Oxygen Transport in Normobaric versus Hypobaric Hypoxia

Christina Angeli, Robert Shute, Roksana Zak, Dustin Slivka

University of Nebraska at Omaha, School of Health, Physical Education, and Recreation, Omaha, NE

Exercise Physiology Lab

ABSTRACT

BACKGROUND: Various physiological changes occur in the human body when ascending to altitude. Exposure to hypoxia increases heart rate and decreases arterial oxygen saturation (SaO_2), with both changes being expedited during exercise. Incremental exercise in ambient conditions decreases muscle oxygenation, specifically with increasing intensity. Previous research has examined heart rate and SaO_2 in response to normobaric versus hypobaric hypoxia. However, there is a lack of research examining exercising muscle oxygenation in response to these conditions. Therefore, additional research investigating acute responses to normobaric and hypobaric hypoxia during exercise is warranted. **PURPOSE**: To examine acute responses in arterial and muscle tissue oxygenation during incremental exercise in normobaric versus hypobaric hypoxia. **METHODS**: Eight recreationally active males and females between the ages of 19 and 45 will be recruited. Subjects will complete an incremental cycle test to volitional fatigue in three conditions in a randomized counterbalanced order, normobaric normoxia (20.9% O_2, 760 mmHg), normobaric hypoxia (14.3% O_2, 760 mmHg) and hypobaric hypoxia (20.9% O_2, 530 mmHg). Two of the three trials will be conducted in an environmental chamber (Darwin, St. Louis, MO) to simulate normobaric normoxia at 350 m and normobaric hypoxia at 3094 m. The third trial will be conducted in Leadville, Colorado at 3094 m. Rating of perceived exertion, heart rate, blood oxygenation, respiration rate, muscle tissue oxygenation, and whole body gases will be analyzed during the trials.

INTRODUCTION

- Previous work from our lab indicates limited skeletal muscle transcriptional differences between normobaric and hypobaric hypoxia despite differences in SpO_2.
- No data currently exist between normobaric and hypobaric hypoxia on skeletal muscle O_2 saturation, which may explain previous findings.

AIMS

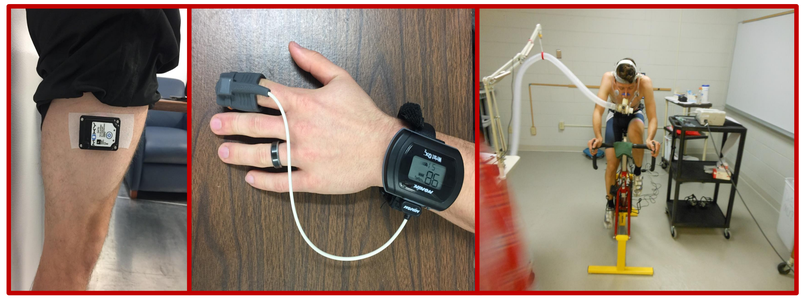
- To identify physiological differences between normobaric and hypobaric hypoxia during incremental cycle exercise.
- To determine differences in muscle oxygenation during exercise between normobaric and hypobaric hypoxia.

METHODS

- 8 recreationally active males and females between the ages of 19 and 45 will be recruited.
- Subjects will be required to visit the Exercise Physiology Laboratory on three separate occasions (initial visit and two experimental trials). Subjects will travel to the field site to complete the fourth trial.
- During the initial visit, informed consent and descriptive data including height, weight, age, and percent body fat (Exertech, Dresbach, MN) will be collected.
- Subjects will complete an incremental cycle test to volitional fatigue in three environmental conditions, normobaric normoxia (350 m), normobaric hypoxia (3094 m), and hypobaric hypoxia (3094 m).
- The trials will occur in a repeated measures, randomized, counterbalanced order separated by at least two days.
- Heart rate, blood and tissue oxygenation, and metabolic gases will be measured for 5 min at rest before exercise.

METHODS

- The normobaric normoxia (20.9% O_2, 760 mmHg) and normobaric hypoxia (14.3% O_2, 760 mmHg) trials will be conducted in an environmental chamber that will control for environmental oxygen concentration, temperature (22 °C) and humidity (40%).
- The hypobaric hypoxia trial will be conducted in Leadville, CO (20.9% O_2, 530 mmHg).
- Metabolic gases (ParvoMedics TrueOne Metabolic System, Sandy, UT) and respiration rate will be measured continuously throughout the trials.



- Blood oxygenation will be measured using a pulse oximeter (Nonin Medical, Inc., Plymouth, MN) worn on the subject's finger.
- Heart rate will be measured using a Polar band and watch (Polar Electronics, Lake Success, NY).
- Muscle oxygenation will be measured continuously using near-infrared spectrometry (MOXY, Hutchinson, MN) of the *vastus lateralis*.

IMPLICATIONS

- This study will aid in understanding differences between normobaric and hypobaric hypoxia, which may influence acclimation strategies.
- Help explain previous data collected by our Exercise Physiology Laboratory.