

Effectiveness of 10-day Altitude Training Camp on

Red Blood Cell Indices

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Introduction

During chronic altitude exposure, the hematological responses of increased hematocrit, hemoglobin, and erythropoiesis have been well documented (Ruiz-Arguelles et al., 1980). Endurance performance benefits from sleeping at high altitude and training at lower altitude have also been demonstrated (Levine and Stray-Gundersen, 1997). The purpose of this investigation was to determine if 10 days of residing at 2,400m could produce beneficial hematological changes and to document the time course of these adaptations. The ultimate goal of this research was to aid in establishing a residency protocol that will be used in the weeks preceding the 2002 Olympic Winter Games.

Methods

Participants consisted of male (n=5) and female (n=1) members of the U.S. Biathlon team. Prior to the study, participants lived below 1,300m and following the initial blood draw, traveled to 2,400m where they resided until day 11. From days 11-21, subjects resided at 1,700m. During the entire course of the study, subjects trained at the Olympic venue (1700m). 15ml of venous blood was taken from an antecubital vein on days 1,4,7,11,14,17 and 21 for the determination of hemoglobin (HB), hematocrit (HCT), ferritin (FER), reticulocytes (RET) and other standard measures. A within-subjects, repeated measures design with 7 time points was used. Statistical differences over time were assessed using Friedman's test and individual post-hoc comparisons were made using paired t-tests. Mean scores were compared between days 1, 11, and 21.

Results

HB and HCT increased significantly from day 1 to 11 and decreased from day 11-21 ($p < 0.05$). RET percentage increased significantly from day 1 to 11 ($p < 0.05$) and remained elevated at day 21. Changes in serum FER were not significant over time.

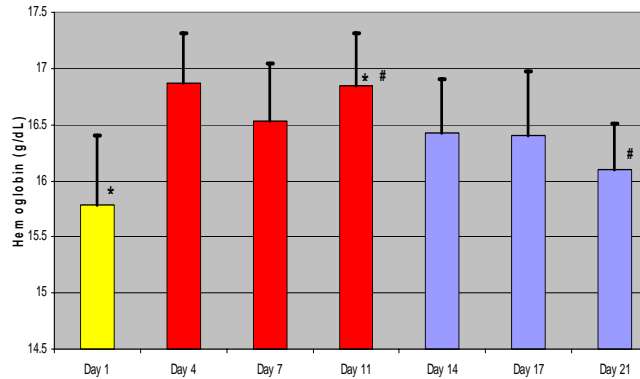


Figure 1. Hemoglobin concentration during 21-day training camp

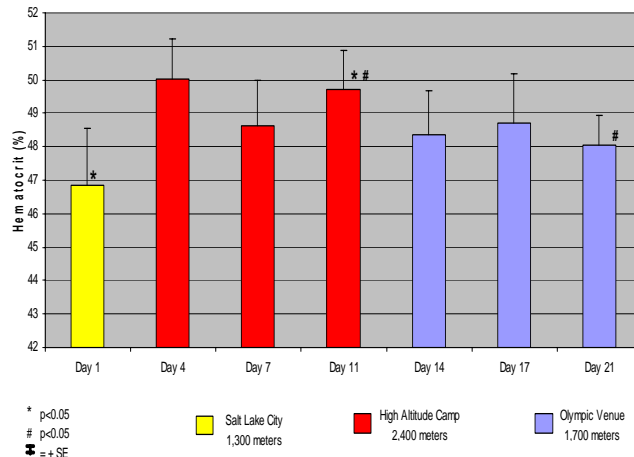


Figure 2. Hematocrit during 21-day training camp

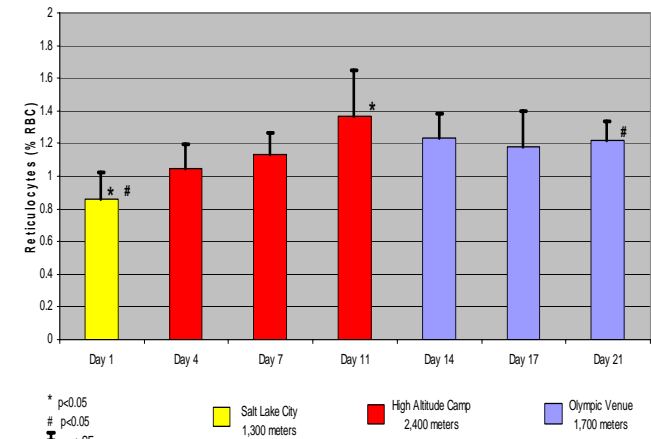


Figure 3. Reticulocyte percentage during 21-day training camp

Discussion

10 days of residing at 2,400m and training at 1,700m was an effective means of stimulating red blood cell production and increasing serum hemoglobin concentration. Although a non-significant decrease in serum ferritin occurred, it appears that iron stores were not appreciably compromised. Following 10 days of residing and training at 1,700m, hemoglobin and hematocrit decreased even though new red blood cell production remained elevated (RET). A decrease in plasma volume with altitude exposure can partially explain some of the changes witnessed and should be considered in future research.

References

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 Ruiz-Arguelles, G.J., Sanchez-Medal L., Loria, A., Piedras, J. Cordova, M.S. 1980. Red cell indices in normal adults residing at altitude from sea level to 2670 meters. *Am J Hematol* 8(3):265-271

