EFFECT ON COGNITION OF ACUTE, SUBACUTE AND REPEATED EXPOSURES TO HIGH ALTITUDE

Kaitlyn M. Bettauer1,2,3, Samantha E. Hall2,3, Lauren L. Drogos PhD2,3, Sara E. Hartmann PhD2,3, Michael Furian MSc4, Adrienna M. Dyck5, Lara Murali6, Mona Lichtblau7, Patrick R. Bader8, Barry Giesbrecht PhD8, Jean M. Rawling MD, PhD7, Silvia Ulrich MD8, Konrad E. Bloch MD8, Marc J. Poulin PhD, DPhil2,3

Department of Psychology, Faculty of Science, University of British Columbia, Vancouver, British Columbia, Canada1; Department of Physiology & Pharmacology, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada2; Hotchkiss Brain Institute, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada3; Pulmonary Division, Sleep Disorders Centre and Pulmonary Hypertension Clinic, University Hospital Zurich, Zurich, Switzerland4; Cumming School of Medicine5; Department of Psychological and Brain Sciences6; and Institute for Collaborative Biotechnologies, University of California Santa Barbara, Santa Barbara, California, United States of America7; Department of Family Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada8

Abstract

Introduction: High altitude (HA) workers experience a unique exposure to sustained hypoxia. However, the impact of this exposure on cognitive function (CF) is unclear. We investigated the effect of HA (5050m) on CF with acute, subacute, and repeated exposures to HA in altitude-naïve young adults, using a pattern of HA exposure common at HA worksites in Chile.

Methods: CF was tested in 21 adults (24.8±3.7 years, 14 females) during two 7-day sojourns to HA, each sojourn including 6 hours/day at HA, with the remaining time spent at 2900m to reflect the pattern of HA exposure experienced by workers at the ALMA observatory. The sojourns were separated by 7-days rest at low altitude (LA; 520m). Testing was conducted at LA before and after HA and on days one and six at HA. The CF test battery consisted of four tasks focused in domains of attention (Reaction Time; Attention Switching Task (AST), and Rapid Visual Processing (RVP)) and executive function (One Touch Stockings of Cambridge). Testing was conducted on an iPad using CANTAB (Cambridge Cognition). Statistical significance was determined with repeated measures analysis of covariance. ClinicalTrials.gov NCT02738607.

Results: AST performance improved with acclimatization as there was decreased response latency (first vs. second sojourn) (F(1,14)=5.85,p=0.033) and greater variability in reaction time by the mean standard deviation during the first sojourn (F(1,14)=4.46,p=0.045). The latency to correct response (i.e. time to a correct decision; RVP) improved in the second sojourn, compared to the first (F(1,14)=8.02,p<0.01).

Conclusions: Reduced CF is observed with acute exposure to HA on cognitive tasks of attention, but not executive function, and is partially reversed after repeated 7-day exposure to HA, likely due to acclimatization.

Methods

Cambridge Neuropsychological Test Automated Battery (CANTAB)

The Cognitive function test battery consisted of four tasks and was performed using the CANTAB Connect Research Suite (Cambridge Cognition) for iPad.

One Touch Stockings of Cambridge (OTS):
The OTS is a measure of executive function, specifically spatial planning ability. Outcomes include time to correct response (latency) and accuracy.

Reaction Time (RTI):
The RTI is an attention test of motor and processing speed. It measures movement time, reaction time, accuracy and impulsivity.

Attention Switching Task (AST):
The AST is an attention task measuring top down control, or inhibition of irrelevant information. It measures reaction time, accuracy, and target sensitivity.

Rapid Visual Processing (RVP):
The RVP is a sustained attention task. It measures reaction time, accuracy, and target sensitivity.

Statistical Approach

• Statistical significance was determined with repeated measures analysis of covariance (ANCOVA).
• All analyses controlled for age.

Results

• There was a significant decrease of response latency on the AST on the second cycle compared to the first.
• There was also greater variability in the latency to respond by the mean standard deviation on the AST during the first cycle compared to the second.
• There was a significant decrease in the mean response latency (i.e. time to a correct decision) on the RVP in the second cycle compared to the first.
• No significant main effects on outcome measures from the RTI.
• There was no main effect of altitude on the OTS mean latency.

Discussion

With acute exposure to high altitude:
• Reduced cognitive function observed in:
  • Cognitive tasks of attention
• No effect of altitude observed in:
  • Cognitive tasks of executive function

Cognitive tasks of attention AST and RVP improved in the second cycle compared to the first.
• This was likely due to acclimatization

References:


Funding and Support: NSERC Discovery Grant (MJP, 2014-05554), The Brenda Strafford Foundation Chair in Alzheimer Research (MJP), the Alma Observatory, Swiss Lung Foundation, Lunge Zurich, Swiss National Science Foundation, and Alberta Innovates Postgraduate Fellowship (LLD).