

# Training at Altitude

# Hypoxic Training/Altitude Training

- Hypoxic training, sometimes referred to as altitude training, is a type of exercise that can help people enhance their athletic abilities and overall health.
- It can (and has) been used by a wide range of people to help in acclimatization at high altitudes with low oxygen levels in the air.
- Hypoxia, or low oxygen air, will present a significant challenge to the human body and hence give the best training environment.

# What are the advantages of hypoxic exercise?

- Regardless of the approach chosen, hypoxic training will bring several benefits.
- Because hypoxia - or exposure to low oxygen air - is such a difficult situation for the human body, it causes a variety of physiological responses.
- Increased capillarization, for example, allows for better oxygen supply to the tissues, muscles, and brain.
- The stimulation of fat metabolism is aided by a reduction in average heart rate and blood pressure.

# During hypoxic training, the following physiological effects have been seen.

- Oxygen uptake in the lungs is increased.
- The kidneys' synthesis of Erythropoietin Hormone (EPO) was increased.
- This increases the production of Red Blood Cells (RBCs) and oxygen delivery throughout the body.
- Greater oxygen flow to the tissues, muscles, and brain thanks to increased capillarization.
- Enhanced synthesis and rejuvenation of mitochondria (the cell's core for aerobic energy generation) and mitochondrial enzymes, allowing for more efficient oxygen usage and improved enzymatic anti-oxidative defence.
- Reduced heart rate and blood pressure on average
- Human Growth Hormone synthesis and release have increased.
- Fat metabolism stimulation
- Decreased oxidative stress from Free Radicals (Reactive Oxygen Species “ROS”)

# The science behind altitude training

- Because oxygen is our cells principal source of energy, exercising in low-oxygen environments may be extremely taxing on the human body.
- Even though there is less oxygen available, the body works to create the needed quantities of energy while it is in a condition of hypoxia.
- To compensate, a protein known as Hypoxia Inducible Factor (HIF-1) triggers a cascade of events.
- The goal of these processes is to improve the body's capacity to use oxygen. This is something that altitude training may assist with.

# Methods of training

The actual training methods are as follows:

- Exercising at altitude
- Sleeping in an altitude tent
- Intermittent Hypoxic Training

