

Effects of Selected Aerobic Exercises on the Depression and Concentrations of Plasma Serotonin in the Depressed Female Students Aged 18 to 25

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ABSTRACT

The aim of this study was to investigate rates of depression and plasma serotonin concentration in depressed female students as affected by eight weeks aerobic exercises. 20 female students with moderate levels of depression were selected by using Beck Depression Inventory (BDI), and divided into two experimental and control groups randomly. At the beginning measurement of plasma serotonin concentration was done of the subjects, and then the experiment group were affected by aerobic exercises (periodic) with 65-60% of maximum heart rate (HRmax) for eight weeks (three sessions per week). Study variables were measured 96 hours after the last exercises session. Results showed that levels of depression significantly decreased in experimental group. There was no significant difference between the two groups in terms of plasma serotonin concentration. Moreover significant relationship between plasma serotonin and depression were observed in both groups.

INTRODUCTION

Depression is the most common mood disorders, which neurotransmitters have an important role in its pathophysiology. This disease has an impact on person performance in the areas of emotional, motor, social and biological, and its severity is varies from mild to severe (Dunn et al., 2002; Sadock and Sadock, 2007). Recent studies by the world health organization (WHO) in 12 countries showed that depression in women is two-fold men. Students' lifestyles have a significant impact on increasing depression (Rosenhan and Seligman, 1995; Blumenthal et al., 1999; Sadock and Sadock, 2007). The amount of tryptophan in the body is a determinant factor in the rate of serotonin production. Monoamine oxidase is the main enzyme involved in serotonin metabolism, and its major metabolite is 5-hydroxyindoleacetic acid (5-HIAA) (Maughan et al., 1997). Free tryptophan can be into the brain cells, and researchers have shown that about 10% of tryptophan is freely in plasma. Other researchers have shown that tryptophan entering to the brain cells and serotonin synthesis is increased with prolonged aerobic

exercise due to increasing the concentration of free tryptophan in the plasma (Maughan et al., 1997). Physical exercise can be used as a treatment strategy to improve severe depression due to increasing the secretion of neurotransmitters (serotonin) (Sadock and Sadock, 2007). Gerin et al. (2008) designed one session aerobic exercise on a treadmill for rats, and measured serotonin levels of the spinal cord dorsal horn after exercise immediately, and concluded that serotonin increased (41%) significantly. Serotonin is synthesized in the pineal gland in the brain's anterior border, cerebellum, hypothalamus and other areas of the nervous system. Secretion of serotonin hormone has a direct relationship with natural light, so in the early days is high and low at night (Sadock and Sadock, 2007). Among depression patients, attempted suicide is more frequent in the people with low serotonin levels in the brain stem and cerebrospinal fluid (Sadock and Sadock, 2007). According to the British national health forum exercise increases brain serotonin levels (Yeung, 1996). Exercise significantly reduced symptoms of depression (Vickers et al., 2006). Steinberg et al. (1998) divided 25 spinal paralysis patients into two experimental and control groups, and concluded that serotonin levels in people with locomotor activity was more of disabled. In this study the effect of therapeutic exercise on treating depression was estimated as psychotherapy. Dey, (1994) investigated the effect of four weeks moderate swimming in major depressive patients, and stated that prolonged exercise leads to better performance of serotonin receptors and improvement in behavior. Donath et al. (2010) in the study measured serotonin levels on two groups of women patients with major depressive episode affected by aerobic training bike (70 to 85% HRmax), reported that there was no significant difference between the two groups in terms of serotonin levels. Chaouloff, (1994) showed that 4 consecutive days and each day one hour aerobic exercise on a treadmill had not significant effect on serotonin receptors and behavior of subjects. Blumental et al. (1999) examined long-term

effects of exercise on 156 patients with severe depression. On their study physical therapy, treatment with sertraline and exercise with sertraline were as treatments. They report that, although the effect of medication was more initially, but after 4 months there was no difference between the three groups in terms of reducing depression symptoms. This study also reported that depression rates and its recurrence on physical therapy group were lower than other groups, with review of these patients 6 months after treatment. Considering the conflicting results of present study and uncertainties including the severity, type and duration of exercise, but most researches confirmed the role of exercise in physical and mental health. Moreover use a variety of exercises (aerobic, anaerobic, resistance, etc.) has been proposed to prevent and control depression. The objective of this investigation was determined the interactive effects of eight weeks selected aerobic exercises on depression levels and the serotonin hormone secretion as a factor in controlling depression in depressed female students.

