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Removing the deficit.. why warming up before competition is so important, taken from:

Hajoglou, A (2005) **Effect of Warm-Up on Cycle Time Trial**. Medicine & Science in Sport and Exercise.

It is common knowledge that a 'warm up' before exercise is important but the reasons for warming up and the potential benefits to performance are not well publicised. The most commonly quoted reason for warming up is to avoid injury, but in sports such as cycle time trial, there's little chance of a muscle strain due to lack of warm up (sticking my neck on the line with a controversial statement).

The real reason for warming up prior to a cycle time trial is to enhance blood flow and oxygen supply to the working muscles. Oxygen is required for the aerobic system to work effectively and without enough oxygen the muscles are forced to rely upon 'anaerobic energy' which results in lactic acid production.

VO_2 kinetics – What is it?

When we start exercising our **aerobic** system is very slow to activate. It is 'lazy' and takes a few minutes to wake up and start functioning correctly. As a result of this, there is a lack of oxygen for the first few minutes of exercise and this is termed the 'oxygen deficit'.

By contrast, the **anaerobic** system is able to respond very quickly and at the start of exercise it 'fills the gap' in energy provision by supplying the muscles with energy whilst the aerobic system slowly lurches into action. Once the aerobic system is up and running, the anaerobic system can hand over the duties of energy production.

The lack of oxygen at the start of exercise and the subsequent 'gap filling' by the anaerobic system, results in lactic acid production for the initial few minutes of exercise. This is one of the reasons why exercise often feels hard when starting and we then reach a point commonly referred to as the 'second wind' (4-6 minutes) after which we feel much more comfortable.

VO_2 kinetics – Things to consider

The speed at which the aerobic system wakes up and responds to exercise is critical for performance. If it takes a full 5 minutes to adjust at the start of a cycle time trial, lactic acid will be produced in high quantities for the full 5 minute period. By contrast, if the aerobic system takes only 1 minute to respond to exercise, we will produce lactic acid for only 1 minute, thereby produce a much smaller quantity.

The intensity at which we start exercising is also very important for VO_2 kinetics. If a rider starts their 10 miles time trial at a fast pace, this would require a very large amount of energy. If the aerobic system is slow to wake up, the large energy demand must be matched by the anaerobic system, leading to a huge amount of lactic acid being produced.

The worst case scenario in a cycle time trial is a rider with very slow VO_2 kinetics starting very quickly! This would result in a large energy demand being met by the anaerobic system and inevitably, the rider would struggle to hold pace for very long due to excessive lactic acid production, thereby struggling in the second half of the event.

This scenario can also be applied to 'cycle road racing', if the pace suddenly increases as the peleton reach a long hill, the rider's energy demand is increased. If the rider has poor VO_2 kinetics they will rely on their anaerobic system to 'fill the gap'. Whilst the rider might remain in touch to the crest of the hill, if the pace increases again with little opportunity to recover, the back door is open and the race is over.

Benefits of warm up

The researchers aimed to identify the benefits of warming up upon 3000m cycle time trial performance. The subjects completed 3 different trials:

1. No warm up beforehand
2. Moderate warm up (15 minutes as 5 minutes @ 70/80/90% of ventilatory threshold)
3. Hard warm up (15 minutes as 5 minutes @ 70/80/90% of ventilatory threshold followed by 3 minutes at Respiratory Compensation Threshold)

**Ventilatory threshold is the point at which breathing rate increases faster than oxygen usage. As lactic acid is produced the body will buffer it with specific substances in the blood and the buffering process leads to carbon dioxide production. The sudden increase in breathing is to remove excess carbon dioxide and not take in extra oxygen.*

**Respiratory compensation threshold is a second threshold point at which breathing rate increases further in an attempt to remove the increasingly excessive level of CO_2 and maintain a normal blood ph. At this stage the breathing will generally feel out of control and exercise cannot be sustained for more than a short period of time.*

The results

There appeared to be no significant difference between the moderate and hard warm up, but both showed a significant improvement in time trial performance when compared against the 'no warm up' protocol.

The researchers measured the amount of oxygen consumed during the 3000m time trial and it was noticeable that oxygen uptake was higher during the early stages of the time trial following a warm up period. This indicates that VO_2 kinetics improved following the warm up period and the aerobic system adjusted more quickly, allowing greater oxygen usage, thereby relying less upon the anaerobic system.

Conclusion

Before completing events such as 10 miles TT it is essential that riders warm up effectively. This encourages efficient VO_2 kinetics, helping to avoid excessive oxygen deficit and excessive lactate accumulation.

Some people think that a warm up period may hinder their performance by tiring them before the start but this is not the case unless the pre-race protocol involves an excessive amount of riding. We suggest a warm up similar to that carried out in this research, start with 5 minutes of easy riding, increase the intensity for a further 5 minutes to 'moderate' intensity and finish with 5 minutes of riding at a pace just below your time trial speed. Do not allow yourself to cool down, aim to finish the warm up and start within 2-3 minutes.

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