INTRODUCTION

Wetsuits are standard competition equipment for most triathletes in North America and Europe who seek comfort in cold water and the 3-7% increase in swimming speed associated with the suit. However, some triathletes who use wetsuits complain of dyspnea during the swim, possibly due to the constricting fit of the wetsuit. It is also possible that the full performance enhancing benefits of the wetsuit are blunted by an increased metabolic demand on the ventilatory musculature. It is known that the metabolic cost of ventilation is dependent on the work of breathing, which is a function of breathing frequency (f), tidal volume (Vt), airway resistance and chest wall compliance. To maintain VE while wearing a wetsuit that limits the compliance of the thoracic cage without altering the ventilatory parameters would require an increased inspiratory force.

It was hypothesized that a wetsuit would increase the VCh associated with a given swimming intensity while maintaining f, Vt and VE. Under these circumstances, it is assumed that this difference in VCh is due to the anticipated increase in the work of breathing.

METHODS

The study used 7 male triathletes who performed two randomly assigned (control and wetsuit conditions) progressive tethered swims to exhaustion with a length of latex surgical tubing substituted as the tether and resistance device. The workload started between 2.5 and 4.0 kg and increased by 0.5 kg every 2 minutes until failure to remain stationary. Metabolic measurements took place continuously (30s means).

The wetsuits were sleeveless and full leg with 5 mm thick neoprene. In the wetsuit condition each subject used their own wetsuit while in the control condition a loose fitting suit with an open zipper was used to closely mimic the wetsuit trial conditions (temperature and buoyancy) without constricting the chest.

A general linear model (GLM) estimated VCh from condition (wetsuit or control), subject, VE, VT, f, HR and workload. GLMs were also derived to estimate the effects of subject, load and condition on each of the physiological variables (VE, VT, f, HR).

RESULTS

The subjects had a mean (standard error) age of 23 (1.2) years, height of 177.4 (1.8) cm, weight of 74.1 (2.1) kg, swimming experience of 7.1 (1.9) years and 5.7 (0.8) years triathlon experience. A sample of the raw VCh data for a subject is provided in Figure 1.
The most parsimonious GLM explaining VCh used VE, HR, subject, load and condition. This model indicated that the wetsuit produced an increase in VCh of 0.144 l-min\(^{-1}\) (F = 14.22, p = 0.0003, 95% CI 0.068 to 0.220 l-min\(^{-1}\)) when all other variables were held constant. The GLMs regressing the four physiological explanatory variables (VE, VT, f, HR) on subject, load and condition indicated that condition only affected HR in a significant manner (+6.3 beats-minute\(^{-1}\), F = 13.53, p = 0.0004, 95% CI of 2.6 to 9.7).

**DISCUSSION**

The data demonstrated an increased VCh due to the effect of wearing a wetsuit. Based on the GLM regressions on the ventilatory parameters, it was possible to assume that the additional VCh was due to an increased force of inspiration. The elevated HR in the wetsuit condition supported this assumption by indicating additional stress on the athletes while wearing the wetsuit.

It was possible to estimate the probable effect on swimming performance\(^5\) using an association of VCh to flume swimming velocity (VCh = 0.7341 + 0.6521-velocity\(^3\)). The magnitude of the potential time deficit for a VCh difference of 0.144 l-min\(^{-1}\) was a function of the 1500 m speed of the swimmer (Figure 2). The net time benefits of the wetsuit incurred from enhanced hydrodynamics were not included in this comparison.

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**REFERENCES**