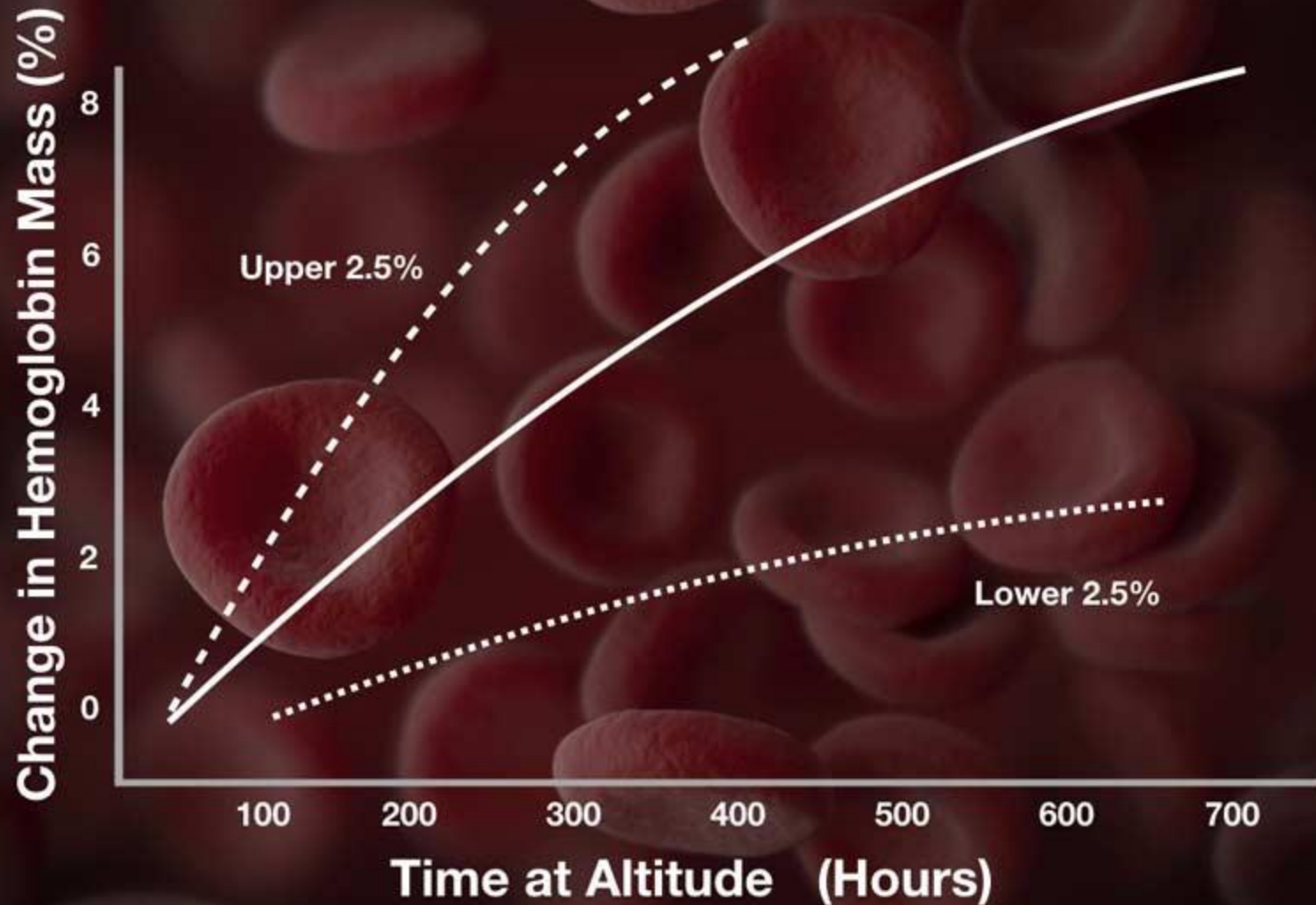
# 1. Exercising at altitude

- Exercising at a higher elevation improves muscle endurance and fitness.
- This is accomplished by high-intensity aerobic and anaerobic exercise.
- Athletes can get the best preparation for contests or sports by doing high altitude sports training in a condition of intermittent hypoxia.
- This will increase breathing economy and develop the body's capacity to stay saturated with oxygen while functioning at a high altitude.

- These exercise will leave you feeling less tired and allow you to recover faster.
- Low-oxygen training can help you enhance your repeated sprint performance, anabolic hormone responses, and red blood cell mass.
- After just 10 days of exercising at a simulated altitude of 8000ft/2500m, studies have shown that a 7.4% increase in VO<sub>2</sub>max and a 7.4% increase in mean maximum power output/kg bodyweight (Wmax) may be attained.



# Hemoglobin Mass and Altitude Training



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# So, what are the benefits of high-altitude sports training for you?

- VO2 Max and Lactate Threshold should be increased.
- Enhance Endurance and Stamina by increasing power output and speed.
- Reduce the time it takes to recover

## 2. Sleeping in an altitude tent

- Sleeping at altitude is the most popular and well regarded hypoxia training strategy.
- It was coined by Benjamin Levine and James Stray-Gundersen and is sometimes summarized as "Live High, Train Low."
- This training approach entails sleeping while being subjected to hypoxia (or low-oxygen air).
- Physical training activities will take place during the day.
- Due to the fact that these elevations are simulated, there is no need to go to or live in a higher altitude area.

# So, what is an altitude tent, exactly?

- It may be simple for someone who lives and exercises at higher altitudes, but for most people, living at or travelling to these heights is tough.
- With the use of an altitude tent, issues such as limited training load in oxygen deficient air, muscle loss, immune system suppression, advanced dehydration, and extreme tiredness may be avoided.
- By exposing you to hypoxia, these sleeping tents will aid in simulated training at an altitude.
- And, given the majority of health-conscious people and athletes live near sea level, this may be the best option.

### 3. Hypoxic Interval Training

- Intermittent Hypoxic Training, or IHT, is an altitude training approach that allows injured or healthy athletes to improve their performance.
- Athletes and other health-conscious persons can improve their fitness while avoiding injuries by practising at high altitude.
- It can also be used to aid in high-altitude pre-acclimatization.
- Short, intermittent hypoxic air inhalations in bursts of 3 to 5 minutes are used in IHT.
- This 10% O<sub>2</sub> hypoxic air replicates heights of up to 20,000 feet/6000 metres.
- These hypoxic air inhalations are interspersed with ambient air inhalations in bursts of 2 to 5 minutes.

# Intermittent Hypoxia Training: The Science

- These hypoxic and hypercapnic (higher CO<sub>2</sub>) cycles mimic a natural physiological training process.
- This training process happens throughout mammalian embryonic development to aid newborns in combating hyperoxia's first oxidative damage.
- An adult's protection against inevitable oxidative stress can be improved and the same impact can be achieved by reproducing this.
- Intermittent hypoxia training is a highly general training protocol, even though it is focused for wellbeing.

