# The Surprising Aerobic Benefit of Sprinting

If you've been involved in running for any length of time you have surely been exposed to the concepts of aerobic and anaerobic training. These two terms are firmly entrenched in the running community, having been in use for more than 50 years. So strong is the belief in the concept of aerobic and anaerobic training zones that some programs are founded on the distinction between these two types of training. The dominating belief in these concepts has caused scientists to continue their investigation into the changes within the body accredited to these two concepts. Scientists have continued to attempt to unravel the changes occurring within the body as a result of both aerobic and anaerobic training, accumulating a large body of research on these two concepts.

Readers familiar with Power Running already know that, based on research, I believe the concepts of aerobic and anaerobic training are inaccurate and do not account for endurance performance. I propose that muscle factors, not oxygen processing factors, truly determine endurance performance. That being said, I remain in the minority in the running community; most runners continue to cling to the belief that aerobic and anaerobic factors play the dominant role in endurance performance. Since many runners continue to make a distinction between aerobic and anaerobic training and some popular programs attach great importance to this distinction it is appropriate to review some recent research on the effect of anaerobic training. Specifically, we will review a 2005 study that examined the aerobic benefits of sprint training and the implication of this research to those training programs that have their foundation built upon the belief that aerobic and anaerobic training produce widely different changes within the body.

## Distinguishing Between Aerobic & Anaerobic

While most mainstream endurance training programs make a distinction between aerobic and anaerobic training, some prominent programs go so far as to suggest that these distinctions are critical. Typically known as "base building" programs they teach that aerobic and anaerobic training must be done in separate stages of training. Perhaps the most famous of the base building proponents is famed coach Arthur Lydiard. In his book Running to the Top Lydiard writes, "You concentrate initially for several months on purely aerobic running. Fast aerobic running if possible, keeping the effort just below that point where it can overbalance into anaerobic running. You must do as much of this aerobic running as you can." "Anaerobic work must not enter the conditioning phase…" and "Keep always in mind that you can never run too slowly but you can run too fast."(1)

Some base building proponents even go so far as to suggest that excessive anaerobic training actually degrades aerobic capacity. Dr. Phil Maffetone, who has worked with world champion triathletes Mark Allen and Mike Pigg, writes in his book Training for Endurance "Anaerobic work can dramatically interfere with aerobic and endurance development." He goes on to say that, "…if you're knowingly or unknowingly sneaking in some anaerobic work, you risk slowing or stopping the base building process."(2).

Hadd, in his famous LetsRun.com document, writes that "…there is a huge improvement in performance that can be made from purely aerobic training, if you get it right." What is that right way that produces huge improvements? Hadd explains that you must run at easy, aerobic paces in order to build a base. "…you must work BELOW (slower than) the pace at which your LT (lactate threshold) currently turns. No pain, no gain, doesn't work with LT training." "…train too fast, they won't happen."

The point of the above is that it is believed by many that aerobic changes cause positive changes within the body that are different from those changes caused by anaerobic training. These changes require that a period of training be devoted exclusively to aerobic training. Furthermore, some suggest that anaerobic training interferes or even degrades aerobic development.

With this understanding of the distinction between aerobic and anaerobic training and why this distinction is considered important in some programs, let's have a look at the most recent research on this topic.

## Research

As noted above, scientists have conducted numerous studies of the physiological changes that occur in conjunction with both aerobic and anaerobic training. In recent years, research on anaerobic research has revealed that repeated sprints have a surprising high aerobic component. The research evidence suggested that improvements in aerobic energy metabolism could be stimulated by brief bouts of high intensity training (i.e. sprints). However, none of the sprint data indicated whether sprint training would lead to improvements in primarily aerobic events. Therefore, a group of researchers at McMaster University in Canada decided to "examine the effect of six sessions of sprint interval training on muscle oxidative potential, VO2peak, and endurance time to fatigue during cycling at an intensity equivalent to ~80% VO2peak."(3)

Sixteen healthy individuals participated in the research – eight assigned to the training group and eight assigned as controls. All of the subjects were recreational active who participated in some form of exercise two to three times per week (running, cycling, aerobics), but none were involved in a structured training program. The subjects were given a battery of tests to establish a baseline and then performed familiarization trials to become oriented to the

testing procedures and training equipment. As part of their pre-training testing, subjects were also given an endurance test to exhaustion at an intensity of ~80% VO2peak.

Training consisted of six sessions of sprint intervals spread over 14 days. Each training session consisted of repeated 30 seconds of all out sprints on a cycle ergometer with 4 minutes of rest between each sprint. Training was conducted three times per week on Mondays, Wednesdays, and Fridays. The number of sprints increased from 4 to 7 over the first five training sessions and on the final session subjects completed 4 intervals.

