

# Altitude Simulation Efficiency for Cyclists - 2000

## Altitude Simulation Efficiency for Cyclists

In conjunction with Cape Town University, conducted research to determine the extent to which gains in efficiency and performance and sub maximal exercise recovery could be attributed to 15 days of altitude simulation for trained cyclists.

### Methodology

In a randomized group trial consisting of two experimental groups and one control group, one experimental group (HYPOXIA – 15, N = 12) was exposed to 15 days of progressive hypoxia at a rate of one hour per day. A second experimental group (HYPOXIA – 3, N = 12) was exposed to 3 days of room (normoxic) air at a rate of one hour per day. A third group (CONTROL; N = 12) did not receive any exposure to the laboratory, the researchers, or to the altitude simulator. This group was pre and post tested but with no other intervention. To control for any placebo effects and systematic bias, subjects in HYPOXIA – 3 were told they were receiving exposure to hypoxic air on three days in order to compare 5-days hypoxic exposure per week. This component of the study ensured these subjects completed the post testing with the expectation that they received some benefit during the 15-day exposure period. In reality they (HYPOXIA – 3) received room air during each session. All subjects performed familiarization tests prior to pre-testing to eliminate any learning effect.

### Testing Protocol

Testing consisted of a Peak Power Output test (PPO), one 20km Time Trial (TT) and one sub-maximal high intensity interval session (HIT). King Cycle ergometers were used in the 20km TT with each subject able to use their own bike. The cycle ergometer continuously measured power output and heart rate. The PPO was completed according to Hawley et al. (1992) with cyclists starting at a workload equivalent to 3.3 watts (W)/kg body mass. The workload was increased by 50 W initially and then 25 W for a duration of 2.5 minutes per stage, until the cyclist could no longer maintain the designated power output. The highest workload that the subject could maintain for the test (seconds) was defined as their PPO. The HIT session was performed on a load bike, consisting of 8 intervals 5 minutes duration at 75% of their PPO, followed by 3 minutes recovery at 50 W.

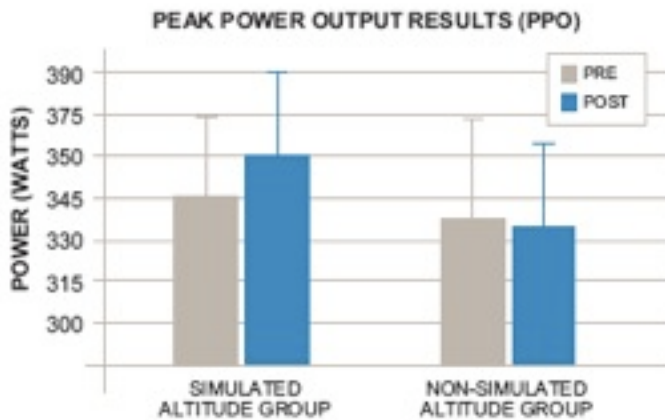
Subjects were cannulated to allow for multiple samples(16 per test) to be drawn.

Week 1	Familiarisation of exercise tests
Week 2	Familiarisation of exercise tests
Week 3	Pre Testing Peak Power Exercise Test (PPO)
	High Intensity Interval session (HIT)
	20km Time Trial (TT)
	Blood Lactates taken
Week 4	Pre Testing Peak Power Exercise Test (PPO)
	High Intensity Interval session (HIT)
	20km Time Trial (TT)
	Blood Lactates taken
Week 5	Altitude exposure
	1 x week Hb, Hct, EPO, RBC sampled
Week 6	Altitude exposure
	1 x week Hb, Hct, EPO, RBC sampled
Week 7	Altitude exposure
	1 x week Hb, Hct, EPO, RBC sampled
Week 8	Post Testing Peak Power Exercise Test (PPO)
	High Intensity Interval session (HIT)
	20km Time Trial (TT)
	Blood Lactates taken
Week 9	Post Testing Peak Power Exercise Test (PPO)
	High Intensity Interval session (HIT)
	20km Time Trial (TT)
	Blood Lactates taken

