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Physiological Energy and Body Composition Reaction after 6 Weeks of Training at 2500m Hypoxia Chamber of Male Sprint

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Abstract

The purpose of this study was to verify the influence of environment assumed elevation (FiO = 15.72% with the altitude 2500m) intermittently to change certain physiological functions, biochemical and body composition of male sprinters in this study. Twelve males were randomly divided into 2 groups, ahypoxia(H) group 2500m (n = 6, age: 20 ± 1.789 years, body height: 171.833 ± 5.672 cm, body mass: 62.7 ± 4.545 kg) and a control (C) group (n = 6, age: 21 ± 2.881 years, body height 178.0 ± 3.688 cm, body mass: 68.017 ± 4.5 kg). For 6 weeks, all subjects performed three high intensity interval training sessions per week. During the interval training sessions, the (H) group trained in a normobaric hypoxic chamber at a simulated altitude of 2500m, while the group (C) performed interval training sessions under normoxia conditions also inside the chamber. Each interval running training sessions consisted of four to five 5 min bouts at 90% of VO2max velocity determined in hypoxia (VO2max-hyp) for the (H) group and 90% of velocity at VO2max determined in normoxia for the group (C).(the speed was increased linearly by 1 km/h per 1min until volitional exhaustion in a run of ≥5 minutes). After the training program the results showed that both groups had significant changes ($p < 0.05$), but the analysis showed that group (H) in the training in hypoxia caused changes significant ($p < 0.05$), better than group (C) (HRmin reduce -9.17bpm, vital capacity (VC) to 0.42 liters, increase in 3000m run (0.94%), VO_2max (3.98%), hemoglobin (1.3%), hematocrit (3:47 %), EPO decreased -2.07%);

Keywords: Aerobic Capacity; Heart Rate (HRmin); Hematorit; Hemoglobin (Hb); Intermittent Hypoxic Training; Male Sprinters; Red Blood Cell (RBC); Vital Capacity (VC); VO2max

Introduction

Over the last few decades many athletes and coaches have used altitude training in various forms to help improve performance at altitude and/or at sea level. The traditional approach to altitude training was for athletes to live and train at moderate altitude. The effects of this form of stimulus on endurance performance have been researched extensively, Roles et al (2007**) [1]**. A recent approach has been for athletes to live and sleep at altitude and train near sea level, the so-called live high train low (LHTL) method or the opposite live low-train high (LLTH) method, to live and sleep at sea level and train at altitude **[2, 3]**. Because the geography of many countries does not allow LHTL or LLTH, other strategies have been developed for athletes, such as being briefly exposed to hypoxia. Intermittent hypoxic exposure with (IHE) or without (IHT) exercise training is based on the assumption that brief exposure to hypoxia (minutes to hours) is sufficient to stimulate EPO release, and ultimately increase red blood cell (RBC) concentration and to induce peripheral modifications in skeletal muscle that in turn might increase performance **[3, 4]**.

Altitude and hypoxic training is common among endurance athletes and recommended by many coaches for potential benefits during subsequent competition at or near sea-level. As altitude increases, atmospheric pressure decreases, and although the fractional concentration of oxygen remains the same (20.9%), the partial pressure of oxygen decreases, reducing the amount of oxygen available for delivery to exercising tissues **[5**]. Like many different training strategies, not all individuals are expected to respond equally to training at altitude. Considerable variation in the individual response to altitude training has been documented both in terms of physiological variables such as red cell and Hb mass as well as endurance performance **[6].** Individual differences in EPO production play a role in determining how RBC volume and Hb mass change in response to altitude and hypoxic training. Plasma EPO concentration, increases in RBC mass and total blood volume were found to differ between athletes who improved their 3 km run performance versus those who did not in a retrospective analysis **[7].** With the above analyzes showing that the effect of exercise at high altitudes with no oxygen environment is not consistent with the viewpoint, athletes still use the simulated assumptions of elevation to improve Sports performance to achieve high performance. Therefore n g porch this study empirically tested the impact of environment assumed elevation 2500m with POI 15.72% after 6 weeks with m Goals are modified indicators of physiological functions biochemical after 6 weeks of training Intermittent contact (IHT) with 90% lactate threshold The ability of aerobic and athletic performance of male sprinters well trained.

