INFLUENCE OF TYROSINE SUPPLEMENTATION ON COGNITION AND PHYSIOLOGY DURING OUTDOOR COLD STRESS

Patrick Zacher[1,2], Timothy Dunn[1], Rebecca Weller[1,2], Rebecca McClintock[1,2], Tony Duong[1,2], Michael Stone[1,2], Lynn Cialdella-Kam[1], Douglas Jones[1]

[1]Naval Health Research Center, San Diego, CA; [2]Leidos Inc., San Diego, CA

BACKGROUND

Cognitive impairment from cold stress is a significant threat in military and occupational settings. While supplementation with tyrosine has been shown to attenuate cognitive decrements during mild, laboratory-based cold stress, its efficacy under more severe, operationally relevant conditions remains unknown. This study examined the efficacy of tyrosine supplementation in ameliorating deficits in cognitive performance during cold-water immersion (CWI) induced severe cold stress conducted during an outdoor military training event.

METHODS

In a double-blind, placebo-controlled study, 34 military personnel (mean ± SD age: 27 ± 6 years, height: 176 ± 8 cm, weight: 82.2 ± 12.0 kg) received tyrosine (TYR; 150 mg·kg-1; n = 17) or placebo (PBO; n = 17) before an outdoor 10-min whole-body CWI (air temperature: -2.1°C; water temperature: 0.4°C). Cognitive performance (match-to-sample [MTS] and simple reaction time [SRT]) and physiological measures (core/skin temperature) were assessed prior to, during, and after CWI. Linear mixed-effects models were used to analyze mean reaction times (RT) and generalized linear mixed models were used for count data (accuracy, errors) to test for effects of tyrosine supplementation. Physiological data were analyzed using mixed-design analyses of variance. Statistical significance was set at $p < .05$.

Figure 1. Subjects during the immersion phase of their cold-water immersion training. Photo courtesy of NHRC.

RESULTS

CWI induced significant physiological stress in both groups, with no differences in core or skin temperature (p's > .05). Temperatures were significantly lower during and after immersion relative to Baseline (p's < .05). A significant cubic effect of Time ($p < .001$) and a main effect of Group was observed for MTS RT ($p = .03$). Specifically, the TYR group had significantly slower overall RT compared to PBO (Δ = 142 ms).

The TYR group also made fewer correct responses on the MTS compared with the PBO group ($p = .04$), while simultaneously producing more omission errors ($p < .01$). A significant quadratic effect of Time was observed for SRT RT ($p < .001$), with worse performance for all timepoints relative to Baseline. No significant main effect of Group or Group x Time interaction was observed for SRT.

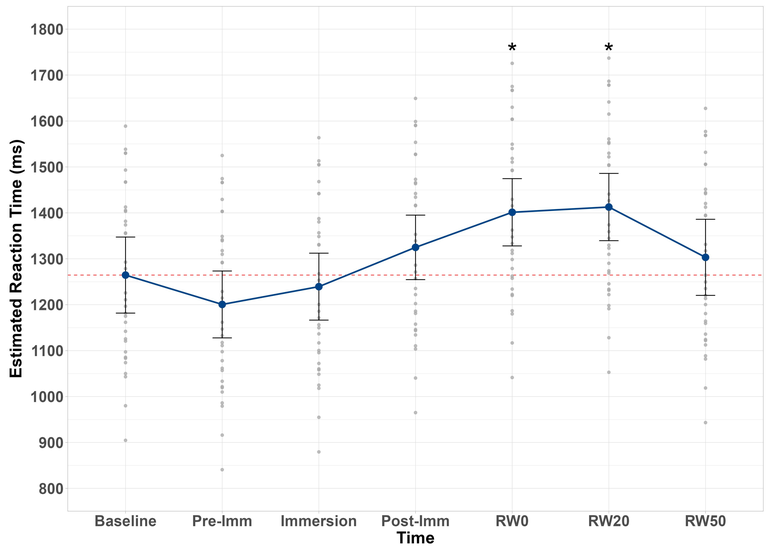

Figure 2. Estimated marginal mean reaction times for the MTS task. The blue line and points represent the overall trend derived from the best-fitting linear mixed-effects model. Gray points are individual participant estimates. Error bars indicate 95% CI. Significance markers denote statistically significant differences compared specifically to the Baseline condition (* = $p < .05$).

