Exercise Biochemistry Review

Proceedings of IBEC 2018, Beijing, China, October 23-25
PO-070

Effects of hypoxic exercise training on aerobic capacity-related proteins in overweight/obese adult males

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Objective Since the Mexican Olympic Games, altitude training has attracted the attention of international sports science circle with its remarkable training effect, which is regarded as one of the effective methods to improve aerobic capacity. With the improvement of altitude training by scholars at home and abroad, hypoxic training has gradually entered the public view. Hypoxic training aims to achieve hypoxic stimulation by artificially simulating the natural hypoxic environment in the plateau or simulating the biological effects of hypoxic on human body. However, whether the aerobic capacity can be improved through hypoxic training requires us to further study and explore the mechanism of hypoxic training. This study explored the mechanism of hypoxic exercise training by stimulating long-term hypoxic exercise training for overweight or obese adult males.
Methods In this study, 40 male (aged 18—47 years) overweight/obese subjects were recruited. No physical condition was abnormal after physical examination, and BMI ≥ 24 was overweight, while BMI ≥ 28 was obese. All subjects were paired according to their weight and divided into the hypoxic group and the normoxic group, the exercise intervention lasted for 6 weeks. The exercise intervention program consists of 30min strength training and 30min endurance training, with 5 minutes of warm-up and finishing activities before and after training. Strength training uses dumbbells, chooses 12RM weight, exercise with 8 actions, which are dead lift, upright row, squat, shoulder press, calf Jump, advance junge, biceps curl and triceps extension, each action 2 Group, rest between groups for 30s. Endurance training grade 0°treadmill, speed range according to the target heart rate adjustment, the target heart rate interval computation method for 60% HR_{max}—70% HR_{max}. Among them, subjects in the hypoxic group wore inhaled low-oxygen devices, which enabled them to exercise in a hypoxic environment. The oxygen content of the inhaled mixed gas was 16%. The subjects in the aerobic group exercised in an aerobic environment. Nutritional education was administered to all subjects prior to the start of the exercise intervention, but diet was not restricted during the intervention. Fasting venous blood before and after intervention, the detection of hemoglobin (Hb) and erythropoietin (EPO), hypoxia-inducible factor 1 alpha (HIF1α), vascular endothelial growth factor (VEGF) and testosterone (T). All test results are the mean ± standard deviation, data comparison between groups using nonparametric the Mann-Whitney U test, data comparison in the group using nonparametric Wilcoxon match the symbol rank test, the significance level of $P<0.05$, very significance level of $P<0.01$.
Results (1) After 6 weeks of intervention, Hb levels were elevated in the hypoxic group, but there was no statistically difference compared with the pre-intervention ($P>0.05$). And the change rate of Hb in the hypoxic group was higher than that in the normoxic group, but there was no statistically significant difference between the subjects ($P>0.05$).
EPO levels were significantly higher in hypoxia group than before intervention ($P<0.01$). There was no significant change in EPO levels in the normoxic group ($P>0.05$). The change rate of EPO in the hypoxic group was statistically higher compared with the normoxic group ($P<0.05$).
The level of HIF1α was significantly increased in the hypoxic group ($P<0.01$), and the change rate of HIF1α in the hypoxic group was statistically higher compared with the normox group ($P<0.01$).

The VEGF level in the hypoxic group was significantly higher than that before the intervention ($P<0.05$). The change rate of VEGF in the hypoxic group was statistically higher compared with the normoxic group ($P<0.01$).
The T level of the hypoxic group was significantly higher than that before the intervention ($P<0.01$), and the T level was decreased in the normoxic group, but it was not statistically difference compared with the pre-intervention ($P >0.05$), the rate of T change in the hypoxic group was statistically significant compared with the normox group ($P<0.01$).
Conclusions 6-week hypoxic exercise training can increase the levels of EPO, HIF1α, VEGF and T in the blood of overweight/obese people.