Research and Methods

Researchers

Twelve male sprinters were randomly divided into 2 groups.

(Table 1) shows, the group (H) (body height 171.83 ± 5.67cm, body mass 62.7 ± 4.55 kg, Fat mass4.57 ± 1.58 kg, Fat = 6.85 ±2.33 %; and the control group (C) (body height 178.0 ± 3.69cm, body mass 67.7 ± 4.4 kg , fat mass 5.08 ± 1.2kg, Fat 8.133 ± 2.87%. Athletes are well healthy, not smoking, family history and self do not suffer from contagious disease, cardiovascular.

Index	Hypoxiagroup (H) (n = 6)	Control group (C)(n = 6)
	Means ± SD	Means ± SD
Body height (cm)	172.83 ± 5.67	178.0 ± 3.69
Body mass (kg)	62.7 ± 4.55	67.70 ± 4.4
Fat mass (kg)	4.57 ± 1.58	5.08 ± 1.2
Fat (%)	6.85 ± 2.33	8.133 ± 2.87

Table 1: Average values of body mass and chosen variables of body composition in hypoxic (H) and control (C) groups during the experiment.

Research Method

Experimental Design

Based on the scientific basis, professional characteristics and equipment system in the division of oxygen, the author builds a program running on the treadmill to apply to subjects studied for 6 weeks The effectiveness of the experimental program used in this study was similar for both groups of randomly assigned (experimental and control) athletes under two different training environment conditions: The group (H): There are 6 athletes training on the treadmill in the simulated Oxygen room at 2500m height with a percentage of O_2 = 15.72%, a temperature of 21^0C, humidity in the range of 40-50%; The group (C): 6 athletes workout on the treadmill at the environment sea level percentage of oxygen is O_2 = 20.93%, temperature and humidity, often depending on the weather.

Training in 6 weeks, each week 3 sessions, each session performed 3 run/one group, one exercise/5 min bouts at 90% of vVO_2max-hyp/ vVO_2max (H group/ C group) separated by 5 min of active recovery at 65% of vVO_2max-hyp/ vVO_2max (H group/C group). Before performing the three bouts, athletes in both groups performed a 15 min warm up. The warm-up intensity was set at 65% of vVO_2max-hyp/vVO_2max for its first 10 minutes and 80% of vVO2max-hyp/vVO_2max for its last 5 minutes. After the interval session, athletes in both groups performed a 10 min cool-down, at an intensity equivalent to 65% of vVO_2max-hyp/vVO_2max. The volume of training during the interval sessions in both groups was increased from 4 to 5 bouts after the second microcyle. Besides registering the intensity and volume of the training process, at the beginning of each microcycle, and after one day of rest, blood samples were drawn from the ante cubical vein to determine changes in hematological variables (Hb, Hct, RBC). Also test heart rate (HRmin), VO_2max, vital capacity (VC) and body composition.

Statistical Analysis

The obtained data were analyzed statistically with the use of SPSS 20.0 and MS Excel 2016. Basic descriptive statistics were calculated, and all variables were examined for normal distribution. The level of statistical significance was set at $p<0.05$. To determine the impact of the exercise program as well as the 2.500m elevation simulation environment affecting the physiological and biochemical changes of athletes after 6 weeks of training.

Results

(Table 2) shows the mean value, standard deviation change in body mass and body composition of athletes both groups (H) and (C) participate in the study after 6 weeks. Table 3 shows the difference was statistically significant variation physiological and ability to absorb maximum oxygen elite male sprinters in aerobic activities.

(Table 4) shows the variation biochemical differences bring operational performance capability for endurance athletes.