## Results

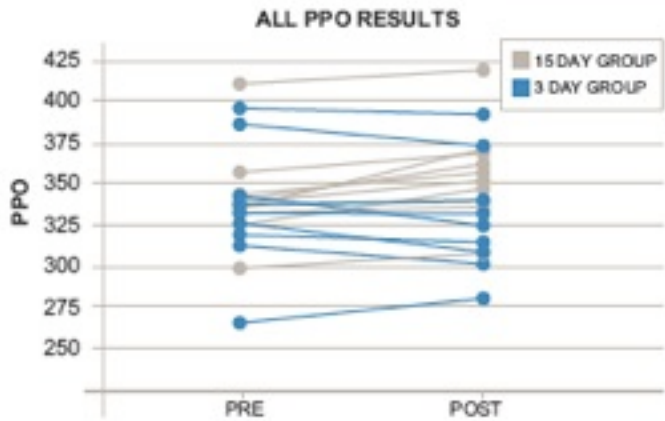
**Figure 1**

Graph indicating power (watts) changes before (pre) and after (post) following 3 and 15 days of simulated altitude training.



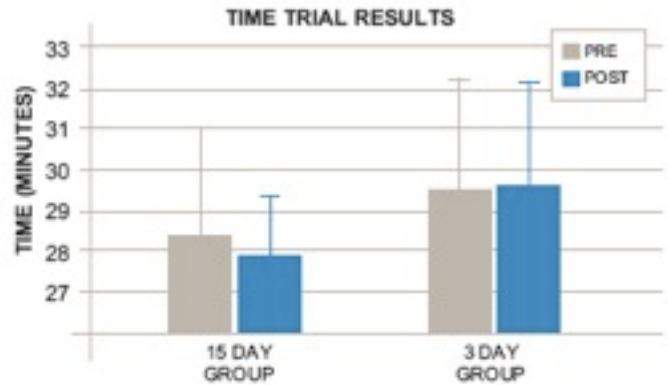
**Figure 2**

Graph indicating individual power (watts) changes following 3 and 15 days of simulated altitude training. The results found the 15-day group achieved a higher peak power output and an increased average wattage of 4.6%, compared to an average of 0.19% in the 3 day group.



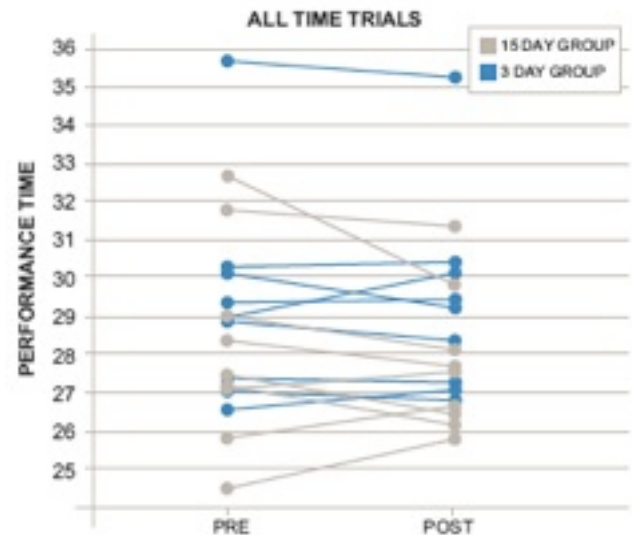
**Figure 3**

Graph indicating time changes following the simulated altitude training intervention of either 3 or 15 days.



**Figure 4**

Individual times for the 20km time trial following either 3 or 15 days of simulated altitude training. Results from the 20km time trial (TT) found the 15 day group improved by 1.93% compared to 0.19% in the 3 day group.



## Conclusion

15 days of Altitude Simulation significantly improved peak power output and enhanced performances in the 20-km TT. Subjects also commented favorably on the subjective effects of having greater control over breathing and feeling as though recovery had improved following the Altitude Simulation program.