EFFECTS OF HIGH ALTITUDE ON HUMANS

Sh. Partap Singh Saini

INTRODUCTION

The idea of training at high altitude for body's physiological changes gives advantage as a "natural blood doping" effect. As the red blood cell increases in volume due to a low availability of oxygen at high altitude. VO2 max also increases. As a result the performance improves at sea level. Sports training at high altitudes decrease the amount of oxygen getting to the muscles. A low atmospheric pressure in the thin air makes the blood less oxygen-rich as it travels to the muscles. Even for well-trained athletes, acute altitude sickness can result in pulmonary or cerebral edema, severe headache, nausea and vomiting, coughing, and swelling in the hands and feet. To complicate matters more, dehydration can be a serious problem at high altitude.

On the other hand, while adaptation to altitude will improve a runner's oxygen transport function, it does not necessarily mean faster running times at sea level. Claims to the contrary argue that since high altitude performance decreases, athletes cannot train at faster paces and therefore race times can actually suffer from high altitude training. The idea of "live high-train low" has developed out of the argument and expensive sleep chambers to induce high altitude conditions have become available. Sports medicine recognizes three altitude regions that reflect the lowered amount of oxygen in the atmosphere:-

High altitude =1,500–3,500 metres (4,900–11,500 ft)

When we refer to "high altitude", we generally mean 7,000 to 8,000 feet above sea level or higher. Low altitude is approximately 4,000 feet above sea level or lower. The human body can perform best at sea level, where the

atmospheric pressure is 1013.25 mill bars .The concentration of oxygen (O_2) in sea-level air is 20.9%, so the partial pressure of O_2 (pO_2) is 21.136 kPa. In healthy individuals, this saturates haemoglobin, the oxygen-binding red pigment in red blood cells In high-altitude conditions, our body draw in less oxygen per breath than you would at lower altitudes. That means less delivery of oxygen to your muscles. This may give like a negative effect, but living in higher altitudes and getting used to breathing "thinner" air can improve elite athletes' athletic performance at lower altitude. During sports training at high altitude, athletes feel like they are applying more effort to perform instead to sea level. The increased rate of perceived exertion is caused by altitude-induced hypoxia, which is a decrease in the amount of oxygen being delivered to the muscles. At high altitude, more red blood cells allows blood to carry more oxygen. When one compete at lower altitudes, one get a natural boost to the muscles when additional oxygen is available. This blood expanding effect can enhance performance in elite athletes by 1 to 2 percent. While that sounds like a tiny improvement. Traditionally, elite athletes have lived and trained at high altitudes, However, "live high, train low" program is the new concept.. Athletes should live and lightly train in high-altitude areas to acclimate their bodies to lower oxygen levels. But they should train harder and compete in lower altitude areas, where the muscles can work harder with the maximal amount of oxygen available for aerobic performance. To benefit, athletes must spend the majority of their time – 12 to 16 hours a day – at the sweet spot of around 8,000 feet above sea level. If they get too much higher, they can develop altitude sickness, lower plasma volume levels, and suffer inadequate sleep patterns. Training should occur around or below 4,000 feet above sea level.

Very high altitude= 3,500–5,500 metres (11,500–18,000 ft)

Humans have survived for two years at 5,950 m (19,520 ft) . This is the highest recorded permanently tolerable altitude. Travel to each of these altitude regions can lead to medical problems, from the mild symptoms of acute mountain sickness to the potentially fatal high-altitude pulmonary edema (HAPE) and high-altitude cerebral edema (HACE). The higher the altitude, the greater the risk.

Extreme altitude = above 5,500 metres (18,000 ft)

At extreme altitudes, above 7,500 m (24,600 ft), Atmospheric pressure decreases exponentially with altitude while the O_2 fraction remains constant to about 100 km, so pO_2 decreases exponentially with altitude as well. It is about half of its sea-level value at 5,000 m (16,000 ft. When pO_2drops, the body responds with altitude acclimatization High-altitude pulmonary edema (HAPE) and high-altitude cerebral edema (HACE). The higher the altitude, the greater the risk. Research also indicates elevated risk of permanent brain damage in people climbing to extreme altitudes.

Death zone

The death zone, in mountaineering, refers to altitudes above a certain point where the amount of oxygen is insufficient to sustain human life for an extended time span. This point is generally tagged as 8,000 m (26,000 ft, less than 356 mill bars of atmospheric pressure Many deaths in high-altitude mountaineering have been caused by the effects of the death zone, either directly (loss of vital functions) or indirectly (wrong decisions made under stress, physical weakening leading to accidents). In the death zone, the human body cannot acclimatize. An extended stay in the zone without supplementary oxygen will result in deterioration of bodily functions, loss of consciousness, and, ultimately, death Scientists at the High Altitude Pathology Institute in Bolivia dispute the existence of a death zone, based on observation of extreme tolerance to hypoxia in patients with chronic mountain sickness and normal fetuses in-uterus, both of which present pO_2 levels similar to those at the summit of Mount Everest.

Long-term effects

Studies have shown that the approximately 140 million people who live at elevations above 2,500 metres (8,200 ft) have adapted to the lower oxygen levels. Populations have better oxygenation at birth, enlarged lung volumes throughout life, and a higher capacity for exercise. A significantly lower mortality rate from cardiovascular disease is observed for residents at higher altitudes. Similarly, a dose response relationship exists between increasing elevation and decreasing obesity prevalence. This is not explained by migration alone. On the other hand, people living at higher elevations also have a higher rate of suicide. The correlation between elevation and suicide risk was present even when the researchers control for known suicide risk factors, including age, gender, race, and income

Acclimatization to altitude

The human body can adapt to high altitude through both immediate and long-term acclimatization. At high altitude, in the short term, the lack of oxygen is sensed by the carotid bodies, which causes an increase in the

breathing depth and rate. However, hyperpnoea also causes the adverse effect of respiratory alkalosis, inhibiting the respiratory centre from enhancing the respiratory rate as much as would be required. Inability to increase the breathing rate can be caused by inadequate carotid body response or pulmonary or renal diseases. In addition, at high altitude, the heart beats faster; the stroke volume is slightly decreased and non-essential bodily functions are suppressed, resulting in a decline in food digestion efficiency (as the body suppresses the digestive system in favour of increasing its cardiopulmonary reserves).Full acclimatization, however, requires days or even weeks. Gradually, the body compensates for the respiratory alkalosis by renal excretion of bicarbonate, allowing adequate respiration to provide oxygen without risking alkalosis. It takes about four days at any given altitude Full haematological adaptation to high altitude is achieved when the increase of red blood cells reaches a plateau and stops.

Suggested tips for handling high altitude:-

Take it easy on first day. Take a walk. Give time to adjust your body before taking on a full workout. Drink lots of water and juices to avoid dehydration when beginning travel to high altitude. Avoid alcohol and smoking. It depresses the normal breathing response to altitude. Do get a good sleep at night. And avoid sleeping pills.

Conclusion

However, it is not clear how long they should train at altitude or how high up they need to be to get the optimal benefits. There are limits to the benefits of training at high altitudes, which also increases levels of .hypoxia-inducible factor (HIF) in the body. By **training** at high **altitudes**, athletes can aim to allow their **bodies** to produce extra red blood cells.

References

1. Life's Little Mysteries Contributor, By Dan Peterson, WWW.active.com