

THE EFFECT OF MILD HYPERBARIA ON THE PERFORMANCE OF A REACTION TIME TEST AND PROFILE OF MOOD STATES

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INTRODUCTION

Changes in barometric pressure may be related to how people feel and how they perform. It is known that a decrease in the partial pressure of oxygen in the ambient air, which results from high altitude or hypoxia, causes decreased oxygen saturation in the blood and related performance decrement (1). Conversely, it has been shown that an increase in the partial pressure of oxygen in ambient air, associated with hyperbaria or hyperoxia, can lead to improved physical performance (2,3). Mild hyperbaria is known to cause a decrease in heart rate and ventilation (2,4). The effect of very small changes in barometric pressure, for example, those associated with changes in weather patterns, on feelings of well being or performance of routine work tasks, however, is not known. This is significant because millions of workers are routinely exposed to changes in barometric pressure as a result of alterations in weather patterns. The purpose of this study, therefore, was to examine the effects of very mild hyperbaria (0.5 psi; 20 mmHg) on the profile of mood states (POMS) and performance on a computerized reaction time test (RTT) in young, healthy subjects.

MATERIALS AND METHODS

Thirteen subjects (5 males and 8 females) participated in this study. All participants read and signed an informed consent form, describing the experiment and possible dangers inherent in the experimental process, which was approved by the Institutional Review Board. This experiment utilized a repeated measures design, with subjects blinded to the test condition. Each subject was tested twice—under normobaric (770 mmHg) and hyperbaric (790 mmHg) conditions. Testing order was counter-balanced with the tests administered 24 or 48 hours apart. Subjects were familiarized with the RTT prior to testing. Temperature and relative humidity (RH) were adjusted to maintain temperatures between 20.0°C and 21.1°C and RH between 45% and 55%. Each test lasted two hours; the RTT and the POMS were administered at the start of the test and every 30 min throughout the test.

The inflatable chamber (PressureCizer Hyperbaric Chamber, Hyperbaric Industries, Amsterdam, NY) was set up to simulate an office environment. An IBM-compatible laptop computer, used for the RTT, and 5 copies of the POMS questionnaire were provided. When in testing, subjects read or worked on the computer. The RTT consisted of 96 questions and took approximately 7 min to complete. Subjects were presented with a statement (i.e., # follows @ @ #) and

were asked to respond true or false as quickly as possible. The computer program provided the number of responses in each of four categories—hits, correct rejections, misses, and false alarms—and provided a reaction time for each category of response. The POMS questionnaire is a 65-question index used to determine the mood state of an individual in five different categories (5). These categories are tension, vigor, confusion, anger, depression, and fatigue. Separate repeated measure analyses of variance (ANOVA) were performed for each of the dependent variables. A significance level of $P < 0.05$ was adopted for all statistical tests.

RESULTS

Ambient temperature did not differ between conditions (20.8°C and 20.3°C for normobaric and hyperbaric, respectively). However, there was a significant condition effect for RH; (RH = 46.9% and 54.7% for normobaric and hyperbaric, respectively).

There were no significant main effects for HR (Figure 1). However, HR tended to decrease with subsequent trials ($P=0.07$) and there was a trend for HR to be higher in the normobaric condition ($P=0.18$).

As shown in Figure 2a, when the correct responses were added together (hits and correct rejections) there were no significant effects, although there was a

trend for the number of correct responses to be greater in the normobaric condition ($P = 0.10$). Conversely, when averaged across all response categories there was a tendency for reaction time (Figure 2b) to be faster under hyperbaric conditions than under normobaric conditions ($P = 0.10$). There was a significant time effect for average reaction time, with reaction time decreasing across the trials.

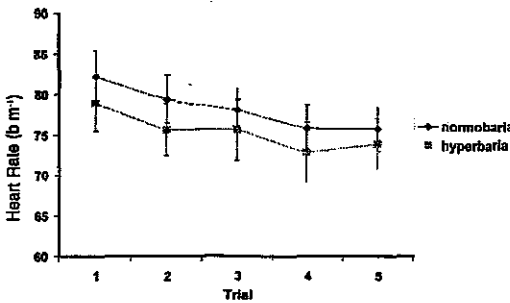


Figure 1. Heart Rate Response in Normobaric vs. Hyperbaric Conditions (mean \pm SE)

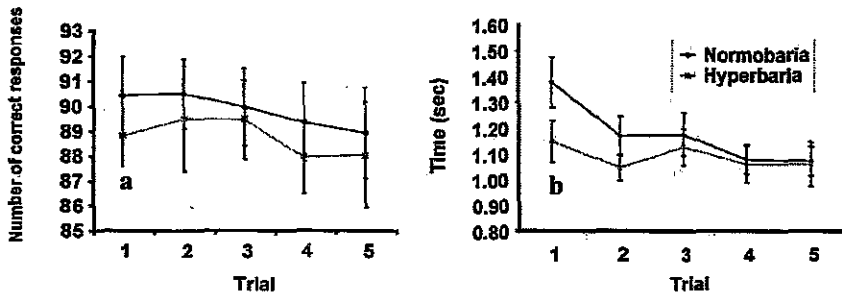


Figure 2. (a) Total correct responses, and (b) Average reaction time for all categories in normobaria and hyperbaria. Values are means with std. dev.

