitude acclimatization, ventilatory drive gradually increases. This means that ventilation will be higher at any pace after altitude acclimatization. While at altitude, this is generally a

positive adaptation, helping to increase oxygen pressure in the lung, and helping to force more oxygen into the blood. However, to increase ventilation requires additional muscular work from the respiratory muscles. If the respiratory muscles work harder, they can “steal” blood flow away from the legs, which can be a negative for performance. Therefore, some of the increase seen in  $\text{VO}_2\text{max}$  after altitude training goes towards fueling the extra ventilation. Data will be presented showing how much of the  $\text{VO}_2\text{max}$  increase is “useful” for athletes, how much goes to ventilation, and how long does it take for the ventilatory acclimatization effects to “decay.”

#### --Running economy

There is debate within the scientific community as to whether altitude training causes changes in running economy. There is data to suggest that running economy improves after altitude training, as prolonged training at slower speeds while at altitude causes changes in mechanics which make the athlete more economical. There is also data to suggest that running economy is worse after altitude training, as the increased ventilation at any pace adds to the total muscular work being done by the athlete. Data will be presented showing running economy changes in our group, and the time course of changes after 4 weeks at sea level.

#### --Neuromuscular adaptations / turnover / mechanics

Many athletes, after an altitude training camp, indicate that they feel like they have “lost turnover” or feel “uncoordinated” running at fast speeds. Some scientists have theorized that the slower daily training speeds done while at altitude may be a cause of this sensation in many athletes. Whether this feeling is due to an actual change in neuromuscular recruitment patterns or running mechanics, or is simply a psychological phenomenon is unknown. Data will be presented on neuromuscular function and running mechanics testing in our group after altitude training.