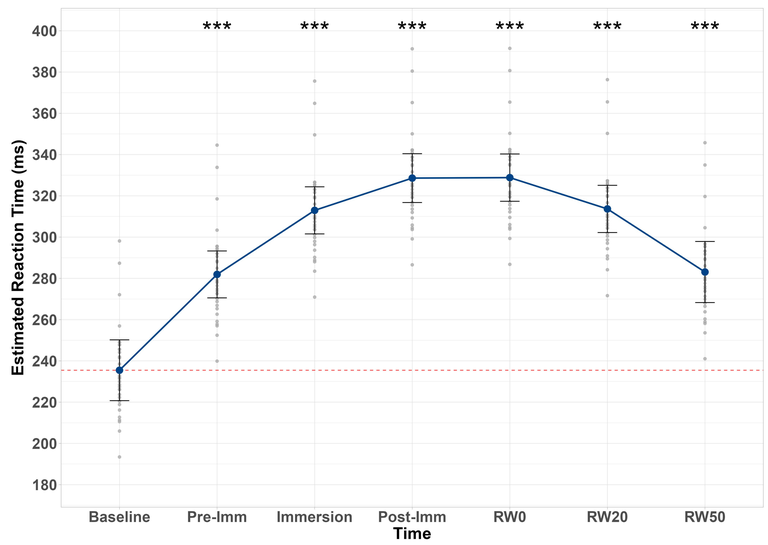

Figure 3. Estimated marginal mean reaction times for the SRT task. The blue line and points represent the overall trend derived from the best-fitting linear mixed-effects model. Gray points are individual participant estimates. Error bars indicate 95% CI. Significance markers denote differences compared to the Baseline condition (* = $p < .05$; ** = $p < .01$; *** = $p < .001$).

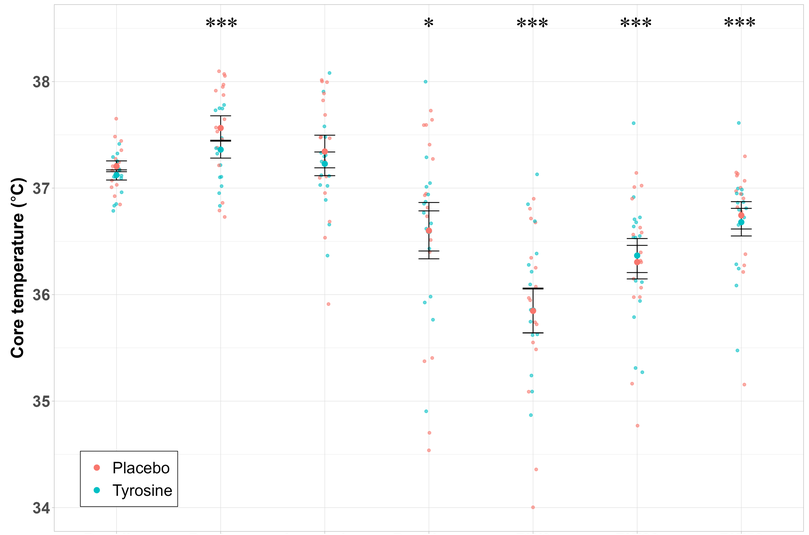

Figure 4. Core temperature (M ± SE) for each phase of the study. Large points represent group means and small points represent individual participant data. Significance markers denote differences compared to the Baseline condition (* = $p < .05$; ** = $p < .01$; *** = $p < .001$).

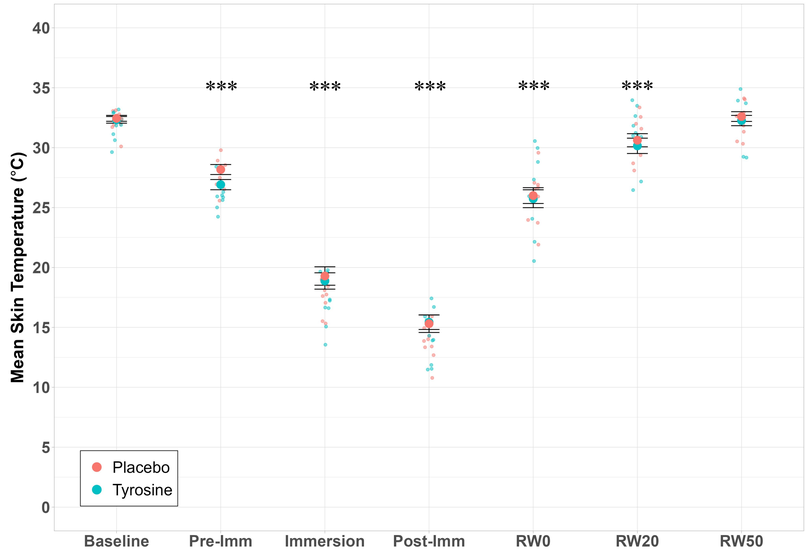

Figure 5. Mean skin temperature (M ± SE) for each phase of the study. Large points represent group means and small points represent individual participant data. Significance markers denote differences compared to the Baseline condition (* = $p < .05$; ** = $p < .01$; *** = $p < .001$).

CONCLUSION

CWI impaired performance on both simple and complex cognitive tasks, as evidenced by slower reaction times and reduced accuracy. Contrary to expectations, tyrosine did not prevent overall cognitive impairment during cold stress. Participants who received tyrosine demonstrated consistently slower and less accurate performance on the MTS task. These findings suggest that, under severe cold stress, tyrosine may not be an effective countermeasure for cold-induced cognitive decline and may even have a negative impact on complex cognitive processing.

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