## Results

After training, individual improvement in cycle endurance ranged from 81% to 169%. However, one subject's performance declined 16% due to sustaining an ankle injury unrelated to the experiment. "Even with the inclusion of this subject's data, the mean increase in cycle endurance time to fatigue for the training group was 100% compared with baseline (51 ± 11 vs. 26 ± 5 min; $P < 0.05$)." Pre-sprint training the subjects managed 26 minutes on the cycle ergometer before reaching fatigue. Post sprint training the subjects average 51 minutes til exhaustion. One subject improved from 50 minutes pre-sprint training to 120 minutes post sprint training. The researchers also found that muscle oxidative potential increased 38% after training.

## Discussion

The really interesting thing about this study was the finding that six sessions of sprints both doubled time to fatigue during aerobic activity and increased the oxygen capacity of the muscles. Increasing from a max of about 30 minutes of endurance performance to a max of about 1 hour of endurance performance is a startling change - especially considering that 30 min - 1 hour of exercise at 80% VO2max clearly falls in the "aerobic" range of training. In their discussion of the impressive increase in endurance performance the researchers had this to say:

> "Several studies have reported increases in VO2peak after 14-24 sprint interval training sessions performed over 2-8 wk. Aside from these observations, however we are aware of no data that suggest sprint training leads to an increased capacity to perform exercise that is primarily aerobic in nature. In the present study, we decided to employ an endurance capacity test in the form of cycling at ~80% VO2peak, a task in which the vast majority of energy is supplied from oxidative metabolism. Our data show that aerobic endurance capacity was dramatically improved after only six sessions of sprint interval training, despite the fact that VO2peak remained unchanged. Indeed, exercise time to exhaustion more than doubled in six of eight subjects who performed the training

> intervention and the mean performance improvement was 100%...To our knowledge this is the first study to show that short sprint interval training dramatically improves endurance capacity during a fixed workload test in which the majority of cellular energy is derived from aerobic metabolism."

The researchers also noted that the 38% increase in muscle oxidative potential was unexpectedly high and was similar to that found from traditional endurance training programs. "Moreover, the increase…in the present study is comparable to that reported by some authors after 6-7 days of traditional endurance exercise training (i.e., 2 h/day at ~65 VO2peak)."

Consider the results of this study in the context of the quotes from Lydiard, Hadd, and Maffetone above. Lydiard, Hadd and, especially Maffetone, preach that a base building phase is necessary to build aerobic capacity and that anaerobic work interferes with or detracts from continued development of the aerobic capacity. However, this study shows that not only does anaerobic work (i.e. sprints) not negatively impact aerobic performance, it actually dramatically improved the aerobic performance of these individuals.

Dr. Ed Coyle, chair of the Kinesiology & Health Education department at the University of Texas, had this to say in response to this study:

> "The findings…challenge the concept that aerobic endurance performance is only enhanced by aerobic endurance training. On the surface, this concept seems logical, but it has been long ago proven wrong both in the realm of athletics as well as in muscle biochemistry. In athletics, this concept is not generally held by elite athletes competing in middle-distance running because they incorporate sprint interval training to improve aerobic endurance."(4)

Note that the results of this study do not negate the belief in the necessity of base building. Base building may be necessary and beneficial – this study doesn't address this point – but this study does indicate that the physiological reason traditionally given for the need for base building (i.e. base building is required to build aerobic capacity) needs to be re-evaluated. Indeed, since anaerobic work improves aerobic capacity then the traditional physiological reason for the need for base building (to build aerobic capacity) is seriously in question. The point is that base building may be necessary and required for optimal performance but the traditional physiological explanation of the benefits of base building likely needs to be changed.

## Summary

Six sessions of 30 second, all-out sprints over a two week period resulted in a doubling of endurance time to exhaustion and an impressive increase in muscle oxidative potential. These results stand in stark contrast to the traditional physiological explanation for the need for a base building phase and also challenge the belief that anaerobic exercise diminishes or negates the positive effects of aerobic training. The 100% improvement in endurance capacity shows that anaerobic training (i.e. sprints) can dramatically improve aerobic capacity and exercise performance in events that are primarily aerobic in nature.

## References:

1. Lydiard A, Running to the Top, *Meyers and Meyers Sport*, 1995, pgs. 41, 78, & 105
2. Maffetone P, Training for Endurance; Guide for Triathletes, Runners, & Cyclists *David Barmore Productions*, 1996, pg 78
3. Burgomaster K, Hughes S, Heigenhauser G, Bradwell S, Gibala M. Six Sessions of sprint interval training increases muscle oxidative potential and cycle endurance capacity in humans *J Appl Physiol* 98: 1985-1990, 2005
4. Coyle, E. Very intense exercise-training is extremely potent and time efficient: a reminder *J Appl Physiol* 98: 1983-1984, 2005