When considered by individual response category, there were no significant condition effects for number of responses, although there was a strong trend for more correct rejects under the normobaric condition ($P = 0.06$). There was also a trend for more false alarms in the hyperbaric condition ($P = 0.08$). Reaction times were significantly faster for the correct rejects and the misses under the hyperbaric condition; values for hits approached statistical significance ($P = 0.07$).

As shown in Figure 3, state anger, state tension, and state fatigue were all significantly lower in the hyperbaric condition than in the normobaric condition. State confusion also tended to be lower in the hyperbaric condition than in the normobaric condition ($P = 0.06$). State vigor was significantly higher in the hyperbaric condition compared to the normobaric condition. There was no significant condition by trial interactions for any of the POMS variables, and only state vigor changed significantly over the trials.

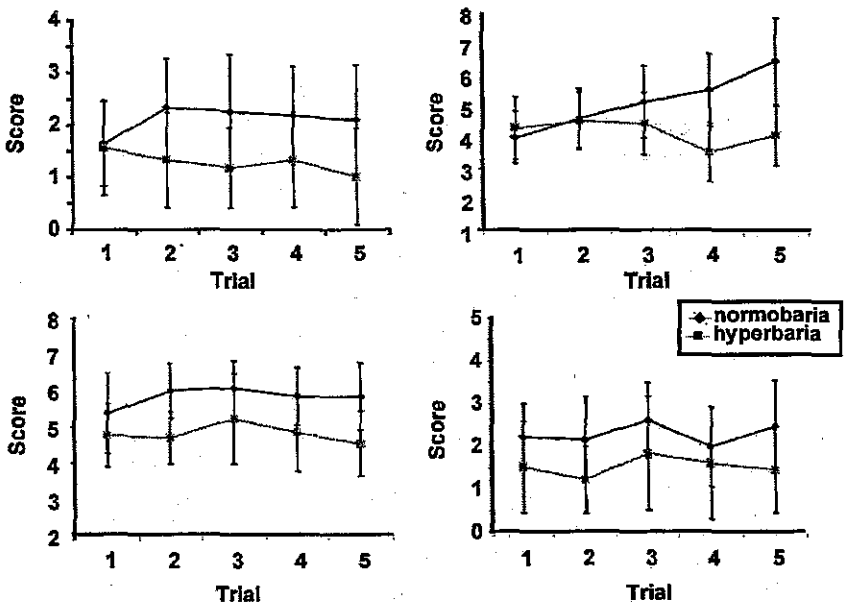


Figure 3. State anger (a), tension (b), confusion (c), and depression (d) responses to normobaric and hyperbaric conditions. Values are means with standard deviations.

DISCUSSION

The small, but non-significant decrease in HR observed during the hyperbaric condition is consistent with previously published research (2) and suggests that the difference in RH between the two conditions did not negate the effects of hyperbaria. When considered in aggregate, there were no significant differences in the number of responses or in reaction time for the RTT, although there were trends toward significance in each case. The lack of significance may be

related to the relatively small subject pool or to the large variability in the data. Interestingly, the number of correct responses tended to be better in the normobaric condition, whereas subjects tended to respond faster in the hyperbaric condition. The speed-error trade-off problem in this type of testing has been discussed (6), but we can not account for why these individuals performed differently under the two conditions. The significant differences between conditions for several of the POMS variables are compelling given the small differences in barometric pressure that we employed. Subjects reported that they felt less state anger, state tension, and state fatigue when working in the hyperbaric condition than in the normobaric condition and they tended to report less confusion. Subjects also reported that they had more state vigor under hyperbaric conditions. Although this study does not elucidate the mechanisms that might account for such findings, the results suggest that subjects feel better when doing routine office work under hyperbaric conditions than normal barometric pressure.

CONCLUSION

In conclusion, the small increase in barometric pressure (approximately 20 mmHg) used in this study was associated with positive changes in POMS and a faster reaction time on a computerized RTT in a group of young, healthy subjects. Given that feelings of well-being may be related to satisfaction at work, and perhaps productivity, these findings warrant further investigation.

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