Response of liver enzymes to acute aerobic exercise in sedentary human subjects

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Abstract: Introduction: The purpose of this study was to measure liver enzymes (aspartate aminotransferase, alanine aminotransferase and alkaline phosphatase) in response to acute aerobic exercise in sedentary women. **Materials and methods:** For this purpose, 24 subjects were randomly divided in to experimental (n= 12) and controls (n= 12) groups. Exercise protocol consisted of running on a treadmill until exhaustion according to Astrand Test. Blood samples were taken from subjects before and after aerobic exercise. After assuring the normal distribution of data by Kolmogrov-Smirnov test, it was analyzed running independent and dependent T tests. **Findings:** Acute aerobic exercise increases the levels of AST and ALP enzymes in the experimental group in compare to pre exercise, but ALT enzyme levels did not change significantly. The comparison between groups showed that the experimental group compared with the control group had higher levels of AST and ALP. Also the ratio of AST to ALT, before and after exercise in both groups, was less than one. The significance level for all data was considered P ≤ 0/05. **Conclusion:** Aerobic exercise until exhaustion in sedentary women causes an increase in AST and ALP enzyme levels but it does not change ALT enzyme significantly.

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1. Introduction

Physical activity increases nutrient metabolism and enhances blood flow to the active muscles, however, it decreases the blood flow towards the liver and the gastrointestinal tract (Rowell et all 1964, Ohnishi et all 1985, Yano et all 1996). On the other hand, liver plays an important role in physical exercise and exercise can cause a variety of effects on liver function (Praphatsorn et all 2010). Liver is one of the main organs to convert the chemical species to various types. It has many enzymes involved in energy production during aerobic exercises and this indicates the important role of the liver in sports exercises. Aspartate Aminotransferase and Alanine Aminotransferase are the most important liver enzymes that cause catabolism of amino acids. Another important liver enzyme is Alkaline Phosphatase enzyme that plays an important role in transferring metabolites such as lipids, across the cell membranes, to produce aerobic energy. These enzymes exist, in addition to liver, in other organs such as skeletal muscles, heart mainly mitochondria but ALT has lower concentration in skeletal muscle and the highest concentration of this enzyme is attributed to liver, thus increase of this enzyme indicates liver damage or too much pressure on liver (Wroblewski et all 1958, Huang et all 2006). These enzymes are used widely to show the liver status in various diseases (Giboney 2008, Nuri et all 2012) and sports exercises (Mir et all 2012, Bijeh et all 2013, Hammouda et all 2012).

Meyer et al (2012) investigated the effect of eight weeks aerobic exercises on liver enzymes in people who suffer from non-alcoholic fatty liver disease, and the results showed that aerobic exercises resulted in a significant reduction in ALT and AST. enzymes. However Bijeh et al (2013) who investigated AST and ALT levels after eight weeks of swimming exercise on healthy women stated that there was no significant change.

Burger Menunka et al (2008) measured changes in liver enzymes in Brazilian triathletes after half iron man competition and found that AST and ALP levels after competition had significant increase, however, ALT value after competition had no significant change. Also Prafatsorn and colleagues (2010) studied the impact of acute exercise on biochemical and histological changes in liver and pancreas of rats. The results indicated that intense exercise with 75% and 90% maximal oxygen consumption caused a significant increase in ALT and AST levels.

Due to conflicting results in previous studies, the aim of this study was to evaluate changes in liver enzymes of Alkaline Phosphatase, Alanine

Aminotransferase and Aspartate Aminotransferase after acute aerobic exercise in sedentary men.

2. Material and Methods

Subjects

This study was conducted using a semi-experimental design. For this purpose, 24 healthy women subjects were randomly divided into two groups of experimental and control, each groups including 12 subjects whose anthropometric characteristics are described in Table 1. All the procedures of the study were performed in accordance with Helsinki Declaration. Participants in the study were non-smokers, not taking any medication, and had no metabolic disease.

Anthropometric measurements

Anthropometric measurements were performed one week before the main test. Height measurement was done without shoes using a Stadiometer SECA made in Germany and the weight of the subjects was done with minimal clothing using a digital scale Pand made in Iran with a sensitivity of 0.1 kg. Body Mass Index (BMI) was calculated by dividing the weight (kg) by the square of height (m). The percentage of body fat was determined using body composition analysis (Body composition), digital Olrmpia model made in South Korea gawon company. The measurements were performed when there were at least 4 hours between the last meal of volunteers with measuring time and subjects had an empty stomach and bladder.

Exercise protocol

Exercise protocol consisted of running on a treadmill in accordance with the Astrand treadmill test in which subjects start running with a speed of 5 miles per hour with zero slope on a treadmill. The treadmill slope was increased by 2.5 percent after 3 minutes, there was a 2.5 percent of increase in treadmill slope after every two minutes. The test continued until the subject was unable to continue.

Blood sampling

Blood samples of 10 ml were taken in two stages, the first stage before exercise between 10 to 11 o'clock AM and the second stage after exercise while sitting on armchair. The samples were poured in tubes containing EDTA and were centrifuged with the speed of 2000 rpm for 10 min. The blood serum was isolated and used to measure liver enzymes.

