

## Ventilatory threshold and maximal oxygen uptake during cycling and running in duathletes

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**Background.** Duathlon, an emerging sport discipline, is an endurance competition based on a sequence without interruption of running, cycling and again running fractions. The performance in duathlon, as well as triathlon, depends on the ability of the athlete to effect the three competition fractions without creating fatiguing levels which would inevitably cause a decrease of the performance in the following fractions. Currently there are no studies which have examined the relation between ventilatory threshold ( $T_{vent}$ ) and maximal oxygen uptake ( $\dot{V}O_{2max}$ ) in the cyclists and the runners comparing them with the ones of the athletes who train and compete in duathlon. Therefore the main aim of the present study has been the following ones:

1) the identification of the relationship between  $T_{vent}$  and  $\dot{V}O_{2max}$  in eight elite duathletes for cycling and running and the comparison of said relationship with the one found in cyclists or runners in maximal trials with cycloergometer and on the treadmill.

2) Moreover it has been carried out an analysis of the modification of the physiological parameters through the laboratory simulation of the commitment faced in a duathlon competition by a top duathlete (Case Report).

**Methods.** The research methods have been the following:

a) maximal incremental test—till exhaustion—on treadmill and cycloergometer carried out on eight duathletes in different days and with an interval of no more than seven days between one trial and the other;

b) incremental exhaustion test carried out on a top duathlete on cycloergometer after 5 km of running; incremental exhaustion test on treadmill after 5 km of running and 30 km of cycling.

**Results.** The study has show, through its data, that  $\dot{V}O_{2max}$  recorded in the duathletes during running and cycling was inferior to the values recorded for triathletes. For the duathletes,  $\dot{V}O_{2max}$  obtained with running was higher than the value obtained with cycling. The ventilatory threshold ( $T_{vent}$ ) recorded in duathletes was lower than the value reported for elite runners but comparable with the one reported for race cyclist, duly endurance trained.

**Conclusions.** These data can be explained with the different training methods for duathletes, both as far as quantity and quality are concerned, in comparison with race top athletes in the single disciplines confirming that the fit answers to the endurance exercise in the single sport are, in par, a function of motion schemes specific for that training,

Key words: Duathlete - Anaerobic threshold - Ventilatory threshold - Maximal oxygen uptake.

The duathlon, an emerging sports discipline, is an endurance competition, based on running, cycling and running in

that respective order. Performance in the duathlon, as in the triathlon, depends on the athlete's capability to carry out the three successive events without accumulating fatigue, which could affect his performance in the following fraction. A successful duathlete should therefore have an extremely efficient aerobic metabolism

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TABLE I.—General physical characteristics, duathlon experience and training regimen data for eight male duathletes.

	Age (yrs)	Weight (kg)	Height (cm)	Duathlon experience (yrs)	Duathlon completed (yrs)	Mean training distances (km/wk)	
						run	bike
1	34	72.5	181	2	12	80	300
2	33	71.7	181.6	3	22	92	340
3	32	62.5	172.7	3	18	88	240
4	41	83.4	189	3	14	75	280
5	38	72.1	177.8	3	12	72	320
	28	68.4	176	2	20	90	280
	29	66.2	175	2	16	86	300
	36	62.8	174	3	24	76	240
Means±SD	33.8±4.39	69.95±6.74	178.4±5.33	2.625±0.518	17.25±4.53	82.4±7.6	297.5±35.36

based on a well developed oxygen transportation and utilisation system, and consequently the ability to produce valuable energy for prolonged periods of time without accumulating metabolic acidosis.

More is the aerobic metabolism efficiency, less is the utilisation of the carbohydrates as energy source. Thus, the intensity of exercise has to be decided in function of the race distance to avoid early muscle glycogen depletion.

Maximal oxygen uptake ( $\dot{V}O_{2max}$ ) is generally considered to be a useful index of good performance in endurance activities when subjects have different  $\dot{V}O_{2max}$ .<sup>1,2</sup>

The anaerobic threshold has been studied as one of the many factors, besides  $\dot{V}O_{2max}$ , which could contribute to success in endurance competitions.<sup>2,3</sup> Several studies confirm that anaerobic threshold could be a critical factor in determining running pace.<sup>4</sup>

Powers *et al.*<sup>1</sup> confirmed that oxygen uptake measured at the anaerobic threshold was a better indicator than  $\dot{V}O_{2max}$  to predict performance in long distance runners. Few studies have examined the relationship between  $\dot{V}O_{2max}$  and anaerobic threshold during running and cycling in a duathlon for athletes who train and compete in these two endurance sports, for each of which the biomechanics as well as the muscles used are different.<sup>1,3-8</sup>

In conclusion the main issues of this research were as follows:

1) The definition of the relationship between  $\dot{V}O_{2max}$  and  $T_{vent}$  in cycling and running, in reference to a high-level duathlete compared to athletes of one or other of the disciplines.

2) The modification of the physiological parameters investigated ( $\dot{V}O_{2max}$  and  $T_{vent}$ ) in the duathlete by simulating race conditions in the laboratory, in order to evaluate the performance of the "human machine" during the various transition phases—from running to cycling to running—to document eventual worsening in performance related parameters.

## Methods

After written informed consent was obtained, eight male duathletes were tested during cycle ergometry and treadmill running. All the athletes were actively training and competing in duathlons during the five-week testing period. The general physical characteristics, duathlon experience and training regimen data for each subject are presented in Table I. The athletes had been training for the duathlon for an average of 2.625 yrs and had completed a mean of 17.25 duathlons of varying distances. Average training distances per week were 82.4 km running and 287.5 km cycling. Two of the eight duathletes were professional competitors. Each of the

