

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

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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 healthy 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 6-8 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 (OTS)]. Testing was conducted on an iPad using CANTAB (Cambridge Cognition). Statistical significance was determined with repeated measures analysis of covariance. ClinicalTrials.gov NCT02738307.

Results: AST performance improved with acclimatization as there was decreased response latency (first vs. second sojourn; (F(1,14)=5.85, p=0.03)) and greater variability in reaction time by the mean standard deviation during the first sojourn (F(1,14)=4.86, 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)=8.62, p=0.011).

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 7day exposure to HA, likely due to acclimatization.

Introduction

• Moderate-to-severe hypoxia has been demonstrated to impair cognitive function in domains of attention^{1,2} and executive function³.

• The impact of sustained hypoxia exposure on cognitive measures of attention and executive function is unclear.

Objective: To investigate the effect of acute, subacute and repeated exposures to high altitude (5050m) on cognitive measures of both attention and executive function in altitude naïve healthy young adults.

Hypothesis 1: There will be a decrease in attention and executive function domain scores after acute exposure to high altitude.

Hypothesis 2: Attention and executive function domain scores will improve after a repeated exposure to high altitude compared to initial acute exposure.

Participants

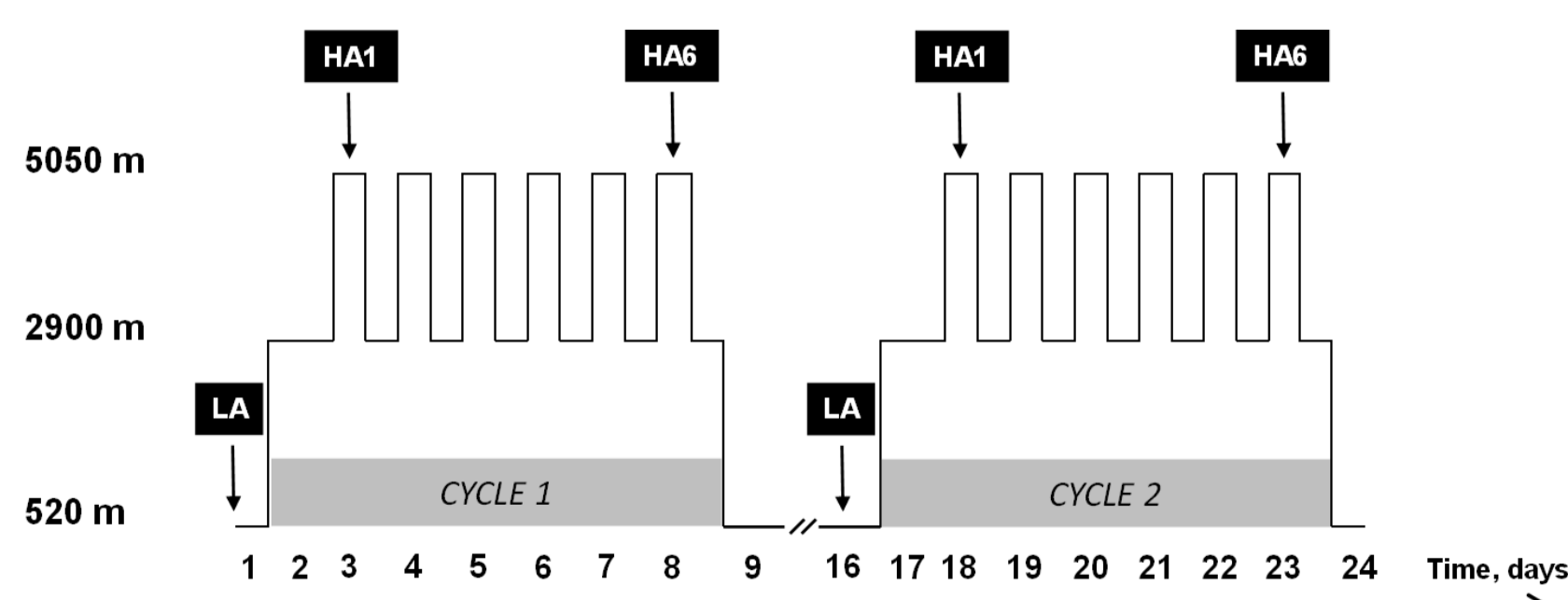
• 21 altitude-naïve healthy young adults (24.8±3.7 years, 14 females) participated.

