POWER breathe®
"for anyone who breathes"™

BREATHING & EXERCISE

ARTICLE 2: The unique challenge of triathlon

Introduction

In the first article of this series, we considered the structure and function of the respiratory pump, as well as the individual demands of swimming, cycling and running. In this, the second article in the series, we will consider the challenges posed by combining the tasks into a single competitive event – the triathlon.

'The lung…an amazing product of evolution, but not built for triathlon'

It surprises many people to learn that the lung does not respond to training as other components of the oxygen transport system are known to do. Unlikely though it seems, the structural and physiological properties of the lungs remain completely unchanged, even in athletes who have trained for many years[1].

Observations that athletes such as swimmers and rowers appear to possess superior lung function to that of their non-athletic contemporaries has led to speculation that physical training during childhood may enhance the development of the lung[2]. However, one cannot exclude the fact that for some sports, having large lungs may provide a positive selection pressure for success. Hence, only competitors with larger than normal lungs succeed and remain to compete in their chosen sport as adults. Until a longitudinal study follows the development of a cohort of athletes through adolescence and into adulthood, the 'nature/nurture' question will remain unresolved.

There is evidence that the lung is subjected to huge demands during triathlon, and there have been repeated observations of reductions in post-event lung function[3]. For example, the diffusing capacity of the lung is impaired post-event[4] (and presumably also during the latter stages of the race), which has implications for oxygen transport.

In the previous article we learnt that swimming 200m at 90-95% of race pace results in the greatest magnitude of inspiratory muscle fatigue (IMF) yet reported in the literature (29%). Its therefore rather surprising that the two studies that have examined the influence of triathlon upon respiratory muscle function have shown little or no IMF after the swim phase[3, 5]. In contrast, both of these studies observed IMF after the cycle and run phases. It is likely that the absence of IMF following the swim phase is due to the triathletes' pacing strategy, and not to the fact that triathletes are more resistant to the IMF induced by swimming than are swimmers. The intensity of the triathlon swim also needs to be taken into account (relatively moderate), as well as the fact that fatigue is cumulative.

The cycle-run transition

A particular focus of research has been the cycle-run (CR) transition, since for many years there was no satisfactory explanation for the increased perception of breathing discomfort that is present during the first minutes of the run phase.

However, research has now shown that during the first minute of the run phase following the CR transition, the ventilatory and metabolic requirements of running are higher, probably because of IMF[6, 7]. A research group in France has attempted to tease out the independent and combined influences of cycling and running upon IMF and lung diffusing capacity.

In one study they compared the influence of a 20-minute cycle followed by a 20-minute run (CR), with that of a 20-minute run followed by a 20-minute cycle (RC) (all at 75% of maximal oxygen uptake). They found that the RC combination induced the greatest magnitude of IMF.

In a follow-up study they tested their hypothesis that the crouched body position of cycling, and its negative impact upon respiratory muscle mechanics, might account for the differences between the effects of CR and RC transitions. Subjects performed either, 20 minutes of cycling, 20 minutes of running, or 20 minutes of cycling followed by 20 minutes of running (CR). Interestingly, they noted that cycling and CR induced almost identical IMF, whereas running induced none.

As mentioned above, changes in lung diffusing capacity have also been noted after CR and RC transitions[8]. As was the case with IMF, the RC transition generated the greatest deficits in diffusing capacity. The authors speculated that this was due to a reduction in the volume of blood within the lung circulation during RC, which would reduce the proportion of the lung available for oxygen exchange between blood and air. Further, they speculated that the reduced lung blood volume was due to altered respiratory pump mechanics induced by IMF.

Thus, it seems likely that there are respiratory impairments induced by cycling that carry over into the run, causing run performance to be impaired. The greater IMF induced by the RC combination (above) most likely occurs because in the CR combination, the inspiratory muscles recover slightly from the impairments induced by the preceding cycle; whereas in the RC combination, the IMF is at its height at the end of the cycle phase. It appears that the mechanical constraints of cycling, which restrict rib cage and diaphragm movement, induce impairments in both inspiratory muscle function and lung diffusing capacity, both of which can impair performance.

