THE ENDURANCE COACH.COM

Does hip angle alter cycling performance and subsequent running performance?

We recently completed a study to examine the effects of 'hip angle' during a cycle time trial upon subsequent running performance and the results gave us some fascinating data. The study identified initially how a 'closed or reduced hip angle' affects pure cycling performance and then there is the additional focus of how it affected the run to follow.

Methodology

The protocol was simple, riders visited us on 2 separate days (week apart) to complete 2 separate 20 minute cycle time trials on an 'SRM ergometer', for the first time trial half the subjects rode with a hip angle of 45 degrees and on the second trial they rode with a hip angle of 75 degrees, the other half of the subjects did vice versa, starting with 75 degrees and finishing with 45 degrees.

What is hip angle?

By 'hip angle' we are referring to the angle between the thigh and the torso as demonstrated in the picture. A hip angle of 45 degrees is a very 'flat back / aero' position whilst 75 degrees is a very 'upright' position. One of the main focus for this study was to examine the effects of 'going aero' on cycling power and subsequent running performance.

Following each cycle time trial the subjects then had 30 seconds for their transition before jumping onto the treadmill and running 15 minutes at 5k race pace. Their pace was selected beforehand by questioning and was exactly the same for both trials, the power produced on the bike ride was controlled by the subjects but run pace was pre-set so we could get an accurate comparison between visits.

Whilst cycling we measured power output as 'watts' and during both cycle and run we measured 'respiratory frequency' (breathing rate), 'tidal volume' (breathing depth), VO2 (oxygen consumption), Ventilation (breathing rate and depth combined) and heart rate.

In addition, during the run we also measured rating of perceived exertion for legs and breathing, in simple terms we asked them how tired their legs felt and how hard they were breathing and rated it on a scale.

What were the cycling results?

Parameter	Aero 45 degrees	Sit up 75 degrees
Average power on the bike (watts)	168	182
Breathing rate on the bike (per minute)	44.8	43.2
Breathing depth on the bike (litres)	2.7	2.8
Heart Rate on the bike (beats per min)	171	169
Oxygen consumption on the bike (ml per min)	3549	3595

What were the running results?

Parameter	Aero 45 degrees	Sit up 75 degrees
Breathing rate running (per minute)	51.6	50.9
Breathing depth running (litres)	2.4	2.3
Heart rate running (beats per min)	175	172
Oxygen consumption running (ml per min)	3522	3394
Perceived leg fatigue running (rating 1-10)	5.9	5.8
Perceived breathing difficulty running (rating 1-10)	6.0	6.0

Discussion

Bike:

One of the key things identified from the bike time trial was the lower power output produced in the aero position, this was expected and backs up other studies which have demonstrated the same thing. When you cycle in a low profile position it alters the ability of your hip flexors to lift your foot over the top of the pedal stroke from 10 o'clock to 2 o'clock.

Aside from the power there were only marginal changes in the other data, the breathing rate was very slightly slower and deeper when in the upright position and HR slightly lower, despite the slightly higher oxygen consumption. It's fair to say that during both trials the riders were working at the same intensity (HR/breathing/oxygen all similar) but the power is lower.

Before you go and raise your handlebars.. power isn't everything, how fast you go is the most important outcome and this is influenced by aerodynamics. Despite producing less power in the aero position, the riders may have gone just as fast due to better aerodynamics, that's something we can't calculate from this study.

It is important to ensure that when riding, especially when trying to hold an aerodynamic position that you keep the hip angle as big as possible. When you drop the handlebars to a lower position the angle automatically closes, to avoid this occurrence the seat should be moved forwards and upwards slightly. Aero bars on road bikes are generally a disaster with regards to hip angles, well fitted time trial bikes tend to avoid this due to different geometry.

Run:

Following the time trial in the aero position, subjects ran with a faster breathing rate, deeper breathing, higher heart rate and consumed more oxygen in comparison to the time trial in the upright position. The results were not statistically significant but they are clear to see.

There are several reasons why running after cycling in the aero position should be more difficult and the most likely is a change in running style or 'mechanics' which then leads to higher oxygen use, heart rate, breathing rate etc.

Cycling in the aero position can lead to shortening of the hip flexors and lengthening of the hamstrings which leads to a 'lordosis' posture (lower back arched inwards and stick your bum out – Homer Simpson posture). In addition to this change in posture, if cycling in the aero position means that you can't use your hip flexors correctly, you will have to compensate by using something else instead and this may also lead to fatigue. Based upon

this, it's possible that altered pedal mechanics may have lead to greater fatigue before running.

What's the outcome?

You need to be wary when adopting an aero position, it's pretty clear that it has a high impact upon your power output and it also worsens running performance to follow. The main culprit for this is the closed hip angle and this should be avoided at all costs. If you have a road bike with aero bars, it's likely that your hip angle is not optimal, a well fitted time trial bike with specific geometry is more likely to guarantee a higher power output and a better run performance.

Don't just think that increasing the hip angle will solve all the problems, whilst it may well increase power output, it will worsen aerodynamics meaning that you have to generate greater power to maintain the same speed! This may result in a slower bike, more fatigue and that may also affect run performance.

The answer is to exploit everything.. aero advantages should definitely be on your hit list but you should ensure that your aero position is achieved with the widest hip angle possible. You should also be wary of shortening on the hip flexors and the possible lordosis posture which may follow as a consequence. Stretch and strength to combat these changes, this will help to maintain a mechanically efficient running stride and reduce the chance of injuries.

Marc Laithwaite
marc@theendurancecoach.com