METHODOLOGY

This study was conducted as a quasi-experimental. The statistical population was consisted of 2700 female students at Aligoudarz Payame Noor University (Iran) with age range 18-25 years. 350 persons randomly completed the Beck Depression Inventory (BDI) among the statistical population. In addition to depression inventory, a personal information questionnaire including: age, sex, weight, marital status, residence, sports and medical records were completed by subjects. After reviewing the questionnaires, 20 single women who were diagnosed with major depression were selected with consider of psychiatrists. The subjects had not medical and sports history and lived in same geographic location. After the justification classes and necessary education for subjects, they randomly divided into two experimental and control groups of 10 people. 96 hours before the pre-test same diet were given to the subjects, and they were asked to avoid of

Table 1. Mean comparison of plasma serotonin in pretest and posttest by using t-test

	Plasma serotonin (ng/mg)				
	Pretest	Posttest	Variance (%)	T-value	Significant level
Experiment group	160.6±92.1	251±113.1	+50.1	-1.9	0.08
Control group	165.5±101.8	184.5±111.6	+11.5	-0.72	0.49
T-independent value	-0.11	1.12	-	-	-
Significant level	0.91	0.28	-	-	-

vigorous physical activity. After 12 hours of fasting blood samples were taken from the brachial vein in the immunology laboratory. Concentrations of the plasma serotonin were measured by ELISA method after samples freezing. Of the control group was asked to pursue their normal life, and do not have any physical activity during the next 8 weeks and consume conventional food. The experimental group continued to exercise with a codified exercise protocol. In this study, many limitations, including accommodation, meals and calories, native, age, weight, marital status, educational status and sports and medical records of subjects were controlled.

Measurement tools

Basic information about depression was obtained by using Beck Depression Inventory (BDI). Beck Depression Inventory is one of the most reliable tools for diagnosing depression. Also Beck Depression Inventory is a short and easy tool to measure depression in clinical trials. Beck inventory is includes 21 symptoms of depression with 94 questions in 21 question groups, and assessed 21 aspects of depression. Concentrations of the plasma serotonin were measured by ELISA method with a commercial kit of German LDN Company.

Measurement of serotonin and depression

Blood sampling was twice (pretest and posttest) of subjects during the study. The first blood samples (pretest) were taken one day before exercise period and fasting. Second blood samples (posttest) were taken 96 hours after the last exercise session

according to the terms and conditions of pretest, until go away the acute effects of last exercise session and the body of subject returns to the initial state. To approximate amount of serotonin secretion in humans is 10 mg per day, which in the early days is high and low at night. On average serotonin concentrations in men are 40-400 ng/ml of blood and 80-450 ng/ml in women. Levels of subjects’ depression were measured by the Beck Depression Inventory simultaneously with the blood sampling (posttest). Classify the severity of depression on this scale is as table 1.

Exercise protocol

Subjects in an 8-week exercise program, run three sessions a week for 40-60 minutes per session. The exercises in each session were including: 10 min heating with jogging, Stretching and flexibility and three sets of moderate-intensity running in six-minute with 65-60% of maximum heart rate (HRmax). Three minutes relaxing was between each running set and each week 1 minute had been added to the running time of each set. Exercise duration was 40 minutes for the first and 60 minutes for the last session. In each stage of exercise, researcher should be controlled the exercise intensity for each tester by the beat of heart and if increasing or decreasing of exercise intensity was needed, had to give suitable reaction to the testers. In each session, the beat of heart had been measured for each tester 3 times and recorded their averages. 4 days after last session, research variables were measured and analyzed according to the conditions and requirements of pretest.

Table 2. Mean comparison of rates of depression in pretest and posttest by using t-test

Rates of depression					
	Pretest	Posttest	Variance (%)	T-value	Significant level
Experiment group	25±5.3	16.6±6.9	-33.6	4.23	0.002
Control group	23.8±4.7	22.8±4.9	-4.2	0.5	0.63
T-independent value	0.54	-2.3	-	-	-
Significant level	0.6	0.03	-	-	-

Statistical methods

Kolmogorov-Smirnov test (K-S test) was used for normal distribution of data. Levin test was used for investigate the homogeneity and heterogeneity of variances. T-independent test was used to determine the difference between the mean of pretest and posttest of control and experiment group. T-dependent test was used to determine the mean difference of variables between groups. Level of significance was considered $p < 0.05$. Pearson coefficient of correlation was used for investigation of relationship between depression and level of serotonin plasma. Measuring factors was done by using SPSS version 16.

RESULTS

Serotonin

According to research findings, shown in Table 1 comparing averages of pretest and posttest for testing group serotonin plasma showed that level of serotonin plasma increased than pretest. This increase was not significant by noticing the calculated t (-1.9) and level of significance (0.08). Level of plasma serotonin increased 11.5% in control group that was not significant.

Depression

According to the information of Table 2, investigating of pretest and posttest means for experiment group depression showed that depression is decreased 33.6% than pretest; this decreasing is significant, by noticing the calculated t (4.23) and level of significance (0.002). It could be resulted that 8 week selected aerobic exercises had effects on decreasing of subjects' depression. Level of

subjects' depression for control group had 4.2 decreasing that was not significant.

