EFFECT OF A SIX-WEEK HIGH-INTENSITY INTERVAL TRAINING ON ANTIOXIDANT CAPACITY AND LIPID PEROXIDATION IN INACTIVE MEN

BEHNAM TAHERI, REZA REZAESHIRAZI
1Department of Physical Education & Sport Sciences, AzadshahhrBranch, Islamic Azad University, Azadshahhr, Iran - 2Department of Physical Education & Sport Sciences, Aliabad Katoul Branch, Islamic Azad University, Aliabad Katoul, Iran

ABSTRACT

The aim of the study was to effect of a Six-week high-intensity interval training on antioxidant capacity and lipid peroxidation in inactive men. The sample consisted of inactive men with an average age of 20.80±1.95 years. Subjects were selected using purposive sampling and were randomly divided into HIIT (N=9) and control (N=10) groups. The training program included four sets of the RAST protocol (35 meter distance) with three-minute rests between sets in the first and second week. One set was added each two weeks, i.e. five sets in the third and fourth week and six sets in the fifth and sixth week, with five-minute rests between sets. The results of the study had shown that there is no significant difference between malondialdehyde levels in the pretest and posttest in the experimental group (P=0.115). Moreover, no significant difference was observed in the control group (P=0.324). The data also show that there is a significant difference between pretest and posttest TAC levels in the experimental group (P=0.023), while no significant difference is observed in the control group (P=0.386). It is recommended that this study be replicated on athletes playing different sport. Also the HIIT protocol can be used for a longer period and/or different antioxidant enzymes can be measured.

Key words: Interval Training, Antioxidant Capacity, Lipid Peroxidation, Inactive Men.

Received February 05, 2016; Accepted March 02, 2016

Introduction

During sub-maximal exercise, metabolism and oxygen uptake increase in mitochondria, thus increasing electron transport and resulting in the formation of free radicals such as superoxide, peroxide, hydrogen, and hydroxy radical. Free radicals damage cell structure and cause a variety of diseases, including cardiovascular disease, cancer, Alzheimer’s disease, multiple sclerosis, and cataracts.

Under natural conditions, reactive oxygen species are neutralized by the body’s antioxidant defense system that consist of enzymatic and non-enzymatic antioxidants. However, when oxygen uptake increases, as in high-intensity exercises, reactive oxygen species may overcome the body’s antioxidant capacity and cause oxidative stress, followed by lipid peroxidation in muscle fibers which is characterized by increased plasma malondialdehyde levels.

Intense exercise, increases oxygen uptake and, as a result, more free radicals are produced. Some studies have reported improvement in body’s antioxidant defense mechanism following resistance training, as measured by total antioxidant capacity (TAC). Moreover, some studies have suggested that prolonged exercise is linked to increased oxidative stress. Meanwhile, few studies have been done on the effect of high-intensity interval training (HIIT) on the markers of oxidative stress and lipid peroxidation. It has been shown that the effect of regular moderate-intensity exercise on body fat is less than the HIIT protocol, at HIIT is highly effective for enhancing fat oxidation and reducing fat tissue.
Given the importance of reducing the harmful effects of high fat metabolism during exercise and the benefits of HIIT for fat oxidation and increased mitochondrial enzyme activity, the present research examines the antioxidant and lipid peroxidation effects of HIIT.

Methodology

A pretest-posttest quasi-experimental design was used in this study. The sample consisted of inactive men with an average age of 20.80±1.95 years. Subjects were selected using purposive sampling and were randomly divided into HIIT (N=9) and control (N=10) groups. The subjects signed an informed consent form after being briefed about the study. They also completed a health survey, reporting the lack of alcohol consumption, absence of any specific genetic or hormonal disorder, and no limitations for participating in the training program. Baecke’s questionnaire to evaluate the physical activity of the subjects (lack of regular exercise over the last three months)\(^9\).

Subjects’ weight was measured using a digital scale with an accuracy of ±0.1 kg, with the subjects wearing no shoes and minimum clothing. Height was measured using a wall-mounted stadiometer with an accuracy of ±0.1 cm in standing position and with the subjects wearing no shoes. Blood samples (5 cc) were collected in the pretest and the posttest at 8:00-9:00 AM after a 12-hour fast from the vein in the antecubital fossa with the subjects in sitting position. To prevent blood coagulation, samples were collected in tubes containing EDTA and sodium heparin and were gently mixed. The solution was immediately centrifuged for 10 minutes at 3000 rounds per minute.