Table 1. Participant Characteristics (n=21)

Variable	Mean (SD)
Age (yrs)	24.8 (3.7)
Weight (kg)	65.7 (9.6)
Height (m)	1.7 (0.1)
BMI (kg/m ²)	22.8 (3.1)
Sex (M/F)	6/9

Figure 1. Study design

• Low altitude (LA) testing was conducted in Santiago, Chile (520 m).
• Participants travel to the ALMA Operations Support Facility (2900 m) and stay for one night before beginning daytime examinations at HA (5050 m).
• Arrows indicate experimental testing sessions to test the effects of: 1) Altitude (520 m vs. 5050 m); and 2) Acclimatization (HA1 vs. HA6).



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 test. 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.

Results

Figure 2. AST Response Latency in switching blocks

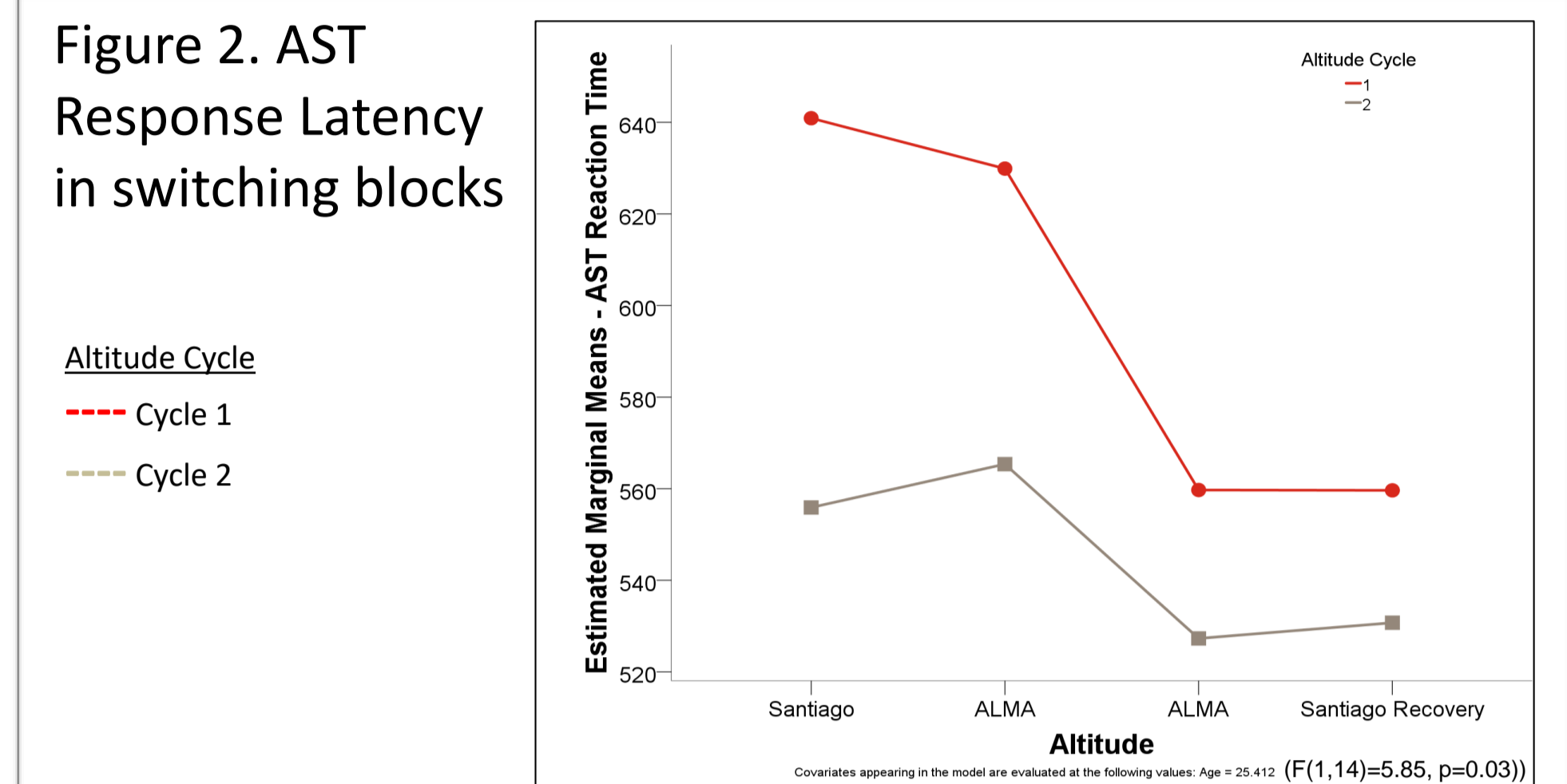


Figure 3. AST SD Response Latency in switching blocks

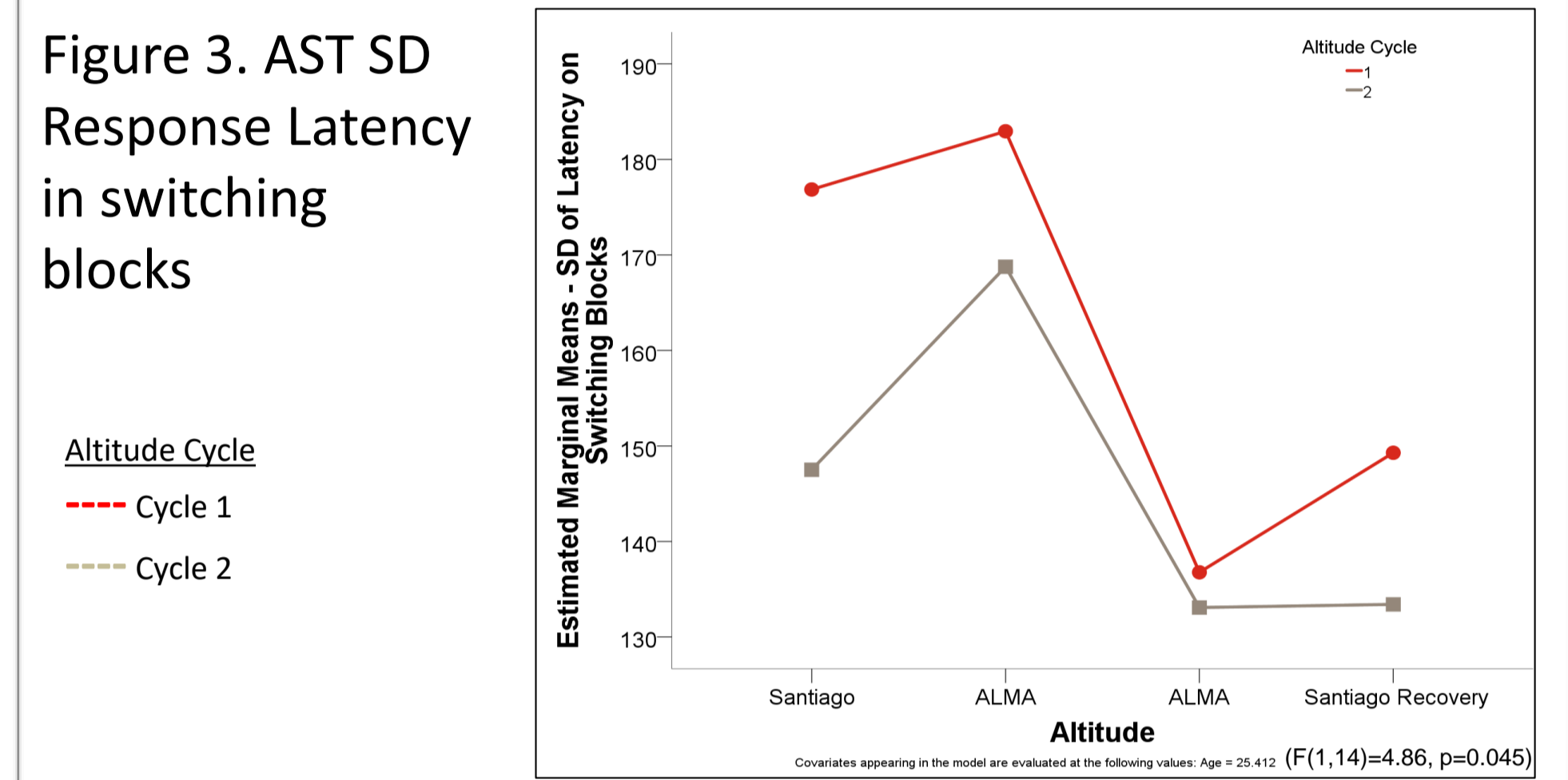
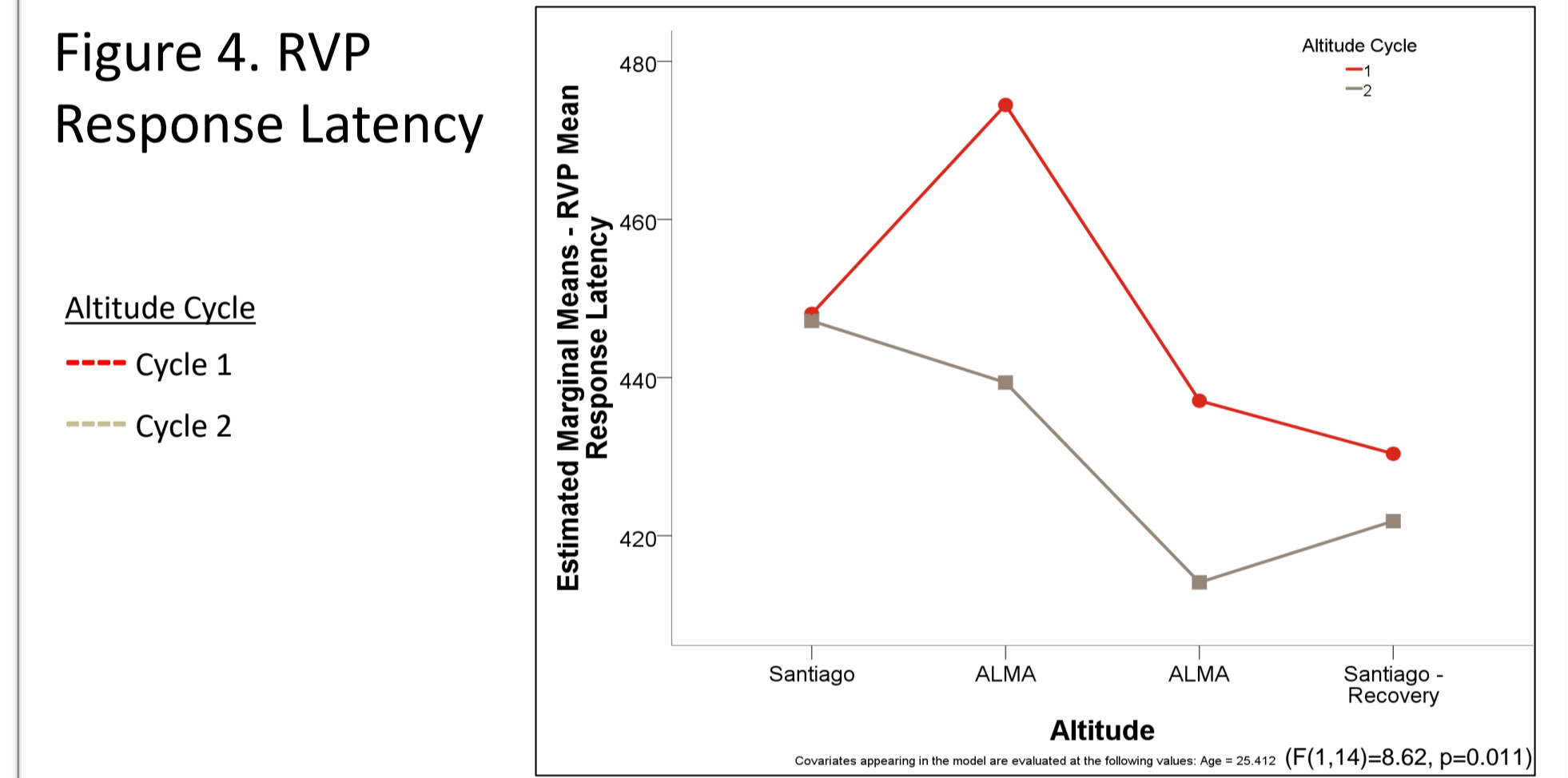


Figure 4. RVP Response Latency



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:

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