Data Analysis

All data were expressed as mean±standard deviation and were analyzed by SPSS version 16. Data distribution using the Kolmogorov Smirnov test showed that it has the normal distribution and there is the possibility of using parametric statistical tests. So independent statistical T test was used to compare the groups, and dependent T test was used to compare changes within groups. The significance level in all stages was considered P≤0/05.

Measurements of enzyme

Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT) and alkaline phosphatase (ALP) were measured as liver enzymes using diagnostic Pars Azmon kits, with spectrophotometer (Model RA-1000, made in USA).

3. Results

The mean and standard deviations of liver enzymes for experimental and control groups before and after exercise are shown in Table 2. Measuring changes within group for the experimental group showed that AST and ALP enzyme levels increased significantly after exercise, but there was no significant change in ALT enzymes. The changes between groups on AST and ALT enzyme levels were significant in P≤0/05 as there was a greater increase in the level of these enzymes in the experimental group than in the control group. However, between group changes in the level of ALT was not significant.

The ratio of AST/ ALT that is calculated as an indicator of liver damage, increased in the experimental group after exercise but this ratio was less than one.

Table 1. Anthropometric characteristics of the subjects.

Measuring variables	Control group(N=12) Mean±SD	Experimental group(N=12) Mean±SD
Age(year)	22.1±3.2	23.3±2.1
Height(cm)	165.5±4.7	168.6±5.2
Mass(kg)	61.3±3.7	65.7±4.8
BMI(kg/m^2)	22.4±2.1	23.1±1.9
Body fat(%)	21.5±3.3	20.7±2.6

Values are expressed as mean±standard deviation.

Table 2. A comparison of aspartate aminotransferase to alanine aminotransferase.

variable	group	Pre-test Mean±SD	Post-test Mean±SD
AST/ALT*	control	0.86±0.2	0.85±0.25
	experimental	0.8±0.2	0/98±0/2

Values are expressed as mean±standard deviation.

Table 3. Comparison of liver enzymes in two groups before and after exercise

Variable	Group	Pre-test Mean±SD	Post-test Mean±SD	Dependent T test p-value	Independent T test p-value
ALP(U/L)	control	76.4±11.7	76.9±9.4	0.89	0.006*
	experimental	77.2±9.7	103.4±6.3	0.002*	
AST(U/L)	control	14.4±3.3	14.5±1.82	0.71	0/03*
	experimental	14.1±2.2	19±3.5	0.01*	
ALT(U/L)	control	16.4±4.3	16.7±3.8	0.41	0/26
	experimental	17.2±2.7	19.2±2.4	0.08	

Values are expressed as mean±standard deviation, *difference is significant at p≤0.05.

4. Discussions

The present study is aimed at investigating AST, ALT and ALP hepatic enzymes after acute aerobic exercise in sedentary men. According to Table 2, the levels of AST and ALP enzymes increased significantly after exercise in the experimental group, however, no significant changes in ALT enzyme levels were found. AST to ALT ratio above one is considered as liver damage or increased pressure on the liver (Park et all 2000) and this ratio before and after exercise was less than one for both groups (Table 3).

The increase in the amount of AST is in line with the findings o Gorbani and colleagues (2013), Praphatsorn and colleagues (2010), and Burger-Mendonca and colleagues (2008); howevere, it opposes the results of Rezaeeshirazi, and colleagues (2011), Mir and colleagues (2012), and Bijeh and colleagues (2013). The increase of ALP agrees with the results of Gorbani and colleagues (2013) and Burger-Mendonca and colleague (2008), but opposes the findings of Rezaeeshirazi, et al (2011) that did not show any significant changes (16) in it. Our study showed no significant changes in ALT levels that oppose the results of Wu et al (2004) and Adedapo and colleagues (2009), but is consistent with the results of Kim et al (2011), Jabbar and colleagues (2010), and Ghorbani and colleagues (2013).

These enzymes are present in muscles and liver and since exercise is associated with increased pressure on muscles, membrane permeability leads to the entrance of these substances into the blood serum, and this happens in most of the sports that lead to muscle damage (Brancaccio et all 2010, Rej 1989). During intense exercises, the activity of skeletal muscles increases to produce energy and maintain muscles. During aerobic energy production, AST and ALT catabolize amino acids, allowing them to enter into the citric acid cycle to produce ATP. ALP increases transfer metabolites such as fats, across cell membranes to produce aerobic energy.

Thus, increased ALP after exercise indicates liver activity for Gluconeogenesis, lipid peroxidation and possibly increased bone turnover increases by the intensity of exercise (Burger-Mendonca et all 2008). ALT enzyme has lower concentration in skeletal muscle and the highest concentration of this enzyme is related to the liver tissue and hepatic status (Ghorbani et all 2013), thus, the increase in the value of this enzyme is known as a sign of liver damage or too much pressure on liver (Burger-Mendonca et all 2008).

According to the results of the present study, despite a significant increase in ALP and AST, there is no significant change in ALT level, and since most of ALT enzyme is in liver, and increase in this enzyme indicates pressure and liver damage, this enzyme is not increased significantly after exercise. The ratio of AST/ ALT, before and after exercise was less than one, so it can be argued that a session of exercise has no effect on liver cells and the increase in AST and ALP enzymes is due to increased pressure on active muscles and that membrane permeability led to the inclusion of these materials into blood and increased levels of these enzymes.

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