Test Content	Hypoxia group (H)		Control group (C)	
	Before	After	Before	After
BM (kg)	66,177 ± 5.72	62.7 ± 4.55	68,017 ± 4.5	67.7 ± 4.4
FM (kg)	5.38 ± 0.88	4.57 ± 1.58	5.817 ± 2.07	5.083 ± 1.2
Fat (%)	8.27 ± 1.4	6.85 ± 2.33	8.367 ± 2.73	8.133 ± 2.87
Note: BM - body mass, FM - Fat mass.				

Table 2: Changes in body mass and body composition in the experimental group (H, n = 6) and control group (C, n = 6) via two checks.

Analysis of the BM of the two groups (H) and group (C) was different from baseline, in which body mass (H) reduced by 5.24%, the (C) 0.47% reduction not statistically significant compared to baseline, but the analysis between the two groups showed a difference between (H) and (C) 11.95% ($p<0.05$). Body compositions between the two groups were not significantly different, in group (H) FM decrease 15.16%, Fat decrease 17.14% compared with the original test and no significant difference statistically, and group (C) have decrease 12.62 %, Fat reduced 2.8 % compared with the original test and no difference is statistically significant **(Table 3)**.

Test Content	Hypoxia group (H)		Control group (C)	
	Before	After	Before	After
HRmin (bpm)	70 ± 4. 2	60.83 ± 2. 04 *	69.33 ± 4.13	62.33 ± 1. 966*
VC (lit)	3,765 ± 0.95	4.18 ± 0.7 8 **	4,202 ± 0.5 5	4.31 ± 0.5 59 *
VO_2max (ml/kg/min)	50.4 2 ± 3.36	54.4 ± 3.0 1 *	51,317 ± 3.27	52.85 ± 2 541
Run 3000m (min)	12,697 ± 0.31	11.76 ± 0. 38***	12.637 ± 0.68	12.1 9 ± 0.552
Note: *, **, ***: $p<0.05$; $p<0.01$, $p<0.001$ show for the differences within a group. Hrmin: heart rate, VC:vital capacity.				

Table 3: Physiological changes in the experimental group (H, n = 6) and the control group (C, n = 6) through two tests.

Analysis of the physiological changes showed that group (H) practiced in high oxygen deficient anaerobes with HRmin decrease -13.1%, VO_2max increase 7.9% and had significant differences 3.96%, 3.82% ($p<0.05$), VC increase (11.02%) had significant differences 4.132% ($p<0.01$), and run 3000m decrease7.38% time, had significant differences 17.05% ($p<0.001$). The group (C) had HRmin decrease -10.1%, VC increase 2.62% had significant difference 3.656%, 2.94% ($p<0.05$).VO_2max increase 7.9%, run 3000m decrease 3.55% time, there was no significant difference with the original test.

However, when analyzing the differences between the two groups (H) and (C) statistical significance was HRmin 3.32% and VO_2max 3.3% ($p<0.01$). As a result of the analysis, the impact of the environment and exercise program has significantly improved aerobic performance for group (H) athletes compared to group (C) shown. The difference is statistically significant across groups, more specifically in HRmin and VO2max **(Table 4).**

Test Content	Hypoxia group (H)		Control group (C)	
	Before	After	Before	After
RBC (x 10^9 L)	5.31 ± 0.7 6	5.212 ± 0.3 1	5.377 ± 0. 34	5.2 ± 0.3 7 *
Hb (g / dL)	14.95 ± 0. 8 4	16.25 ± 0.5 5 *	15.133 ± 1. 1	14.8 ± 1. 12
Hct (%)	45.35 ± 1. 7 4	48.8 2 ± 2.4 *	45.25 ± 2. 84	46.0 7 ± 3.2 3
MCV (fL)	86.65 ± 10 .89	93.77 ± 1.8 2	86.9 ± 3.5 5	88.62 ± 1 .74
EPO	9.172 ± 3.48	7,105 ± 2.3 1 *	8.295 ± 2. 2 3	7.28 ± 1. 59
Notes: *: $p<0.05$ show for the differences.				

