INTRODUCTION: Cold-induced vasodilation (CIVD) is a mechanism that protects the peripheries from cold-related injury. There is a need to elucidate mechanisms that attenuate reduced cognitive and motor performance in hypoxic environments.

PURPOSE: The purpose of the present study was to investigate the effects of cold-water hand immersion (CWI) on changes in thermoregulation, measures of CIVD, executive function, mood, and memory in normobaric hypoxia before and following submaximal exercise. METHODS: 10 apparently healthy men (23±3 years) volunteered for this study. The two experimental trials (13% O₂, 21% O₂) were counterbalanced and blinded from the participants. Following a 60-min. acclimation the experimental trials consisted of two 15-min. exposures to 5°C water of the non-dominant hand. The exposures were separated by a 30-min. bout of submaximal exercise producing the equivalent of 400 watts (W) of metabolic heat. Executive function (Stroop), total mood disturbance (TMD), memory (RMCPT), mean body temperature (MBT), oxygen saturation (SaO₂), and thermal sensation (TS) of the arm were collected during the final 5 min. of each stage. CIVD was measured pre- and post-exercise during each of the cold water exposures on the nailbed of the middle finger on the non-dominant hand. RESULTS: No significant interaction or main effects of time or condition were reported for any score of executive
function \( F \leq 3.12, p \geq 0.069 \) or mood \( F \leq 0.773, p \geq 0.477 \). A significant time by condition interaction exists for throughput score \( F = 3.19, p = 0.039 \), a measure of RMCPT. The score during CWI in the 13% \( O_2 \) condition was significant lower compared to the 21% \( O_2 \) condition \( p = 0.05 \), as well as when compared to acclimation of the 13% \( O_2 \) condition \( p = 0.02 \). However, the worsening TMD trend led to positive associations between skin temperature during CWI and TMD scores at baseline \( r = 0.753, p = 0.012 \), acclimation \( r = 0.653, p = 0.041 \), and CWI \( r = 0.657, p = 0.039 \) in the 13% \( O_2 \) condition. A main effect of time is observed for MBT \( F = 42.477, p < 0.001 \) in that both exercise and CIVDpost values of MBT are significantly greater than values observed at baseline, acclimation, and CIVDpre \( p < 0.001 \) in all instances). A significant time (baseline, acclimation, CIVDpre, exercise, and CIVDpost) by condition (13% \( O_2 \), 21% \( O_2 \)) interaction was observed for \( SaO_2 \) \( F = 38.4, p < 0.001 \). Significant differences between conditions exist at all time points with the exception of baseline \( p < 0.001 \) in all instances). Onset time was significantly later in 13% \( O_2 \) \( p = 0.043 \) compared to the 21% \( O_2 \) condition at time point CIVDpre. A main effect of time was observed for amplitude temperature \( F = 20.034, p < 0.001 \). Both peak time and amplitude temperature were significantly different \( p \leq 0.03 \) across conditions during CIVDpost. **CONCLUSION:** CWI has no effect on executive functioning in both normoxia and normobaric hypoxia. The decreased skin temperature observed during CWI correlates to reduced mood throughout all time points in a hypoxic state. It appears that during rest in normobaric hypoxia, a cold stress test has minimal effect on MBT and the CIVD response. During exercise, reduced CIVD amplitude is associated with reduced \( SaO_2 \). It is clear that a
submaximal bout of cycling exercise is not the proper stimulus to acutely induce a CIVD response to the magnitude at which positive physiological adaptations occur. Further research is necessary to elucidate mechanisms to improve mood in normobaric hypoxia.