Different Altitude Training Protocols

Currently, the most popular form of altitude training by endurance athletes is the live high, train low (LHTL) model of altitude training. The two main forms of LHTL currently in use are natural LHTL (living at altitude and driving down to a lower altitude for training) and artificial LHTL (living near sea-level but spending significant time each day in an altitude chamber and training near sea-level). Other forms of altitude training currently practiced are live high, train high (LHTH - living and training at high altitude) and artificial live low train high (LLTH - live at altitude but spend significant time each day in a higher-oxygen chamber and train at altitude). Research has shown mixed results for the various forms of altitude training, which is why this topic is so popular to debate (Bonetti DL, et al., 2009; de Paula P, et al., 2012). A recent meta-analysis looked at 6 protocols of altitude training. The results of this important study showed that substantial improvement of endurance power output was likely with intermittent LHTL and continuous LHTL, and possible with artificial long continuous LHTL. These endurance enhancements were unclear with LHTH, artificial brief continuous LHTH, and LLTH. In elite athletes results only showed clear enhancement in natural LHTL, while the other training protocols were unclear. The study concluded that the current scientific research shows LHTL to be the most effective training enhancement to endurance performance (Bonetti DL, et al., 2009).

East African Dominance

The effect of high altitude on endurance training is a highly debated and researched topic among exercise scientists, coaches, and endurance athletes. The popularity of this topic is due in large part to the domination of endurance sports by athletes raised or living at high altitudes.
The possible effects of high altitude on performance improvement is especially evident in distance running, with athletes from Kenya and Ethiopia winning a disproportionately high number of medals in the last 5 Olympic Games. These accomplishments are listed below:

Total Medals in Distance Events of Last 5 Olympic Games - 53 of 90 have been won by Ethiopia and Kenya (Official Website of the Olympic Movement, 2013)

Breakdown of Medals:

Marathon (Men) - 8 of 15
Marathon (Women) - 6 of 15
10,000m (Men) - 11 of 15
10,000m (Women) - 9 of 15
5,000m (Men) - 9 of 15
5,000m (Women) - 10 of 15

What makes Kenya’s totals even more astounding is the fact that “75% of Kenya’s best runners come from just 1 of the country’s 40 tribes, the Kalenjin, who comprise approximately 10% of the total Kenyan population.” The Kalenjin tribe lives in the Great Rift Valley, a high altitude region of Kenya, located at an elevation between 6,000ft and 8,000ft above sea level. In addition, the top training camp for elite Kenyan distance runners is located in Iten, Kenya at an elevation of approximately 8,000ft. above sea level. Most top Ethiopian distance runners come from a similar high altitude area called the Arsi tribal region and secondarily from the Shewa tribal region. Both of these regions are also located in the Great Rift Valley. The city of Addis Ababa is the capital of Ethiopia and also the training capital for the best Ethiopian distance runners. Addis Ababa is located at an elevation of approximately 7,700ft. Even greater altitudes are used for training in the nearby Entoto Hills, which reach an elevation of approximately 10,000ft. above sea level (Wilbur RL, et al., 2012). Not only do Kenyan and Ethiopian runners take advantage of these training camps, but some of the top American and European distance runners also spend time training in these locations as evidenced by this video: [http://www.youtube.com/watch?v=9kFF71MT5tE](http://www.youtube.com/watch?v=9kFF71MT5tE). Many factors have been theorized as having a major influence on the success of Kenyan and Ethiopian distance runners, but living and training at high altitude is one of the most scientifically tested and most agreed upon influences (Wilbur RL, et al., 2012). The most recent scientific knowledge may point away from LHTH being the most effective form of altitude training (Bonetti DL, et al., 2009). However, there are studies which point to different adaptations arising in Kenyans, Ethiopians, and possibly other residents of high elevation. A recent study shows that longterm adaptations may have occurred in Kenyans and Ethiopians due to a combination of chronic exposure to altitude, along with a LHTH lifestyle (Wilbur RL, et al., 2012).
1. High Altitude Endurance Training:
Other countries, such as the United States, have tried to recreate the success of the Kenyans and Ethiopians by instituting high altitude training camps and basing professional running groups in areas with high elevation available. The majority of professional distance running teams in the U.S. are based at or within close proximity of moderate altitude, as listed below:

American Distance Project - Colorado Springs, CO - 6,035 ft. elevation: [http://www.americandistanceproject.com/Index/Welcome.html](http://www.americandistanceproject.com/Index/Welcome.html)


- Elevation over 4,000-ft. within 50 miles


Furman Elite – Greenville, SC – 1,000 ft. elevation: [http://www.runfurman.com/](http://www.runfurman.com/)

- Elevation of 3,500-ft. within 30 miles


- Elevation of 4,500-ft. within 25 miles

Team Indiana Elite – Bloomington, IN – 771 ft. elevation: [http://www.teamindianaelite.com/](http://www.teamindianaelite.com/)


In addition to the high proportion of high altitude running groups, all 3 of the U.S. Olympic Training Centers are also located at or within close proximity to high elevation, which are listed below:

- Lake Placid, NY – 1,801 ft. elevation: [http://www.teamusa.org/About-the-USOC/Training-Centers-and-Sites/Lake-Placid](http://www.teamusa.org/About-the-USOC/Training-Centers-and-Sites/Lake-Placid)

Though there is scientific research available detailing the different forms of high altitude training, elite runners use a variety of forms. As evidenced in the previously discussed meta-analysis, the verdict is still out on whether there is a best form of high altitude training for everyone (Bonetti DL, et al., 2009). This research, coupled with the individual nature of distance running training, has led elite runners and coaches to incorporate high altitude training in a variety of ways. In the videos below, some of the top distance runners and coaches weigh in on what forms of high altitude training have led to their success.

Damon Martin (Head Cross Country/Track Coach of Adams State College in Alamosa, CO - Elevation 7,500+ft.):


Jack Daniels (World-Class Coach)

Credentials: [http://www.runnersworld.com/race-training/coach-class-jack-daniels](http://www.runnersworld.com/race-training/coach-class-jack-daniels)


Ryan Hall (World-Class Marathon Runner)
1. High Altitude Endurance Training:

Credentials: http://www.usatf.org/Athlete-Bios/Ryan-Hall.aspx
http://www.youtube.com/watch?v=MpMEHaMSkQI

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