# IHT has the following advantages:

- Alzheimer's disease, diabetes, and cancer are examples of chronic and degenerative diseases that can be prevented and/or alleviated.
- The ageing process is being slowed.
- Overall health, wellbeing, and rejuvenation are improved.
- Patients with spinal cord injuries may benefit from intermittent hypoxic therapy.

# Training Modalities

- Athletes have employed altitude training to achieve physiological changes associated to acclimatization, which is thought to help them to increase performance both at altitude and at sea level.
- When training at high altitudes, various variables should be considered since they affect the intensity of the reactions: altitude level and time spent, intensity and training type, and characteristics such as past fitness level and individual responses to hypoxia and training.
- A variety of modalities combine a natural or manufactured hypoxic environment, continuous or intermittent hypoxia exposure, and various altitude levels.



# Modalities

- Living high-Training high (Hi-Hi)
- Living high-Training low (Hi-Lo)
- Living low-Training high (Lo-Hi)
- Intermittent Hypoxia Interval Training

# Traditional altitude training

- Athletes that participate in traditional altitude training, also known as LH-TH or Hi-Hi, live and exercise at moderate elevations ranging from 1,500 to 3,000 metres.

It has two techniques for measuring performance:

- The first is concerned with the acclimatization process and various system changes that promote oxygen transport and/or use.
- Hypoxia, on the other hand, serves as an extra training stimulus.

Despite the fact that traditional altitude training has been demonstrated to enhance performance in well-trained athletes, controlled studies including top athletes have found little benefit. To avoid overtraining or detraining, training intensities should be carefully evaluated and tailored to the person.

- Insufficient altitude, insufficient time, or a lower training load have all been blamed for the lack of a clear beneficial impact with Hi-Hi.
- Individual responses to the acclimatization process, such as erythropoiesis and an initial fall in aerobic performance capacity, as well as a transitory performance decline after returning to sea level, were also determined.

# Living high– Training low

- The Hi-Lo or LH-TL paradigm combines high-altitude living with daily training trips to lower elevations.
- It was designed to avoid the loss of training power and intensity that comes with altitude training.
- The athlete benefits from acclimatization effects by living high; by exercising low, the athlete maintains past training intensities and avoids the negative consequences of chronic hypoxia, such as muscle mass loss, weariness, and impaired aerobic performance.
- The strategy comprises living and sleeping at elevations between 1,800 and 2,800 metres, as well as transferring athletes to lower altitudes (1,300 metres) for training.

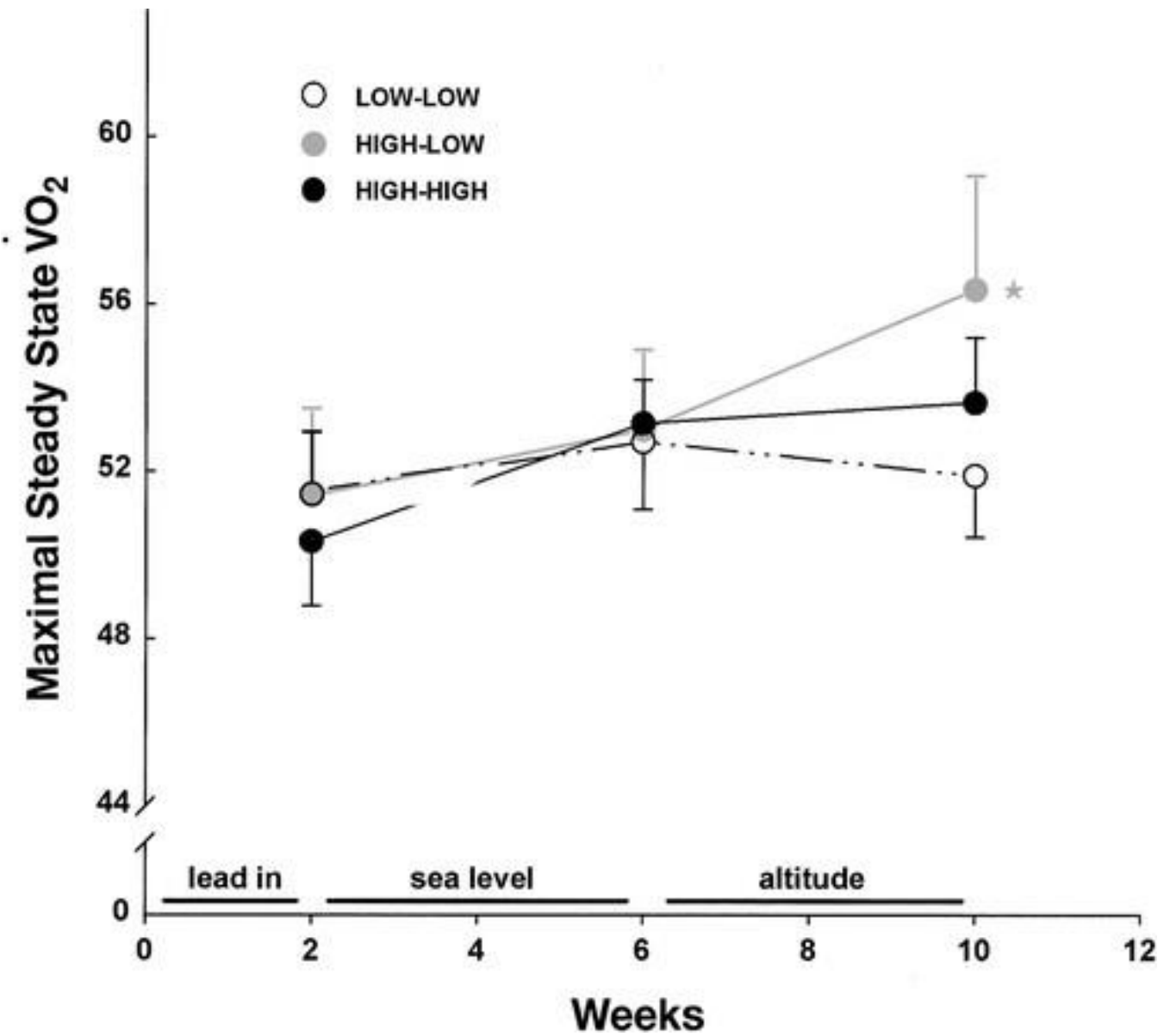
- Levine and his study group suggested his technique.

