TACSM Abstract –

"Elevation Training Mask" Induces Hypoxemia But Utilizes A Novel Feedback Signaling Mechanism

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ABSTRACT

Introduction: Regular exercise training at elevations ≥2,000m stimulates erythropoietic and angiogenic adaptations that increase oxygen transport capacity. Marketers of a novel combined inspiratory/expiratory muscle training device claim their product elicits these same adaptations at sea level. **Purpose:** The present study determined whether these claims had merit. **Methods:** 5 healthy males (Age: 27.8±2.3yrs; Bodyfat: 13.2±2.4%; VO_{2peak}: 54.9±2.8ml/kg/min) performed treadmill exercise while wearing the device in three different "altitude" configurations: Low Altitude: 1,080m; High Altitude: 2,743m; and Very High Altitude: 4,572m. The exercise bouts were identical (20min duration, workload equivalent to 60%VO_{2peak}, 20-22°C / 15-20%RH environment), completed in a randomized order, and separated by a minimum of 48hrs washout. Ventilation (V_E), fractions of expired oxygen (F_EO_2) and carbon dioxide (F_ECO_2), oxygen saturation (S_PO_2), heart rate (HR), and ratings of perceived exertion (RPE) were measured at 1min intervals. Given the restrictive nature of the ventilator training device, we also had subjects complete the Beck Anxiety Inventory (BAI) after each exercise trial. A 2-Factor [Condition x Time] Repeated-Measures ANOVA was used to discern significant differences ($p<0.05$) and Tukey's HSD post hoc tests were used where appropriate.

	Low Altitude: 1,080m	High Altitude: 2,743.2m	Very High Altitude: 4,572m
V_E (L/min)	86.9 ± 0.4	67.0 ± 0.4*	68.1 ± 0.4*
F_EO_2 (%)	16.0 ± 0.1	14.8 ± 0.1*	15.0 ± 0.1*
F_ECO_2 (%)	5.3 ± 0.1	6.2 ± 0.1*	6.4 ± 0.1*
S_PO_2 (%)	95.0 ± 0.2	92 ± 0.3	90 ± 0.4*
HR (bpm)	139 ± 3.0	140 ± 3.0	142 ± 3.0
RPE (au)	8.5 ± 0.3	12.1 ± 0.6*	11.5 ± 0.4*
BAI (au)	0.4 ± 0.2	4.8 ± 2.0*	6.4 ± 1.9*
Au = arbitrary units. Data are Mean ± SEM for N=5. *Different than Low Altitude ($p<0.05$).			

Results: With the exception of HR, all of the variables we measured were altered when the ventilatory training device was configured to either the "High" or the "Very High" altitude settings. From what we could tell, there is no difference between these two settings. **Conclusion:** This combined inspiratory/expiratory muscle training device induces hypoxemia but utilizes a signaling mechanism that has not been previously described: $\downarrow V_E \rightarrow \uparrow F_ECO_2 \rightarrow \downarrow F_EO_2 \rightarrow \downarrow S_PO_2 \rightarrow \uparrow$RPE $\rightarrow \uparrow$BAI. Stated simply, hypoxemia is caused by the rebreathing of expired CO_2 that has accumulated in the mask's large dead-space area (100ml).