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Cognitive Performance and Physiological Stress during an Expedition in Antarctica

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Abstract : The Antarctica environment can be a great challenge for human exploration. Explorers need to be focused on the task and require the physical abilities to succeed and survive in complete autonomy in this hostile environment. The aim of this study was to observe cognitive performance and physiological stress with a biomarker (cortisol) and hand grip strength during an expedition in Antarctica. A total of 6 explorers were in complete autonomous exploration on the Forbidden Plateau in Antarctica to reach unknown summits during a 30 day period. The Stroop Test, a simple reaction time, and mood scale (PANAS) tests were performed every week during the expedition. Saliva samples were taken before sailing to Antarctica, the first day on the continent, after the mission on the continent and on the boat return trip. Furthermore, hair samples were taken before and after the expedition. The results were analyzed with SPSS using ANOVA repeated measures. The Stroop and mood scale results are presented in the following order: 1) before sailing to Antarctica, 2) the first day on the continent, 3) after the mission on the continent and 4) on the boat return trip. No significant difference was observed with the Stroop (759±166 ms, 850±114 ms, 772±179 ms and 833±105 ms, respectively) and the PANAS (39.5 ±5.7, 40.5±5, 41.8±6.9, 37.3±5.8 positive emotions, and 17.5±2.3, 18.2±5, 18.3±8.6, 15.8±5.4 negative emotions, respectively) ($p>0.05$). However, there appears to be an improvement at the end of the second week. Furthermore, the simple reaction time was significantly lower at the end of the second week, a moment where important decisions were taken about the mission, vs the week before (416±39 ms vs 459.8±39 ms respectively; $p=0.030$). Furthermore, the saliva cortisol was not significantly different ($p>0.05$) possibly due to important variations and seemed to reach a peak on the first day on the continent. However, the cortisol from the hair pre and post expedition increased significantly (2.4±0.5 pg/mg pre-expedition and 16.7±9.2 pg/mg post-expedition, $p=0.013$) showing important stress during the expedition. Moreover, no significant difference was observed on the grip strength except between after the mission on the continent and after the boat return trip (91.5±21 kg vs 85±19 kg, $p=0.20$). In conclusion, the cognitive performance does not seem to be affected during the expedition. Furthermore, it seems to increase for specific important events where the crew seemed to focus on the present task. The physiological stress does not seem to change significantly at specific moments, however, a global pre-post mission measure can be important and for this reason, for long-term missions, a pre-expedition baseline measure is important for crewmembers.

Keywords : Antarctica, cognitive performance, expedition, physiological adaptation, reaction time
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