The athletes (runners) in the first research lived at 2,500 metres but trained at 1,300 metres for four weeks. When compared to the control group, they increased their VO<sub>2</sub>max by 4.3 percent and were 25 seconds quicker in a 5 km time trial. The same group analysed 39 runners in a second investigation.

- For four weeks, the athletes were divided into three groups: Hi-Hi (2,800 m), Hi-Lo (2,800 and 1,250 m), and living and training low (150 m) (Lo-Lo).
- Despite increases in EPO, RBC mass, and VO<sub>2</sub>max in both altitude groups, only the Hi-Lo group improved their time in the 5,000 m time trial as compared to pre-values.

- Traveling up and down the mountain every day to train at low elevations, spending one or two hours driving, and adapting to various weather conditions, however, causes tension and weariness in the athletes.
- New techniques have been investigated in light of these detrimental impacts on athletes as well as the increased financial expenditures.
- Two or three times a week, the Hi-Lo modality blends living and training at high altitudes (2,000-3,000 m) with high-intensity exercise at low altitude (1,250 m).
- Thirteen collegiate runners participating in the Hi-Lo regimen improved their endurance and VO<sub>2</sub>max to the same extent as the Hi-Lo group.

- The Hi-Lo idea was further changed as a result of technological advancements that allowed devices to offer artificial altitude without having to travel to the mountains.
- The artificial atmosphere can be generated in a building, room, or tent by obtaining hypobaric or normobaric hypoxia by nitrogen dilution or lowering ambient pressure.
- In hypoxia, subjects can sleep at night and relax during the day, which is similar to elevations of 2,000 to 3,500 metres.
- Sleeping in simulated hypoxia of 2,650-3,000 m for more than 3 weeks provided practical benefits to top athletes, according to Normobaric Hypoxia studies evaluated by Hahn et al.
- These advantages, however, are not the same because of the increased Hbmass or  $VO_2\text{max}$ , but rather, muscle buffer capacity and mechanical efficiency have adapted.





# Intermittent hypoxic exposure (IHE)

- Shorter hypoxic exposure has been tested to see if it improves performance.
- Intermittent hypoxic exposure (IHE) is described as a short-term or long-term hypoxic exposure that can be repeated over several days or weeks.
- Breathing normobaric or hypobaric hypoxic air comparable to an altitude between 5,000 and 6,000 m for 1.5–5 hours each day for 2–3 weeks is known as intermittent hypoxia at rest (IHR).
- It provides for a higher hypoxic stimulation, which is often well tolerated, because it is delivered at rest and for shorter periods of time.
- Intermittent hypoxic training (IHT), also known as LL-TH or Lo-Hi, is IHE mixed with hypoxia training.
- It is always at sea level in IHT athletes practicing under hypoxic circumstances.

**THANK YOU**