Samples were placed in 2 microtubes. Pretest samples were kept at -70° C to be used after pretest samples were collected. Plasma malondialdehyde (MDA) concentration was measured using Cayman’s TBARS Assay Kit and total antioxidant capacity (TAC) was measured using Cayman’s Antioxidant Assay Kit (Cayman Chemical, Ann Arbor, MI). Variables were measured 48 hours before performing the training protocol. HIIT was performed three times a week for six weeks. The training program included four sets of the RAST protocol (35 meter distance) with three-minute rests between sets in the first and second week. One set was added each two weeks, i.e. five sets in the third and fourth week and six sets in the fifth and sixth week, with five-minute rests between sets\(^10\).

Findings

The mean and standard deviation of age, weight, height, and BMI of the subjects in HIIT and control groups are provided in Table 1.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Experimental</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>21.2±1.8</td>
<td>20.4±2.1</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>69.5±9.2</td>
<td>72.3±11.4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>178.5±4.2</td>
<td>176.2±6.7</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24.73±2.4</td>
<td>25.68±3.3</td>
</tr>
</tbody>
</table>

Table 1: Descriptive characteristics of subjects.

As the data in Table 2 show, there is no significant difference between malondialdehyde levels in the pretest and posttest in the experimental group (P=0.115). Moreover, no significant difference was observed in the control group (P=0.324). The data also show that there is a significant difference between pretest and posttest TAC levels in the experimental group (P=0.023), while no significant difference is observed in the control group (P=0.386).

Discussion and conclusion

The benefits of exercise depend on a variety of factors, including exercise intensity, frequency, and duration.

Comparison of pretest and posttest plasma malondialdehyde(MDA) levels as a marker of cell membrane lipid peroxidation showed no significant difference in either group. It must be noted, however, that reduced MDA levels were observed in the experimental group, but it was not statistically significant. Studies have shown that intense or irregular aerobic exercise increases oxidative stress and lipid peroxidation by increasing hormones such as catecholamines and prostanoids as well as...
macrophage activity\(^{(11)}\). Reduced local blood flow to organs such as active muscles, the liver and kidneys at the beginning of these exercises is another factor that increases lipid peroxidation\(^{(12)}\). However, regular exercise, as in the case of the present study, can enhance the body’s antioxidant defense system and reduce lipid peroxidation and protein oxidation\(^{(9)}\).

Exercise duration and intensity seem to be major factors in lipid peroxidation response. The duration and intensity in the present training protocol may have not been enough to trigger a significant decrease in MDA levels. Given the nature of HIIT, the intensity may have been too high and the number of sessions too low to generate reactive oxygen species (ROS) and cause lipid peroxidation. A study on the intensity and duration of different training protocols have shown that higher-intensity and longer-duration exercise induces greater increase in the markers of oxidative stress\(^{(13)}\).

Comparison of pretest and posttest TAC levels showed no significant differences in the control group, while significant differences were observed in the experimental group. It appears that HIIT can be effective in enhancing oxidative metabolism within cells, which in turn enhances antioxidant defenses mechanism. It has been reported that HIIT increases the activity of antioxidant enzymes in skeletal muscles\(^{(13)}\).

The present findings are consistent with the results of Elosua et al.\(^{(4)}\) who showed that a 16-week aerobic physical activity program (five days per week and at 81% VO2 max) increases antioxidant capacity. The protocol used in the present research may have had sufficient intensity and duration to increase antioxidant capacity. Shemshaki et al.\(^{(44)}\), showed that regular exercise does not increase free radicals in male alpine skiers, and that the balance between increased oxidative stress and induction of antioxidant pathways as a result of regular exercise increases plasma antioxidant capacity.

In sum, it appears that high-intensity interval training does not change the plasma levels of lipid peroxidation markers, but enhances total antioxidant capacity. Moreover, the present findings, in line with a number of previous studies, indicate that high levels of antioxidant enzymes do not suggest better defense against oxidative damage, but indicates a potential risk that threatens different structures in the body.

The body makes changes in production and storage of antioxidant enzymes to adapt and prepare itself for facing these threats. Given the importance of minimizing oxidative stress in exercises and achieving the benefits of post-exercise adaptation, it is recommended that this study be replicated on athletes playing different sport. Also the HIIT protocol can be used for a longer period and/or different antioxidant enzymes can be measured.

References


Corresponding author
rezaii725@yahoo.com