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The older I get.. the faster I was.. does muscle efficiency improve year on year with consistent training? Taken from:

Santalla, A. Naranjo, J. Terrados, N. (2008). **Muscle Efficiency Improves Over Time in World-Class Cyclists.** Medicine & Science in Sports & Exercise.

It's commonly believed amongst athletes that once you have several years of training under your belt, it's much easier to maintain your fitness and perform at a higher level. We commonly see athletes gaining success after many years of competition as if there may well be a physiological maturation or long term change essential for success. Certainly, it appears that athletes with several years of training and racing to their name are more able to take time off due to injury and return to the same level relatively easy. Based on this, you would presume that there is some kind of accumulative effect which occurs year after year, giving benefits to the athlete.

Santalla et al compared testing data for 32 world class cyclists over a 5 year period. The cyclists completed the same test using the same equipment at the same time every season and amongst them were winners of the Tour De France, Vuelta, UCI World Ranking and World Time Trial Championships. The researchers were interested in 2 key factors:

1. VO2 maximum
2. Muscle economy

Muscle economy is simply the amount of energy required to perform a specific amount of work e.g. how many calories are used to ride at 20mph. Essentially this is the cyclist version of 'miles per gallon'. The researchers specifically wanted to measure changes in economy over the 5 year period and for this purpose they chose to measure delta efficiency (DE).

What is Delta Efficiency?

Delta efficiency can be defined as the 'ratio of change in work against the change in energy expenditure'.

Scenario: A rider producing 200 watts of power in a time trial increases to 300 watts of power and as a consequence their energy consumption increases from 750 kcal/hr to 1000kcal/hr. A 50% increase in speed (200-300 watts) resulted in a 20% increase in energy consumption (800-1000kcal/hr).

Delta efficiency is generally calculated to give a single percentage figure. In an ideal world riders would increase their power output by the largest possible amount in return for the smallest possible increase in energy consumption. If the single percentage figure is 'higher' during repeat testing this means they are able to produce more power for a smaller change in energy consumption and vice versa.

A very famous study published by Edward Coyle in 2005 used changes in delta efficiency to explain the tour winning exploits of Lance Armstrong, this paper generated much discussion relating to economy and the reasons for such changes.

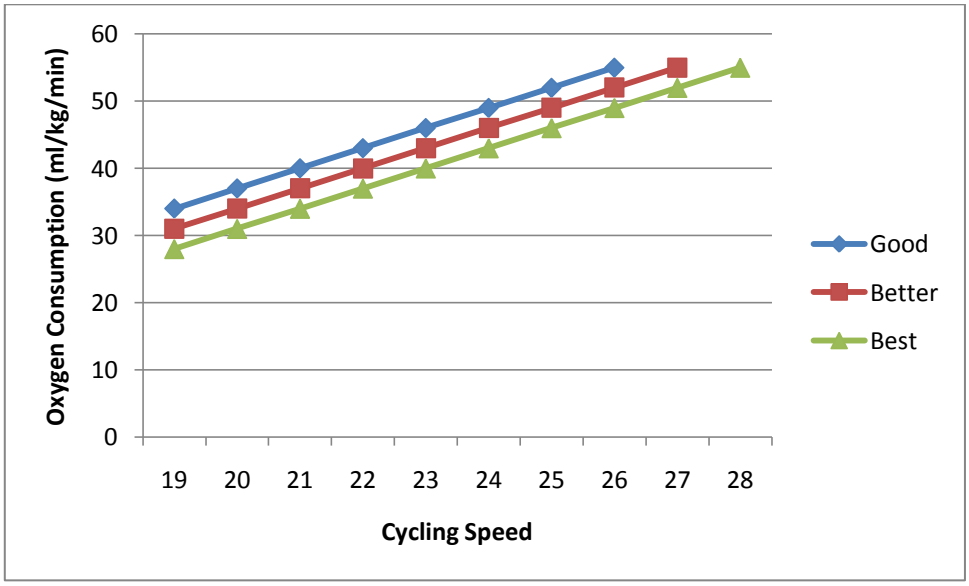
What did our researchers find?

In simple terms they found VO2 max to be unchanged over the 5 year period which supports most research in this area. More importantly DE increased from 23.61% to 26.97% over the 5 year period. This means that the riders were able to produce more power for the same change in energy consumption, that's faster riding for the same amount of fuel.

What does this mean?

As you accumulate years of training there may well be some kind of physiological adaptation which enhances performance by improving economy. Muscle fibre changes are the most commonly given explanation, this is supported by the fact that athletes with slow twitch fibres tend to have much better delta efficiency scores.

The improvement in delta efficiency can also compensate for reduction of VO2 max in older athletes. Consider the 3 riders below, all of them have the same VO2 maximum of 55 ml/kg/min but they are very different with regards to economy. The 'best' rider consistently uses less oxygen (and therefore less kcal/hr) at all cycling speeds and as a consequence is able to ride at 28 mph before finally reaching their VO2 max, the other 2 riders reach their VO2 max at 26 & 27 miles per hour respectively. This clearly shows that VO2 maximum is not necessarily the predictor of performance, it's how long it takes to reach it..



If nothing else this article has made me feel slightly more optimistic about the approaching years.. at 37 I've got a few years left I think!

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