The benefits of inspiratory muscle training

The data described above creates a fairly compelling argument in favour of specific inspiratory muscle training (IMT) in order to minimise the detrimental influence of the mechanical constraints to breathing that are imposed by cycling. Unfortunately, there are so far no published studies evaluating the benefits of IMT for triathlon performance. However, we can infer the likely benefits by considering the following facts, as well as data from studies of IMT in cyclists, all of which suggest that good breathing and avoiding IMF are central to success:

- All three disciplines of the triathlon elicit inspiratory muscle fatigue (IMF) when undertaken individually;
- Inspiratory muscle training improves performance in both cycling[9] and running[10];

- The cycle-run component of the triathlon is associated with IMF, as is the event as a whole[3, 5];
- Inexperienced cyclists using aerobars experience detrimental effects on their breathing and a decrease in mechanical efficiency compared to cycling in the upright position[11];
- Something that sets professional cyclists apart from mere mortals is the fact that their breathing remains deep and strong throughout intense exercise, maximising efficiency and minimising the metabolic cost of breathing[12].

There will be more about POWERbreathe IMT in later articles, but for now, I'd like to share some facts regarding the time efficiency of POWERbreathe IMT compared to any other training adjunct. POWERbreathe training requires less around 4 minutes per day and can produce a 4.6% improvement in 40km cycling time trial performance[9]. Let's consider what else you could add to your training in order to achieve a similar magnitude of benefit.

Very few studies have examined the influence of adding a different type of training to the endurance regimens of already highly trained endurance athletes. Fortunately, one of the few studies to have undertaken such an appraisal utilised a 40km cycling time trial as an outcome measure, making it possible to compare their data directly with those obtained using POWERbreathe. The authors examined the effect of a number of interval training regimens, one of which produced an improvement in 40km time trial performance of ~5% over the 4-week period of their training intervention[13]. The intensity of training was very high, being set at the power output that elicited maximal oxygen uptake (VO_{2max}) during an incremental exercise test. Athletes were required to undertake 8 intervals of ~2.4 minutes duration interspersed with recovery periods of ~4.8 minutes. Athletes trained twice per week and the duration of each session was ~53mins. Compare this to the twice daily POWERbreathe training session that lasts just ~2mins!

Over the 4 weeks of the intervention, the total duration of high intensity interval training required to elicit a 5% increase in 40km time trial performance was 7hrs. Compare this to the total time required to attain a 4.6% improvement in performance following 6wk of POWERbreathe training, which is around 1.8hrs. Another very salient point is the intensity and duration of each training session (53min at VO_{2max} *vs.* 2 min at moderate inspiratory muscle load), as well as the fact that POWERbreathe training can be undertaken anywhere; there's no need for a bike, or even to break into a sweat! The choice is yours.

Summary comparison of high intensity cycle interval training vs. POWERbreathe® training

	High intensity cycle interval training[13]	**POWERbreathe® training[9]**
Performance enhancement in 40km time trial	5 (%) 3 min	4.6 (%) 2.76 min
Duration of training	4 weeks	6 weeks
Type and intensity of training	$VO2_{max}$ on a cycle	50% of inspiratory muscle strength using POWERbreathe®
Session regimen	8 intervals of 2.4 minutes	1 set of 30 breaths, twice daily
Session duration	53 min	2 min
Session frequency (per week)	2	14
Total training time per week	106 min	28 min

Summary

In this second article we have considered the unique challenge to breathing posed by the triathlon, as well as the rationale for training the breathing pump. We've also considered what else you could add to your training to obtain the same performance improvement that has been demonstrated in response to POWERbreathe training. The numbers speak for themselves and make the argument in favour of POWERbreathe is a complete 'no brainer'. It's quick, it's easy, it's convenient, and you don't need to flog your guts out.

Just add 4 minutes per day of relatively easy exercise to your normal training to achieve a 4.6% gain in your 40km time trial performance!

In the next instalment of the article series we'll consider why the inspiratory muscles fatigue, as well as the wider physiological implications for your performance.

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