Introduction: Series of articles on Breathing & Exercise for Ironman

As Alexander Pope cautioned almost 300 years ago, 'a little knowledge is a dangerous thing', and this old truism has been responsible for the fact that respiratory limitations to performance have been ignored for so long. Everyone thinks that they know that breathing doesn't limit exercise performance, because they know (believe) that breathing doesn't limit maximal oxygen uptake (VO_{2max}).

But what people have overlooked, including the sport scientists, is that breathing is a process brought about by a complex and life-preserving group of muscles. These muscles function as a pump, and their metabolic work has both sensory and metabolic repercussions during exercise. In other words, the work of the respiratory pump muscles contributes to the level of perceived exertion, as well as placing demands upon the cardiovascular system for a finite [and limited] supply of blood flow.

Most readers would agree that if fatigue is present in a group of muscles following a given task, these muscles are probably placing some limitation on the performance of that task.

The earliest reports of inspiratory muscle fatigue following a competitive event appeared in the early 1980s, where significant declines in inspiratory muscle strength were observed following marathon running[1]. Later research confirmed these findings following marathon running[2], but also provided data suggesting that ultra-marathon[3] and triathlon[4] competition were fatiguing to the respiratory system.

Under laboratory, or field-based research conditions, my own research group has also demonstrated inspiratory muscle fatigue following rowing[5], cycling[6] and swimming[7], as well as a sprint triathlon[8]. If only scientists had looked beyond VO_{2max} over these last two decades, they would have seen a simple, but compelling rational for specific training of the inspiratory muscles.

For the purposes of this introductory article, and to cut a very long, but interesting story short (for the time being at least), my research team *did* look beyond VO_{2max}, and what we found has surprised even us. Following very rigorously controlled laboratory studies of inspiratory muscle training (IMT, see figure 1) we've shown convincingly that training these muscles (but not the expiratory muscles) improves time trial performance in rowers [5] and in cyclists[9].

Our observations of improved performance following IMT have also been confirmed by other researchers in cyclists[10] and runners[11]. So unlike most other training adjuncts, gadgets or supplements you might be tempted to try, IMT has been scientifically validated. When used as prescribed, IMT improves performance, and that's a fact.

How do we train these muscles? Well, like changing a bottom bracket bearing on your bike; if you have the right tool, its simplicity itself. In the course of our research we have developed the POWERbreathe®, which is designed specifically to resistance [weight] train the inspiratory muscles. Some years ago, I coined the term *'dumbbells for your diaphragm'*, and that pretty much sums up POWERbreathe®.

In a series of articles over the coming months, I hope to provide readers with a working knowledge of the physiology of breathing, as well as the keys to overcoming the limitations that breathing places on your performance – even if you're not aware of them.

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