Differences in Skeletal Muscle and Brain Tissue Oxygenation during Exercise in the Cold

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ABSTRACT

BACKGROUND: During exercise, the demand for oxygen in the skeletal muscle and brain tissue is increased causing a deficit known as deoxygenation.. Deoxygenated tissues cause the body to make adaptations in energy production due to oxygen's role in mitochondrial energy production during oxidative metabolism. Previously, we have demonstrated alterations in markers of mitochondrial development when the stimulus of temperature exposure has been combined with exercise. However, the effects of environmental temperature exposure on tissue deoxygenation of the skeletal muscle and brain remains unclear. **PURPOSE**: To examine the effects of cold temperatures on skeletal muscle and brain tissue oxygenation during exercise using near infrared spectroscopy (NIRS). NIRS measures muscle and brain tissue oxygenation by calculating the change of the scattering and absorption properties of a continuous infrared light wave. **METHODS**: Twelve recreationally trained males will perform two exercise trials cycling on a Velotron cycle ergometer (RacerMate Inc., Seattle Washington) at 60% of their peak power for 1 hour in an environmental chamber (Darwin Chambers Company, St. Louis) that is controlled for temperature and humidity. Temperatures will be chosen in a randomized counterbalanced order and set at either -6 °C or 7 °C. Oxymon NIRS probes (Artinis, Netherlands) will be secured above the vastus lateralis muscle of the thigh and the frontal lobe on the right side of the forehead. **IMPLICATIONS:** The proposed research seeks to examine the role of temperature during exercise in skeletal muscle and brain tissue oxygenation.

INTRODUCTION

- Previous findings from our lab have demonstrated mitochondrial alterations in response to environmental temperatures.
- Mitochondria uses O_2 in the process of oxidative phosphorylation to make ATP energy.
- As we exercise, the demand for oxygen becomes greater to meet higher workloads creating a deficit in the skeletal muscles and brain tissue known as deoxygenation.
- To date no data exists linking skeletal muscle and brain tissue oxygenation to environmental temperature.
- It is unclear whether environmental temperature has an effect on skeletal muscle and brain tissue oxygenation.

PURPOSE

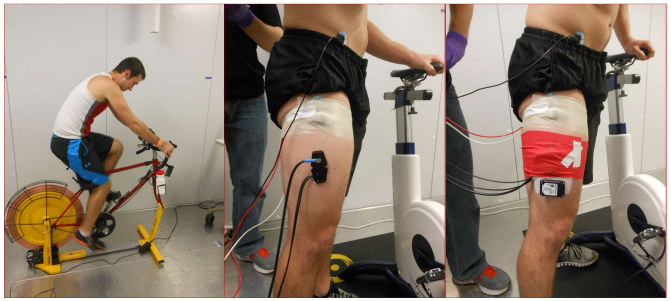
- To examine the effects of cold temperatures on skeletal muscle and brain tissue oxygenation during exercise using near infrared spectroscopy (NIRS).

METHODS

- 12 recreationally trained males between the ages of 19 and 45 will be recruited.
- All subjects will make three separate visits to the Exercise Physiology Laboratory to complete an initial assessment and two experimental trials.
- The initial assessment will include an informed consent and the collection of descriptive data including age, height, weight, and percent body fat (Exertech, Dresbach, MN) The subject will also complete a VO_2max test on a cycle ergometer to determine their peak power.
- Experimental trials will be conducted in a randomized counterbalanced design and separated by seven days.
- During these trials, subjects will cycle on a Velotron cycle ergometer (RacerMate Inc., Seattle Washington) at 60% of their peak power for one hour.

METHODS

- Heart rate, as well as skeletal muscle and brain tissue oxygenation will be measured continuously throughout the trial following a 5 minute resting measure before exercise begins.
- An Oxymon NIRS probe (Artinis, Netherlands) will be secured above the vastus lateralis and the frontal lobe to measure skeletal muscle and brain tissue oxygenation. Probes will be covered with a compressive wrap to reduce escaped light emissions.
- Experimental trials will be conducted in an environmental chamber (Darwin Chamber Company, St. Louis) set to either -6 ℃ or 7 ℃.



IMPLICATIONS

- The proposed research seeks to examine the role of temperature during exercise in skeletal muscle and brain tissue oxygenation.
- Determine if colder temperatures elicit an adapted mitochondrial response through adaptation in tissue oxygenation levels.
- Help explain previous data collected by our Exercise Physiology Laboratory.