AltoLab
SIMULATED ALTITUDE TRAINING

INTERMITTENT SIMULATED ALTITUDE EXPOSURE VIA RE-BREATHING ON CYCLING PERFORMANCE

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Performance in well-trained cyclists improved an average of 3-4.5% in aerobic natured events. This is a tremendous improvement in athletic accomplishment for a highly trained individual.

The finding of an average 4.5% improvement in the 60min time trial was substantially better, than what was reported for athletic improvements, as a result of moderate altitude stays for several weeks.

PURPOSE

To quantify the effects of intermittent simulated altitude exposure via re-breathing on cycling performance in trained male cyclists. More specifically the following null hypotheses were tested 1) Intermittent simulated altitude exposure will have no effect on power (aerobic or anaerobic), 2) Intermittent simulated altitude exposure will have no effect on measured physiological parameters (heart rate, oxygen consumption, lactates), 3) Intermittent simulated altitude exposure will have no effect on hematological characteristics (hematocrit, reticulocytes, ferritin).

Why? Adaptation to the reduced availability of oxygen at altitude has the potential to benefit cycling performance at sea level.

METHOD

The study was a controlled trial in which 18 subjects were randomized into two groups – a simulated altitude group of low constant exposure and an altitude group of progressively increased exposure. Each exposure consisted of alternating between AltoLab and atmospheric air for 6min and 4min, respectively over 1 hour.

Subjects were managed and monitored for factors which may influence performance; detailed records of training, diet, overall health, and well-being were recorded on a daily basis. Hematological measurements were performed at PRE and at POST. Performance testing and blood draws were specifically timed to ensure adequate physiological adaptation (red blood cell production) to the altitude stimulus.

Oxygen saturation was monitored with a pulse oximeter; and either held constant (98% over 15 days; equivalent altitude equal 150m) or progressively reduced (90% on the 1st day to 77% on the 15th day; equivalent altitudes equal 3600-6300m).

Exercise Performance Tests

Subjects performed exercise performance tests on three occasions: a familiarization trial, a baseline trial two weeks later (the day before the beginning of daily simulated altitude exposures) and 5 days after the completion of altitude exposures. Each testing session consisted of a 15min warm-up, a maximal sustained effort of 15min, an active recovery period of 15min, a maximal sustained effort for 3min, and an active recovery period of 10 minutes. The workload for the maximal sustained efforts was individually controlled by the cyclist and closely mimics a time trial effort. Cycling speed, cadence, average power, and time were continually recorded. The average watts (W) over 60 minutes were calculated from the Critical Power function.

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VISIT 1 Day 0	VISIT 2 Day 14	VISIT 3-17 Day 15-29	VISIT 18 Day 34
Performance familiarization, Dietary Counsel, and Hematological Baseline Measurement	Performance Baseline Measurement	Simulated Altitude Treatment	Performance & Hematological Post-Measurement

RESULTS

Our results indicate the altitude group significantly increased their average 60min power output at POST by an average of 14.5watts. This is nearly 5% increase in power output from initial performance scores.

Chronic exposure to simulated altitude via re-breathing resulted in no change in a sea level cycling event which relied heavily upon anaerobic power (3min time trial). Chronic exposure to simulated altitude via re-breathing, did improve sea level performance when tests relied highly on aerobic power (15min time trial and estimated 60min time trial). An improved heart rate economy as a result of improved oxygen utilisation, may be a contributing factor which is accountable for this occurrence. These findings are in agreement with other conclusions drawn subsequent to chronic terrestrial or simulated altitude exposures.

The results of this study warrant the use of a re-breathing device (AltoLab as employed in this investigation) as an alternative to terrestrial altitude or other forms of simulated altitude. This was done to mediate performance gains in events which rely heavily upon aerobic power. In fact, the re-breathing form of simulated altitude could possibly become the preferred method of acclimatisation. The large performance gains associated with minimal time of exposure and considerably less cost as compared to other forms of simulated altitude makes this device an important methodology.

CONCLUSION

In conclusion to the three tested hypothesis;

1) aerobic or anaerobic power: chronic exposure to simulated altitude via re-breathing resulted in no change in sea level cycling events which relied heavily upon anaerobic power, yet it did improve sea level performance when tests relied highly on aerobic power.

2) physiological parameters: VO2 Index and Lactate Index did not change from PRE to POST in either the constant or progressive altitude groups. There was an improvement in the Heart Rate (HR) Index at POST in the progressive altitude group. The HR average / Watt average decreased after simulated altitude acclimatisation via re-breathing, that is the efficiency of HR was improved. At POST a lesser HR was required to perform the same workload.

3) hematological characteristics: the measurement of erythropoesis (the making of new red blood cells), resulted in no significant changes for either group from PRE to POST.

The primary finding of this study, was that the re-breathing form of simulated altitude increases performance in well-trained male cyclists as shown by an increase in power output in the 15 minute time trial.

A 1-3% increase in performance as a result of acclimatization has been well-established when spending 8-20 hours per day for weeks at a time at moderate altitude (Levine & Stray-Gunderson, 1997; Baker & Hopkins, 1998; Chapman et al., 1998, Julian et al., 2003). **The data from this study reveals that exposure to high altitude for a short period of time (less than an hour per day) elicits similar and possibly larger gains in performance adaptations.**