Correlation between serotonin and Depression

The relationship between plasma serotonin and rates of depression by using Pearson coefficient of correlation by noticing amount of correlation -0.52 and level of significance 0.02 showed that there was significant relationship between plasma serotonin and rates of depression for women subjects (Table 3). Table 3. Results of plasma serotonin levels and Depression by using Pearson correlation test

Discussion and Conclusion

The majority of researches about level of serotonin hormone and depression show that exercises are caused increasing serotonin hormone and decreasing depression. Results of this research show that selected aerobic exercises don't influence on level of plasma serotonin for women subjects. According to Table 1, means of serotonin hormone for pretest of experiment group is 160.6 ng/ml blood and for posttest is 240 ng/ml; but this difference was not significant statistically. Donath et al. (2010) didn't find any enhancement in level of subjects'

Table 3. Results of plasma serotonin levels and Depression by using Pearson correlation test

	Correlation coefficient	Significant level
Serotonin depression	-0.52	0.02

serotonin after a period of aerobic exercises. Although, in this research, level of serotonin is increased 50.1% and its protocol was done with less intensity. It seems that there was a relationship between production of lactate and serotonin concentration. According to some researchers strong exercises increases blood acidity and disturbing mechanism of serotonin synthesis, but in long time aerobic sports causes free tryptophan density in plasma and entering tryptophan into brain cells and serotonin synthesis and spreading it in blood circulation (Maughan et al., 1997; Babyak et al., 2000; Langfort et al., 2006). Results of this research are similar to findings of Chaouloff, (1994). Although Chaouloff, (1994) investigated short time aerobic exercises in order to improve receptor of serotonin, his exercise protocol was 4 days and 1 hour in each day with average speed on treadmill. In contrast, Steinberg et al. (1998) and Peirce, (1999) reported that level of serotonin for depressed subjects who had regular aerobic exercises, was more than active persons. To explain this contrast, limitations can be mentioned such as short time of exercise program (4 weeks aerobic exercises), intensity and kind of exercise (watery aerobic exercise in contrast with ground aerobic exercise) and kind of sampling. Alberghina et al. 2010 investigated one session strong exercise on concentrations of plasma serotonin on Italian horses and sampling blood was done as soon as exercise was finished and also 30 minutes after it. Results showed that there is significant enhancement for level of serotonin in both stage of posttest (after exercise and 30 minutes after it). It seems that time of serotonin measuring in posttest stage is an important factor. Majority of research shows that researchers were looking for effect of sport on serotonin hormone and for this reason; they had done sampling as soon as exercise was finished. This research tries to investigating long time effects of sports on serotonin hormone density and because of this, changes of serotonin in posttest stage was noticed 96 hours after last exercise session, till strong impacts of last exercise session almost

disappear and subjects bodies returns to first state. Other finding of this research was significant effect of selected aerobic exercises on decreasing depression of subjects. Labotz et al. (2006) compared behavior of athletic and non athletic students and after analyzing findings mentioned to the negative relationship between sport exercises and depression. Results of this research are similar to Grieist et al. (1970), McCann et al. (1984), McCartney, (2000), and Dunn et al. (2002). On the other hand, some of researchers reported that aerobic exercises influence on strong depression and different amount of exercise can be used to treatment of depression. These researches notice that selection of aerobic exercise should be done exactly, unless person doesn't do the exercise or because of strong physical or mental stress, quit it (Dimeo et al., 2001; Payne, 2001; Dunn et al., 2002). Some researchers had reported positive effect of exercise protocol on personality of depressed patients with 70-80% maximum heart beat (Bartholomew et al., 2005). Rethorst et al. (2010) compared effect of sport and anti-depression's drugs on depressed persons. They considered depressed 18-23 year old patients in interval exercises for 5 weeks. Results showed that effect of sport on decreasing depression is similar to anti-depression drugs. To explain constructing the serotonin plasma and controlling depression, thinking more about this hormone and function of neurotransmitters in nerve system is needed. In this research we find significant relationship between plasma serotonin and depression of subjects. Findings of this study are similar to findings of study in London academy of health which expresses aerobic sports cure depression by increasing level of brain serotonin. Also this research is similar to findings of Peirce, (1999) and Dey, (1994). they showed that long time sports improve serotonin and its receptors and decreasing level of depression. Results of this research were not similar to Chaouloff, (1994) findings. Reason of this contrast probably is related to factors such as type and method of exercises, first state of testers, age, geographical, educational,

and financial state of subjects. Buchman et al. (1991) studied relationship between exercise and depression and didn't find any relationship. Absolutely curing depression by sport needs more study and to do such a cure needs experts in psychology and sport to know all aspects of both fields and use a mixture of them scientifically. Totally results of this study showed aerobic exercises with intensity 60-65% maximum heart rate (HRmax) can be used as a strategy to cure depressed students and these exercises with specific and suitable volume and intensity decrease level of depression and make their behavior natural that this effect probably is independent from plasma serotonin concentration.

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