Table 4: Biochemical changes in the experimental group (H, n = 6) and the control group (C, n = 6) through two tests.

Hematological analysis showed that group (H) practiced in high oxygen deficiency anaerobic room had transform RBC decrease - 1.85% , MCV increase 8.21% were no statistically significant, Hb increase 8.7%, Hct increase 7.64%, the EPO decrease 22.54%, which was statistically significant at 2.82%, 2.656%, 2.573% ($p<0.05$), and group (C) practiced at sea level with transform RBC decrease - 3.29% statistically significant ($p<0.05$), and Hb decrease 2.2%, Hct increase 1.81%, MCV increase 1.98%, EPO decrease 12.24% were no statistically significant ($p>0.05$).

When comparing the differences between the two groups (H) and (C), Hb, Hct, MCV were statistically significant 5.04%, 6.58%, 11.56% ($p<0.001$). Analytical results show that the effect of presumptive environment of 2500m elevation and exercise program have a great impact on the biochemical changes in the positive side, contributing to the improvement of aerobic activity for athletes after 6 weeks of training.

Discussion and Conclusions

The study showed that the effectiveness of the program with 3 sessions per week and 90 minutes in 6 weeks of training changed body mass, body composition, physiologicalbiochemical of athletes,especially theeffect ofexp osure to the presumptive 2500m elevation environment, increase VO_2max, increase the aerobic activity of athlete. Although after 6 weeks of RBC exercise does not increase, but Hb and Hct increase, improve blood regeneration, oxygen is bound to hemoglobin (Hb) increase, EPO stimulates red blood cells to respond to deficiency state oxygen, this leads to better blood oxygen transport capacity for endurance activity.

The effect of environmental exposure assumes altitude:

According to Sinex et al. (2015) **[5],** aerobic capacity in sports is associated with a number of factors, including increased red cell mass, increased oxygen uptake, and increased cardiac activity. Through exposure to the environment and exercise in the high altitude environment. Physiological adaptation to a presumptive high altitude environment (2000-3000 m) over 12h/day requires up to 21 days.

From research with 6 weeks of short-term hypothetical environmental exposure, increased oxygen intake of the blood will increase the ability of oxygen to transport the muscles, providing energy for aerobic activity to be better. Improved durability performance was demonstrated through a test run of 3000m, decrease 7.38% time, HRmin decrease -13.1%, but VO_2max increase 7.9%. This study is consistent with Roels et al. (2005) **[8]**studied on high-intensity cyclist (100% - 90% peak power) for 7 weeks at 3000 m simulated height and VO_2max ability of the pretest team it is better than grouping near sea level. Truijens et al. (2003) **[9],** showing the effect of 5 weeks of training in a 2500m elevated presumptive environment, improved aerobic performance compared with exercise near sea level, modified but not this is consistent with the findings of the study, which is consistent with Truijens et al. (2003) **[9],** as RBC did not increase after 6 weeks of training. This study is also consistent with the study by Tadej Debevec (2011) **[4],** which are stimulated by the Erythropoietin (EPO) hormone. As EPO plays an important role in stimulating red blood cell production, EPO is mainly synthesized by the peritubular fibroblasts of the renal cortex and liver, like are action resistant hypoxic state [**4; 10-13].**

The most important finding of this work states that a 6-weekly intermittent hypoxic training protocol with high intensity intervals (3 x 3 group x5min bouts at 90% of VO2max-hyp) is an effective training means for improving aerobic capacity at sea level. On the other hand, it is the Hb, Hct and EPO variants in the (H) group that are statistically significant in order to increase the oxygen transport ability of the body to perform better than the (C), RB increase, but athletic performance of athlete is still improved. The study concludes that exercise in high-intensity discontinuous hypoxia (near and above latitude) of the median time (40-60 minutes) is an effective way to improve performance aerobic and endurance activities for athletes.

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